

XII PLAN DOCUMENT (2012-2017)



सत्यमेव जयते

**DEPARTMENT OF HEALTH RESEARCH
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EXECUTIVE SUMMARY

ACHIEVEMENTS XI PLAN

Department of Health Research (DHR) was created in 2007 and started functioning on a regular basis around end of 2008 when new Secretary who is also the Director-General of Indian Council of Medical Research (ICMR) joined. DHR has been assigned ten business of which nine are new and administering and monitoring the ICMR was the only ongoing activity.

During the XI Plan period the Department of Health Research took a number of initiatives to implement the nine new tasks besides the strengthening of ICMR. Four schemes have been prepared after wide consultations which will serve as Phase I of new Department. These schemes pertain to infrastructure development for research in medical colleges and rural areas in State services; human resource development; network of laboratories and mechanisms to deal with outbreaks/ epidemics/ pandemics and other disasters and grant-in-aid to projects which require inter-sectoral coordination to develop affordable technology/ knowledge to address public health issues. All the schemes have been approved in principle by the Planning Commission and other procedures are being completed to launch within XI Plan. Further, in order to improve the research governance, various policies like Health Research Policy, Knowledge Management Policy, policy to map and recognize health institutions as well as Bills for Assisted Reproductive Technologies; revised Bill on Ethics – The Biomedical and Health Research involving human participation Regulation Bill, 2011 has been developed.

In the meantime, the DHR through its century old organization ICMR has made many important scientific contributions to face the challenges of national crises like H1N1 pandemic, previously not reported infections such as Crimean Congo fever and also contributed to new knowledge towards development of technologies that have/ will have potential application in our national programmes on communicable as well as non-communicable diseases.

Two new institutes the National Institute for Research in Environmental Health (NIREH), Bhopal and National Centre for Disease Informatics and Research (NCDIR), Bangalore were set up during the XI Plan period.

Some significant achievements are listed below.

- Four flagship programmes of the Department of Health Research viz., Tribal Health Research Forum, Vector Science Forum, Special support to medical colleges and Translational Research have been initiated during this plan.
- During 2007-11, 15 Centres for Advanced Research were established in addition to 283 multi-centres Task force studies and 623 ad-hoc research projects.
- About 1200 projects are ongoing in epidemiology and communicable diseases, reproductive, maternal & child health, Nutrition, non-communicable diseases, basic medical sciences, health systems research and socio-behavioral aspects.

- Tribal Health Research Forum has been established to synergize and intensify the research efforts of seven ICMR Institutes engaged in the area of tribal health and work towards translating the identified leads to public health benefit.
- Vector Science Forum, created to promote focused co-ordinated research on vector-borne diseases meets regularly to review progress, identifies new areas that need focused attention and which could be introduced into our national programme.
- Special support to medical colleges on a mission mode has been initiated as part of the DHR/ICMR's outreach programme; this programme has identified several medical colleges, especially those located in North, North-eastern parts of India where the outreach was minimal, for intensive training of the faculty on research methodology, study design *etc* and has started providing seed grants.
- Translational Research that envisages harvesting the innovations/leads identified into products/processes/methodologies with a portfolio of over 100 potential leads for a wide spectrum of disease conditions and for varied application as diagnostics, methods that have application in disease control programmes, has about 50 leads in advanced stage of validation and refinement for converting them to products, processes and methods for public good.
- The flagship journal of the Council, The *Indian Journal of Medical Research* continued to be the top medical journal in India with highest impact factor. The Journal is now available full text free-to-access since inception (1913) and has totally web-based editorial management.
- During the period, about 50 patents (both in India and abroad) were filed and several technologies are in advanced stage of commercialization.

Creation of New Infrastructure

- Some major institutions set up include the School of Public Health at NIE, Chennai in July 2008.
- New field stations of RMRC Portblair at Car Nicobar, Nancowry and of NIV Pune at Gorakhpur, UP and Alappuzha, Kerala were established. The NIMR shifted to its own campus at Dwarka, New Delhi and is fully functional. The Institute has also been identified as Centre of Excellence (COE) in malaria research by the NIH, USA.
- All ICMR institutes have further strengthened their linkages with State Governments in local health related issues for technical and operational support.
- Model Rural Health Research Unit at Ghatampur was strengthened so as to develop it as a model of partnership with states for transfer of technology to end users.
- The National Clinical Trials Registry in India, an online system for registration of all clinical trials (www.ctri.nic.in) in India was established.
- A Network of Viral/ Infectious Disease Diagnostic laboratories set up in the country to build capacity for handling outbreaks of all emerging-re-emerging and common viral diseases all across the country and to carryout research, three different levels of laboratories are being set up. Sixteen new (14 BSL II and two BSL III) laboratories have been established within ICMR and also other institutions so far during XI Plan to deal with these pathogens; one BSL IV plus a few other category of such laboratories

are scheduled to be commissioned soon. Eventually this programme will merge and synergize with DHR.

- A network of laboratories for diagnosis and characterization of H1N1 influenza virus was established with NIV, Pune as coordinating Institutions during the crisis of the 2009-2010 pandemic. NIV has earlier been identified as a WHO referral center and reference center with eight other regional centers.
- Malaria Parasite bank (*Plasmodium falciparum*, *P. vivax* and *P. malariae*) with over 1075 isolates serves as a national resource/facility for Plasmodium isolates in the country. Other repositories on mycobacteria, HIV and leishmania also continued to function during this period.
- National Tumor Tissue Repository (NTTR) at Tata Memorial Center, Mumbai has about 15000 normal and tumour tissues from various anatomic sites for research in cancer.

Human Resources Development

- ICMR Awards/Prizes to encourage and coordinate medical research in the country but also recognizes the contributions. The Council gives a total of 37 awards including the prestigious Dr. B.R. Ambedkar Centenary Award.
- A total of 45 medical doctors joined the MD-Ph.D. Programme of ICMR during XI Plan whereas 250 have availed of the scheme that offers financial assistance for MD/MS/MCH/ DM thesis.
- Over 500 Senior/Junior Research fellowships and more than 3500 Short Term studentship programmes to undergraduate medical students were sanctioned during the Plan period.
- A new Centenary Post-doctoral Fellowship scheme was launched, 33 fellowships have been awarded so far.
- International Fellowship scheme launched to provided support to Junior (12) and senior level (6) biomedical researchers.
- Newly created fellowships (6) under German Science Centre for Infectious Diseases (IGSCIDI)

Technology Development and Translational Research

- Detection of JE virus antigen in desiccated vector mosquitoes.
- Indigenous production of monoclonal antibodies PfHRP2 and pLDH achieved for improved diagnostics for malaria.
- Climate based model developed for impact of climate change on malaria.
- Species-specific PCR developed for detecting *Leishmania donovani*, tested in the endemic area and widely utilized in referral labs as a confirmatory test.
- Camp approach was found with higher case yield than house-to house survey for surveillance of Kala-azar.
- A real time RT-PCR useful for early diagnosis was developed for detection of dengue viral RNA.

EXECUTIVE SUMMARY

- A kit for JE developed and supplied for national programme.
- DNA chips developed for studying the survival of TB and lepra bacilli in host and several useful candidates for translation identified.
- New rapid molecular methods for detection of rifampicin, isoniazid and ethambutol resistance in TB developed.
- Developed a new DNA fingerprinting method useful for diagnosis of TB and other mycobacterial infections.
- Luciferase reporter phage assay developed using recombinant mycobacteriophages for both rapid diagnosis and drug susceptibility testing.
- Study of genomic diversity of leprosy bacillus and expression of its genes in human host has led to identification of genetic markers with potential to elicit diversity among *M. leprae* strains.
- Developed an immune-chromatographic dipstick kit for the rapid diagnosis of cholera with sensitivity and specificity of 92% and 73% respectively.
- Monoclonal antibody based indigenous diagnostic assay developed for diagnosing patients with *Chlamydia trachomatis* infection.
- Rapid IgM ELISA and Latex Agglutination Tests for Leptospirosis developed.
- Technology developed for the production of mosquito larvicide, *Bacillus thuringiensis* var. *israelensis* was transferred to industry.
- Multiplex PCR for detection of *An. annularis* species complex and their vectorial attributes developed.
- Bivalent rapid diagnostic malaria kits tested, approved and successfully inducted into the National programme.
- Real-time PCR assay developed to diagnose and simultaneously estimate parasite load in clinical samples of visceral leishmaniasis (VL) and Post Kala-azar Dermal Leishmaniasis (PKDL).
- Developed a ELISA kit for identification of paragonimiasis (lung fluke) after characterization of *Paragonimus* species in NE India.
- Non - invasive prenatal diagnostic technique developed for hemoglobinopathy shown to be suitable detection in the 10 to 15 week pregnancy.
- Simple and inexpensive screening test for Fragile X syndrome, a common cause of mental retardation in males, developed.
- Established an inexpensive, fast and accurate flow cytometric technique for evaluation of osmotic fragility in hemolytic anemias.
- Technology for estimation of vitamin A in blood samples using Dried Blood Spot (DBS) developed.
- Technologies of double fortified salt (DFS) and fortification of wheat *atta* with iron and other essential nutrients transferred to the industry.

Clinical Trials for National Health Programmes

- The current dosing schedule leads to adequate plasma levels of nevirapine in HIV-infected children receiving antiretroviral therapy with fixed dose combinations.
- A bivalent whole cell killed oral cholera vaccine (developed by International Vaccine Institute) in a Phase III randomized control trial in Kolkata showed protective efficacy of 67% in all age groups at the end of two years and 65% at the end of three years post vaccination.
- Developed and proved the concept of common regimen for treatment of leprosy, now adopted as Uniform Multidrug Therapy Regimen (UMDT) by WHO.
- Co-administration of albendazole with DEC is operationally feasible, safe for community use and has an edge over DEC alone for the Lymphatic Filariasis (LF) elimination programme and has been accepted and implemented by the National Programme.
- Established that the combination therapy of DEC and albendazole for filariasis resulted in enhanced efficacy against geohelminths.
- Demonstrated better efficacy of reduced osmolarity ORS in young children and adults in dehydrating diarrhoea compared to that of standard ORS.
- Phase-III Clinical Trial with an intravascular injectable male contraceptive RISUG® did not indicate any side effects after two years of intervention.
- Long-term retrospective follow up study (after 9-10 years) of RISUG injected subjects showed no serious adverse clinical symptoms suggesting its safety and efficacy as a long term male contraceptive.
- Phase – 3 clinical trial with subdermal contraceptive single rod implant Implanon indicated its efficacy and acceptability to women as a contraceptive.
- Low dose magnesium sulphate was as good as standard dose for management of eclampsia.
- DEC fortified salt has been demonstrated to be a potential supplementary strategy to MDA of annual single dose DEC.

Epidemiological/Operational Research

- Oxidative stress parameters studied in anaemic pregnant women with daily vs weekly oral iron supplement & less oxidative stress in the weekly oral iron.
- Need based intervention to reduce episiotomy rates indicate a higher incidence of perineal injury, infection and vulval hematoma in women when episiotomy is universal.
- A combination of metformin and life style modification could help women with Polycystic Ovarian Syndrome (PCOS), improve ovulation, pregnancy outcome, self-esteem and endocrine parameters.
- Phase-I trials indicated the safety of polyherbal BASANT cream when applied once daily for 14 consecutive days in RTI/STI.
- 3-day amoxycillin was as effective as 5-day co-trimoxazole for the treatment of non-severe pneumonia in children aged 2–59 months.

- Daily zinc supplementation 1RDA (5mg) dose had no beneficial effect in preventing severe disease (diarrhea, ARI) in low birth infants.
- Registry of People with Diabetes in young established.
- Key results on the Home based management of young infants are: In the *Shishu Rakshak* arm there was 21% decline in early neonatal mortality rate compared to control arm. Decline in IMR (29%), young infant mortality rate (25%) post-neonatal mortality rate (42%) was observed in *Shishu Rakshak* arm compared to control arm. In the *Angan Wadi* Worker arm also 13% decline in IMR was observed compared to control population but it was statistically not significant. The impact on NMR, post-neonatal mortality rate and young infant mortality rate in the AWW arm was less remarkable and / or statistically insignificant.
- ‘Developed a Mental Health Needs Scale’ of the mental health needs of the people living with HIV-AIDS (PLHAs) which is now being used by National AIDS Control Organization (NACO).
- Mathematical models for HIV/AIDS epidemic developed to study the transmission dynamics of HIV/AIDS in the population.
- Epidemiological studies at Ghatampur (UP) have showed a steep decline in prevalence of leprosy indicating the endemicity to be due to back-log of cases and that *M. leprae* persists in environment.
- Use of Remote Sensing (RS) and Geographical Information system (GIS) established for assessing the density of malaria vectors.
- A filariasis transmission risk map for India was created using a GIS based geo-environmental risk model.
- Control of *Aedes* spp. successfully demonstrated using Temephos and environmental management in a peri-urban area through involvement of community volunteers.
- Allowing of paramedics to provide emergency contraceptive pill/services would enhance its accessibility manifold.
- The Pune low birth weight study - birth to adulthood showed that all LBW children showed poor speed on differential aptitude test with lower IQs.
- The National Level Expert Group recommended a maximum residue level of one part per billion (ppb) for an individual pesticide for carbonated water based on the ICMR data.
- Revision of nutrient requirements and recommended dietary allowances for Indians carried out.
- Based on the findings on ICMR-ICAR data, on analysis of aflatoxin levels government recommended PAU-201 rice variety samples collected from Punjab to be safe for human consumption and black spots are not indicative of fungus.
- Data on the safety of consumption of *lauki* juice was evaluated, it is recommended that *lauki* should be tasted before extracting juice that it is not bitter.
- An intervention model to manage the effects of fluorosis was prepared through the combination of *Safe drinking water and supplementation* mainly with calcium,

vitamin C, iron and vitamin D₃ led to complete reversal of bone deformities caused due to fluorosis both in mild and moderate cases and partial reversal in severe cases.

- *Jaivigyan* Mission Mode Project on Rheumatic Fever and Rheumatic Heart Diseases revealed the prevalence of beta haemolytic streptococci (BHS) in 26.5% and 8.8% respectively, whereas, that of Group A streptococcus was 11.1% and 2.5% in throat samples respectively in Chandigarh and Vellore. A significant development of the project has been up-scaling of this project to Punjab Rheumatic and Congenital heart disease Programme by Chandigarh nodal centre. The programme has also been initiated in four districts of Himachal Pradesh.
- Database on national prevalence data on diabetes for different time periods.
- Published Cancer Atlas that helped map patterns of cancer.
- Developed a magnifying device (Magnivisualizer) for cancer screening in the field.
- National Cancer Registry Programme (NCRP) provided information about patterns of cancer patient care and survival through Cancer Registries.
- Genetic polymorphism established in relation to hypertension in North East.

Guidelines

- National Guidelines developed for Prevention, Management and control of Reproductive Tract Infections including Sexually Transmitted Infections (RTIs/STIs).
- Guidelines for Management of Diabetes were developed.
- Guidelines for management of three type of cancers (oral, buccal and stomach) developed.

CRITICAL ONGOING & PROPOSED ACTIVITIES XII PLAN

CRITICAL ONGOING PROGRAMMES: INTRAMURAL

Infrastructure

- A Science Centre Complex of ICMR will be set up at ICPO Noida which will house some new centres of ICMR. Work on new building of the ICMR Hqrs will be initiated.
- Various important activities/ studies are progressing which will spill over to XII plan, their continuation is essential for conclusive outcomes & explore larger perspectives. Major initiatives like the Vector Science Forum, Tribal Health Forum will be continued.

Communicable Diseases

- Among the vector-borne diseases the focus will be on malaria, leishmaniasis, filariasis and other viral infections.
- The priority areas in malaria and filariasis will continue to be epidemiological studies, genetic bio-diversity, population genetic analysis of vectors, insecticide resistance, diagnostics, anti-malarial therapies, climate change, molecular markers besides providing technical and epidemiological/operational support to National Vector Borne Disease Control Programme (NVBDCP).
- The main areas of research in leishmaniasis will be conventional vector control strategies, development and evaluation of new chemical and other insecticides, monitor drug resistance, clinical studies including drug trials, development of diagnostic assays through molecular biological tools.
- Research on bacterial infections like leptospirosis, giardiasis, chlamydiasis, trachomatosis will be intensified.
- **Tuberculosis** will continue to be a priority area of research with intensified efforts on operational research, chemotherapeutic tools, taxonomical studies, molecular markers for new drug targets and diagnostics, monitoring drug resistance, continue support to the national TB control programmes.
- In the area of leprosy, some priority area where research will be intensified would include sero assays, molecular tools to detect drug resistance, immunotherapy, nerve decompression studies *etc.*
- Studies on diarrhoeal diseases will be intensified with focus on disease surveillance, monitor emergence of drug resistance, policy treatment, policy guidelines, molecular typing, identification of novel virulence factors of rotavirus, *Salmonella enterica serovar Typhi*, *Vibrio cholerae*, diarrhoeal diseases surveillance, molecular epidemiology of cholera.
- Among the virus diseases surveillance of Chikungunya infection, hepatitis B, viral diseases: Dengue, DHF and DSS and H1N1, identification and characterization of new viruses, AFP surveillance and polio eradication support, environmental surveillance for wild poliovirus, Development of a national virus repository, setting up of BSL-4 facility, study of zoonotic pathogens, provide technical support to outbreak investigations.

- Research areas under HIV/AIDS include epidemiological studies, pathogenesis studies, screening of new molecules for anti-HIV activity, Operational research to improve ART adherence among PLHA, to test Intervention model for better contraceptives, preventive strategies through raising HIV/AIDS awareness, development and validation of anti-retrovirals.
- Research on vaccines would continue on identification of new targets and vaccines, testing of new vaccines and clinical trials on malaria, leptospirosis, cholera, chikungunya, HPV, HIV and other pathogens.

Non-communicable Diseases

- Among the areas for research on cancer include the nation-wide surveillance through the urban and rural cancer registries, detection, development and testing of diagnostics, biomarkers, vaccines for various cancers and molecular biology.
- In the area of occupational health the strategies of preventive, promotive research in occupational hazards in unorganized sectors including vulnerable population women, children and elderly, impact of ambient air pollution, climate change, disaster epidemiology, develop ergonomic measures, dust control devices, *etc.*

Reproductive, Maternal & Child Health and Nutrition/Other Areas

- In reproductive health the areas of interest include clinical, endocrinological and molecular biology of female fertility, genetic analysis of sex chromosomes, anti-fertility vaccine, reproductive cancers, diagnostic tools, congenital adrenal hyperplasia, endometriosis, bone turnover markers, tests for assessing sperm quality *etc.*
- The priority areas in nutrition include safety of genetically modified plants, research on fluoride, Indian food composition database, nutrient profiling of rice varieties, assess diet and nutritional status of rural population, improve iron bioavailability from Indian diet, integrated Indian food composition database project.
- Research on genetic diseases and hemoglobinopathies would be continued on genetic syndromes, prenatal diagnosis of thalassaemia and sickle cell disease, genetic polymorphism, clinical manifestations, neonatal screening for sickle cell disease for early intervention, development of rapid tests and genetic counseling.
- Publication, information & communication and bioinformatics activities will be continued and strengthened.
- Intellectual Property Rights Management: Activities in respect of identifying, protecting and commercializing of IP generated by ICMR supported research would be continued and strengthened.

EXTRAMURAL RESEARCH

During XI plan period extramural funding was provided to investigators in 69 medical colleges with 256 projects in the year 2007-08 that expanded to 87 medical colleges with 451 projects in 2010-11. Funding to non-ICMR Institutes/organizations rose from 274 institutes with 1119 projects (2007-08) to 329 with 1445 projects in 2010-11 showing the increasing outreach. About one third of the projects initiated during the XI plan will be continued in the XII Plan on relevant and essential research areas.

Epidemiology & Communicable Diseases

- Approximately 400 projects will continue into the XII plan. A total of 98 Task Force projects on virology, Acute Encephalitis Syndrome, Leprosy, Tribal Health, STD's, and Parasitic Diseases, About 300 projects on different areas of communicable diseases will continue.

Reproductive Health and Nutrition

- About 250 studies (Task force, ad-hoc, fellowship projects) in the areas of Reproductive Biology & Fertility Regulation, Contraception, Infertility, Maternal Health, Child Health, Microbicides, Nutrition, Diabetes Mellitus will continue into the XII plan period.

Non-communicable Diseases

- Approximately 200 projects and one Centre for Advanced Research would be continuing. Some major areas include National Cancer Registry Programme, cancer atlas, cancer screening, Guidelines for management of cancers, cardiovascular diseases, diabetes, mental health, Population Based Stroke Registry, ageing, epilepsy, muscular dystrophies, occupational health, Integrated Management of non-communicable diseases, oral health, otolaryngiology *etc.*

Basic Medical Sciences

- About 300 (Taskforce, ad-hoc and fellowship studies) on basic biology aspects on human genetics, genomics and molecular medicine, pharmacogenomics, anatomy, hematology, Stem Cell Research, allergy and immunology, biochemistry, cellular and molecular biology, nano-medicine, physiology, medicinal plants and traditional medicine, pharmacology, and project on Indian Normatives for Clinical Laboratory Parameters (INCLAP) will be continued in the XII Plan.

International Health Division

- International collaboration through workshops and other training programmes would be continued.

Human Resource Planning and Development

- The ongoing award of Junior Research Fellowships, MD-Ph.D. Programme, assistance for MD/MS/MCH thesis, Short-Term Training Scholarship Programme, international travel grant to non-ICMR scientists, ICMR Centenary Post Doctoral Fellowship Programme, ICMR Awards and Prizes for excellence in biomedical research would continue.

Health Systems Research

- 27 projects on improving RCH services, health insurance of the poor, effective knowledge utilization, health system manpower, service delivery, health system utilization *etc.*

Social and Behavioral Research

- Ongoing multicentric studies in the areas of gender discrimination, illegal abortion, diseases with social stigma would be continued.

Medicinal Plants Unit

- All the activities would be continued and strengthened.

PROPOSED ACTIVITIES - INTRAMURAL

Strengthening of Human Resources

- In order to strengthen the administrative, technical and scientific infrastructure in the DHR as well as ICMR the following new posts are proposed: 61 key positions in the administration, 120 in scientific and technical cadre for Regional/State/district level infectious diseases laboratories; 250 scientific and technical posts for Model Rural Health Research Units; 210 scientific and 400 technical posts for Dedicated Research Cadre in the DHR, 10 posts each for the Regulatory Structure Frame Work being set up through Medical Technology Assessment and Medical Technology Development Boards.
- For the new activities of the ICMR, 376 scientific posts, 500 Technical Officers, 105 Scientific and 315 Technical Assistants to handle the highly sophisticated and bio-terrorism related activity; 580 scientific, technical and administrative posts for the new long term (permanent) research infrastructure being established for research on Vector Control Programmes including malaria control & reproduction; 201 posts in different categories for National Institute for Research in Environmental Health, Bhopal and around 700 posts in Bhopal Memorial Hospital and Research Centre, Bhopal; 16 scientific posts for the proposed Deemed University and 10 posts for the Directorate of Recruitment and Assessment Board.

Infrastructure

- Setting up of the Directorate of Recruitment and Assessment Board, new field units/centres of the ICMR institutes in the areas of communicable, non-communicable, basic medical sciences, nutrition, reproductive health, maternal & child health will be established. These include: Centre for Research on Pesticides and Food safety, Centralized Biobank facilities, climate cell at NIMR, Culture collection Centre of the ICMR, Centre for Research on Drug Resistance, National centre for clinical Pharmacology, National Centre for Research on Allergies, Translational Research Centres, National Institute for Molecular and Transplant Immunology, Institute of Ageing, ICMR Schools of the Public Health & National Animal Resource Facility for Biomedical Research *etc.*
- To cater the needs of the tribal and under privileged population and people living in far flung remote areas, it is proposed to open new Regional Medical Research Centres.
- Activities related to extramural research will be extended further to cover most of the medical colleges particularly colleges located at the periphery and other non-ICMR institutes.
- Many new Centres for Advanced Research in the area of pharmacology, human genetics, stem cell research, diabetes, cardio-vascular diseases, neuromuscular disorders, mental health, ageing, oral health, trauma, bone health, zoonosis, influenza, nutrition, climate change and in the area of medicinal plants will be established.

- Numbers of adhoc projects, fellowships are also expected to increase many fold in the XII plan.

Research Activities -Indian Council of Medical Research

- Intramural research efforts of the Council are carried out currently through 32 disease/ discipline specific research institutes/centres/units located all over India.

Major specific activities proposed for XII plan are outlined below:

Communicable Diseases

Vector Borne Diseases

- New areas of research on malaria include genome sequencing of vectors and parasites to study insecticide susceptibility, drug resistance, rapid molecular diagnostics for Plasmodium, new therapeutic targets for malaria, immunodiagnostics, HIV/malaria co-infection, safety of Artemisinin Combination Therapy, impact of climate change *etc.*
- Research on kala-azar would be continued with the following new lines: pharmacovigilance, development of new chemotherapeutics, drug modalities and establishment of effective drug delivery systems for unresponsive and co-infected cases of kala-azar and PKDL, cost-effective, highly sensitive non-invasive diagnostic tools, new targets molecules for drug and immunoprophylaxis, co-infection specially HIV, tuberculosis, safety and efficacy of combination drugs.
- In filariasis, new research areas during XII Plan include evaluation of single annual dose of DEC vs 6 monthly dose of DEC, and its effect on infectivity, application of lymphatic filariasis quality of life (LFQoL) instrument, geo-environmental risk in relation to climate change, development of tools and strategies for vector surveillance/control, development of Nanotechnology-based and other vector control formulations, large scale evaluation of biomarkers, GIS mapping of vector borne diseases in NE India *etc.*

Leprosy and TB

- In the area of leprosy, some new areas include molecular epidemiological and basic epidemiological studies in Agra, Firozabad, Ghatampur and adjoining areas, genomic and proteomic approaches for identifying new targets for diagnostics of leprosy and tuberculosis, an integrated approach for rapid detection of drug resistant tuberculosis, validation of new gene probes for second line anti TB drugs, pharmacokinetics, various anti-TB agents, interferon gamma and other biomarkers for diagnosis of childhood TB, bioprospecting for new anti-TB molecules, study various interventions and alternative drug regimens, shortening of treatment of TB using newer drug molecules, trials for treatment of MDR-TB, trials for new TB vaccines and drugs, strengthening of Model Rural Health Research Unit to study the trends in epidemiology of relevant diseases-leprosy, TB and filariasis, methods of integration of HIV and TB control programs, estimating the burden of TB and co-infections *etc.*
- New research on diarrhoeal diseases would include a repository on pathogenic bacteria that cause diarrhoea, immune response studies on *Shigella dysenteriae*, *S. flexneri* 2, *Giardia lamblia*, molecular pathophysiology of infectious diarrhoea, develop new anti-diarrhoeal compounds, *H. pylori* and gastric cancer *etc.*

- In the area of HIV new studies would include immune response generated by the *nef* gene of HIV-1, micro-RNA in immune system of HIV infected patients *etc.*
- Monitoring of human influenza virus in NE India, host innate immunity and persistence of Hepatitis B in NE India, molecular epidemiology of human respiratory syncytial virus in NE, development of antivirals for dengue and chikungunya, HLA and cytokine genes on immune response to measles vaccine, polio vaccine trials and serosurveys in eastern UP, development of Norovirus genotype specific immunoassays, PCR test for HPV detection, multiplex real time PCR method for the detection of flaviruses (Japanese encephalitis, West Nile and Dengue) and Alpha virus (Chikungunya) in the vector mosquitoes, single step diagnostic kit for simultaneous detection of dengue and chikungunya, community approach to reduce the inequity of utilizing TB diagnostic services, pharmacokinetics of rifabutin during lopinavir/ritonavir co-administration, new therapeutic regimens in the management of Hepatitis B and C viruses, clinical trials with a indigenous and combined vaccine for Hepatitis A, B and E, and HEV, surveillance of wild polioviruses in cases of AFP, HIV drug resistance database and network, establishment of pediatric HIV cohort.
- Behavioral and social science strategies for scale-up HIV prevention, injection and non-injection drugs, alcohol abuse and alcoholism and its impact on acquisition and/or progression of HIV/AIDS and STIs, interventions to prevent mother-to-child transmission of HIV, antenatal care, innovative methods for providing single-dose nevirapine and cancer as a co-morbidity of HIV infection and other STIs
- Generate the evidence for new vaccine introduction including disease burden and operational research to validate efficacy of various vaccines, capacity building and site preparation, use of adjuvants to improve immunogenicity of vaccines, studies on alternate delivery of vaccines such as aerosol, mucosal application *etc.*

Non-communicable Diseases

- New research on **Cardiovascular diseases** would focus on studies to determine the role of various macro and micro nutrients in hypertension.
- In **Diabetes Mellitus** : the focus will be on use of animal models to test the efficacy of anti-diabetic and anti-obesity drugs.
- Studies on linking asthma and obesity as well as nesfatin and obesity, molecular basis of the complications of diabetes; development of biomarkers (proteomic and genomic studies); nutritional profile of diabetic complications; screening and testing molecular target-based nutraceuticals.
- In the area of **Cancer**, the focus would be on the discovery of new leads with potent anticancer activity, molecular studies on different types of cancers of stomach, oesophagus, breast, lymphoma, leukaemias *etc.* Development of a National Electronic Disease Surveillance System policies for control programmes on cancer, diabetes, CVD and stroke, stem cell therapy *etc.*
- Research in **Occupational Health** during the XII Plan would focus on neuro-behavioural toxicology studies to establish occupational standards, occupational and environmental exposures in glass bangle industry *etc.*, evolve research based analysis and guidelines on different regulatory requirements, study of functional genomics of MIC-induced acute

lung injury and systemic injury, specific biomarkers for acute and chronic exposure to MIC as well as other chemical agents, cancers, genetic disorders, health status of second and third generation children *etc.* in the MIC exposed population.

Reproductive, Maternal & Child health/Other Areas

- New research on **Reproductive health** would include management of complications with IUCDs, ultrasonography, gynecological cytology, management of infertility and reproductive disorders, and detection of reproductive tract infections, stem cell biology, endometrial function, metformin and hormonal, metabolic and endometrial profiles, preclinical reproductive and genetic toxicology *etc.*
- **Child health** research in XII Plan would focus on the - risk factors of infant mortality, child immunization practices, estimate various micronutrient deficiencies, maternal undernutrition in fetal programming for adult diseases using embryonic cells, *etc.*
- New studies on **Nutrition** would include safety testing of food supplements, nutraceuticals, and genetically modified foods, analytical methods to detect organo phosphorous pesticides, establishment of a surveillance system for monitoring of food borne diseases in India, newer food fortification strategies, updating the nutrient requirements and recommended dietary allowances (RDAs), studies on obesity and NCDs, food-based approaches to prevent and manage osteoporosis, Creation of a Centre of Excellence in Micronutrient Research *etc.*
- Studies on **Genetic diseases & hemoglobinopathies** would find priority with the following new areas - cytogenetic and molecular studies on mental retardation, establishment of National Database for Genetic Disorders, pre-implantation genetic diagnostic (PGD) facility for intervention research, genomic and proteomic studies in hemophilia A, Fanconi anemia, chronic myeloid leukaemia, hyperdiploid ALL, hematological malignancies, Myelodysplastic syndromes, systemic lupus erythematosus, vasculitis, and development of DNA banking facilities.
- Some new activities in the areas of **Publication, Information and Communication** would include special issues/special sections of IJMR on topics of national interest, create specialized national resource centres in ICMR Institutes/Centres, develop institutional repositories through digitization of the institutional content, set up journal consortia, establish a high end ICMR data centre for data storage and analysis, medical applications of systems biology. Continuation of ICMR-NIC centre & strengthening of IndMED & MedIND databases under the Project National databases of Indian Medical Journals. *etc.*
- **Intellectual Property Rights Management** in XII Plan would be strengthened through new activities on translational efforts for product development and formulation of national policies for promoting access to health products.

XII PLAN PROPOSED ACTIVITIES: EXTRAMURAL

During the XII Plan special support system would be initiated to Medical Colleges, especially that are outside the mainstream through both infrastructure as well as the faculty development, to enable these colleges to assist ICMR and other national bodies to forge an integrative academic, clinical and translational research efforts that can synergize multi-disciplinary and inter-disciplinary efforts; catalyze the application of new knowledge and techniques to

clinical practice at the frontline of patient care at the community level, help in knowledge management, to support studies addressing the problems of technology access to marginalized and underprivileged groups by focusing on issues pertaining to gender and health, tribal health, maternal and child health.

Some new initiatives in the extramural mode during the XII Plan are listed below:

Epidemiology and Communicable Diseases

- Strengthening ICMR Networks of-Virology laboratories, reference laboratories for antimicrobial resistance, epidemiological and laboratory surveillance network for rotavirus, bacterial diarrhoea, meningitis, expand support in the broad areas of basic, clinical, epidemiological , vaccine development programs for all important bacterial, parasitic and viral infections.

Reproductive Health & Nutrition

- Research in the HRRCs would be strengthened and expanded.
- In Basic Reproductive Biology new research would focus on gamete biology, implantation, embryology, infertility, genomic of male & female infertility, disorders of sex development, endometriosis, preeclampsia, polycystic ovarian syndrome, development of biomarkers, reproductive cancers, environment & reproductive health *etc.*
- New studies in the **Reproductive health** would include areas like emergency contraception, especially evaluation of existing contraceptives for their safety and efficacy, conducting pre-clinical toxicity studies with new contraceptives, development of new contraceptives both for male and female and conducting post marketing surveillance *etc.*
- Some important areas in Maternal Health that would be clinical, operational and implementation research for implementing best practices, epigenetic studies, epidemiology and pathophysiology of Intra Uterine Growth Restriction, development of new, safe and accessible methods of preventing the transmission of HIV/AIDS, HIV in pregnancy, mother to child transmission *etc.*
- In the area of Child health the focus would be on - to reduce morbidity and mortality in children through new regimens for treatment, tools for rapid diagnosis, setting up a surveillance system and capacity building of secondary level hospitals, ARI and pneumonia, paediatric, databases for hospital based surveillance for neonatal, perinatal and childhood morbidity and mortality, birth defect registry, evaluation of national programmes in reducing perinatal, neonatal and childhood mortality besides starting several new Centres for Advanced Research in child health.
- Nutrition Research during XII plan would focus on micronutrient fortification, role of diet and lifestyle in relation to NCDs, nutritional status of elderly and tribal populations with focus on evidence based interventions, food safety issues especially GM foods, dental and skeletal fluorosis with focus on specific interventions, nutrition research and training with special focus on North-East, tribal and inaccessible populations.

Non-Communicable Diseases

- New research in Oncology would focus on human papilloma virus, biomarkers for prevention and early detection of cancers, biorepository for tumour/blood samples, clinical trials for management of common cancers, chemoprevention and quality of life of cancer patients.
- In the area of Cardiovascular diseases the focus would be on management of hypertension, genetic and non-genetic determinants of coronary artery disease, developing biomarkers for prevention and control of CVDs, and innovative technologies to improve quality, efficiency and cost of care, development of affordable stents and other medical devices *etc.*
- Some new activities in the area of Mental Health would include urban adolescent mental health, alcohol and drug abuse *etc.*
- New areas in Neurology would include molecular and genetic studies in stroke for determining genetic risk factors, genetic disorders focusing on Duchenne muscular dystrophy, spinal muscular atrophy, and spinocerebellar degenerations and neuro-metabolic disorders.
- Studies in Diabetes would be intensified with new genetic approaches to the understanding of T2D, bio bank of People with Diabetes with Young Age at the Onset, revise Guidelines for Management of Type 2 Diabetes, transplantation of pancreas, developing cost effective tools for management and care.
- Age related macular degeneration (ARMD) and childhood blindness would be the new areas in Ophthalmology.
- Some new studies in Environmental and occupational health would include biomarkers of environmental exposures, management of asthma and COPD *etc.*
- Other areas in non-communicable diseases are Orthopaedics & Rehabilitation would have, osteoporosis, spinal cord injury as priority areas; Geriatrics Research to understand mechanisms of ageing and longevity; Research on Gastroenterology with focus on inflammatory bowel diseases, chronic liver diseases *etc.* Oral health priority areas would be caries and diseases of dental hard tissues, periodontitis, malocclusion and dentofacial anomalies, edentulism, cleft lip and palate anomaly in India *etc.*; Trauma, accidents and injuries would find priority with studies on types of injuries, demographic profile of the injured and the economic impact *etc.*; In the area of Nephrology some new areas would be paediatric uropathies and CKD, genetic basis of renal morbidity in congenital uropathies and gene environment interactions; In the area of Otolaryngology prevalence of hearing impairment, genetic basis of hearing loss, new cochlear implants *etc.*

Basic Medical Sciences/Other Areas

- All the major basic science areas would find to conduct new research from Allergy, Anatomy, Anthropology to Genomics, Nano-medicine, Organ Transplantation, Stem Cell Research and Therapy, *etc.*, The strong open-ended fellowship, ad-hoc research schemes would be continued. Several Centre for Advanced Research on pre-clinical toxicology, clinical pharmacology and clinical trials, Molecular Medicine,

Genetics of Lysosomal storage disorders, stem cell research and on Congenital Defects will be set up. National Centers would be started on Clinical Pharmacology and Allergy. New **Task Forces would be on** Inborn Metabolic Disorders, geo-ethnic clustering for genetic disorders, molecular pharmacology, Human Embryonic Stem Cells and Induced Pluripotent Stem Cells.

- **New Revised Guidelines /Policy Documents** would be prepared on Stem Cell Research and Therapy, Ethical Guidelines for Biomedical Research involving human subjects, Enactment of the Biomedical and Health Research involving Human Participants (Regulation of Ethical, Legal and social issues) Bill, Ethical Guidelines for Conducting Research on Mental Illness or Cognitive Impairment and Research Involving Mentally ill or Cognitively Impaired Individuals, Compensation to Participants for Research Related Injury in India, Guidelines on Data Sets and Bio-banking *etc.*
- In the area of International Health new initiatives would be to establish collaborative Centres of Excellence, collaborations with developing countries in Africa, Asia and Latin America *etc.* programme for attracting young overseas Indian researchers, harmonization of national laws, standards and regulations with other countries/agencies *etc.*
- Human Resource Planning and Development would continue to be a priority with ICMR Centenary Post Doctoral Fellowship Programme, Scheme to help middle aged women scientists *etc.*
- Priorities for **Health Systems Research** would include new studies on public, public-private and NGO partnership for improving RCH services, health insurance scheme, health economics *etc.*
- Social & Behavioral Research would attempt new studies on understanding the awareness and other social and psychological dynamics of increasing social problems like substance use, accidents and injuries, sexual abuse *etc.*
- New areas in **Medicinal plants** would include: developing of protocols for *in vitro* propagation of plants and *in vitro* production of bioactive compounds with high medicinal value, setting up a Centre for Advanced Research on quality standards of Indian medicinal plants, phytochemical reference standards on some medicinal plants, developing a compendium from ancient texts on plant drugs with focus on toxicity *etc.*, databases on country's ethno medicinal and biological wealth *etc.*

DEPARTMENT OF HEALTH RESEARCH

XII PLAN DEPARTMENT OF HEALTH RESEARCH

The Working Group of Planning Commission has underscored the fact that our health outcome indicators continue to be weak vis-à-vis our level of development. The Group has underscored the need for both enhanced allocation for health as also well laid down monitorable targets for critical health indicators as infant mortality (IMR), maternal mortality (MMR), institutionalised delivery, extent of full immunisation, *etc.* (*Faster, sustainable and more inclusive growth: Approach to the Twelfth Five Year Plan*, Planning Commission, 2011). As we move towards the XII Plan, there has been some improvement in these parameters. The IMR is down from 57 in 2006 to 50 in 2009, deliveries in institutions rose to 73% (2009) from 54 % (2006) while the MMR came down by 32 points to 212 (2007-2009). Significant as they are, the need for further acceleration has been underscored by the Working Group. The Group also recognized that the spending by government is currently less than 1 per cent of GDP as also the need to increase to 2 or 3 percent in the XII Plan (*Faster, sustainable and more inclusive growth: Approach to the Twelfth Five Year Plan*, Planning Commission, 2011). The *Approach Paper* also recognized that the shortage of health professionals at all levels has severely constrained the progress in achieving the targets set and the need for stronger impetus for human resources development during the XII Plan.

To achieve the health targets set for the XII Plan in the *Approach Paper*, it is imperative that there are substantive changes in health and biomedical research in India. We need to:

- Improve the health research infrastructure across the country, impart training to doctors and other supportive staff, especially in medical colleges to meet the targets on IMR, MMR and other indicators set by the Millennium Development Goals.
- Create rapid response systems for critical emergencies due to the emerging and reemerging infections and outbreaks that occur at regular intervals all across India for which the current centrally located disease-diagnosing and fighting infrastructure (largely in New Delhi, Pune *etc.*) is rather not an appropriate system.
- Upscale infrastructure, human resources, incentive systems, budgetary support, and a policy framework to help create our own cost-effective tools, processes and other interventions to reduce dependence on health products developed abroad, through a nation-wide translation research initiative.
- Create an evidence-base for application in the Indian public health system.

These deficiencies were eloquently argued in the National Health Policy (2002)

“Biomedical Research has mostly revolved around research institutions under the Indian Council of Medical Research and some departments of important medical institutes, specialized centres funded by some science departments. In the current context, the health research has

to be broad based and needs to cover areas ranging from basic to applied including those concerned with implementation. The research needs to be focused on therapeutic drugs/ vaccines for tropical diseases which are normally neglected by international pharmaceutical companies on account of their limited profitability potential. The thrust will need to be in the newly-emerging frontier areas of research based on genetics, genome-based drug and vaccine development, molecular biology *etc.*”

Almost a decade later, there appears to be little substantive change at the ground level. Unsurprisingly, the health problems at the beginning of the XI Plan continues to stare at us alongside new challenges. The health challenges identified during the XI Plan like dual disease burden due to communicable diseases (HIV, TB, Malaria and emerging and reemerging infections); non-communicable diseases (cardio-vascular diseases, diabetes, cancer, mental health, chronic and pulmonary diseases, asthma), nutritional problems; reproductive & child health *etc.* continue to be worthy of serious attention.. In fact, according to the latest data from the WHO (2011), India ranks very high among the nations with a steep rise in ‘premature deaths’ caused by non-communicable diseases, mainly cardiovascular, cancers, chronic respiratory, blood pressure and diabetes with a death toll of about 38% in males (2,967,000) and 32.1% (2,273,000) in females below 60 years. Overall, the NCDs currently account for over 53 percent of all deaths. India also ranks among the top 10 countries burdened with highest mortality arising from communicable diseases, especially tuberculosis, as well as high maternal and child mortality. Around 37 percent of deaths in India are caused by communicable, maternal, prenatal and nutritional conditions.

To compound the problem, there is now a third dimension ‘triple disease burden’ with accidents and injuries contributing significantly to the morbidity and mortality, especially in the urban areas with over 220000 deaths due to accidents.

To address these complex health problems, our national health research agenda needs to be constantly revamped and updated. A paradigm shift is required with the thrust and focus to shift from merely continuing the same way of doing things to a strong, directed knowledge generation paradigm focused towards development of new products and processes for our health problems using cutting edge tools based on genetics, molecular biology, *etc.*, which are the strengths of resurgent India. The transition from the concept of medical to health research and the need for strengthening the governance structure for health research are urgently called for.

New Scenario

Since independence, India has spent most of its resources and energy on the development and deployment of new knowledge about various diseases (especially infectious diseases which account for most deaths) in a concerted attempt to control, treat or eradicate them. While tools used were mostly global, the strategies developed were local. The new disease control/ treatment regimens and methods of their usage in public health were the original concepts from India, especially for diseases like tuberculosis and leprosy. These strategies have been widely acclaimed and recognized and have found their way into international programmes operated through agencies like the WHO. India has thus spent considerable efforts in successfully putting various ideas into action. As a result, we have achieved great successes in the area of infectious diseases like elimination of guinea worm disease, eradication of smallpox, elimination of leprosy and polio as public health problems. During the recent times, the country showed remarkable and globally acclaimed successes in controlling the speed of spread of H1N1

epidemic. In addition, there have been emerging and re-emerging infections like H1N1, exotic viral infections that have been continuously challenging the health system. As the infectious diseases have no respect for borders, we may well have prevented a disaster of spread of these epidemics in the Indian sub-continent. While we count these successes with legitimate pride, there have been failures in some sectors. We have also not been able to successfully address issues like the huge maternal and child mortality and have been way behind in the achievement of MDGs 4 and 5. We have also not been very successful in providing access to even minimal health care to our large tribal and marginalized communities. All these remind us of the need for constant vigilance and a nation-wide targeted, concerted and committed time-bound action plan. Such efforts need to be on a mission-mode with defined deliverables keeping in mind available human resources, infrastructure available and unique socio-economic as well as geographical realities while setting achievable and realistic targets for the XII Plan.

The XII Plan Approach Paper for S&T lays emphasis on

- (a) An in depth review of our existing institutions, structures and mechanisms so that the much needed resources, financial and human, are deployed in an optimal fashion. There is no alternative but to focus on innovations to develop and deploy affordable tools for the management of various diseases guided by equity as the core value.
- (b) Building of alliances and partnership as another key element for a vibrant innovation ecosystem for translating research outputs to measurable social and national outcomes.

This is especially important as in the post-TRIPS era, there is little chance of using products and processes developed abroad in India in view of new intellectual property rights regimes. Discovery and development of indigenous health products is therefore imperative to achieve equity with access to our large populations. However, India has often been found wanting in converting ideas and leads into products and processes for various reasons. Building of alliances and partnerships for a vibrant innovation ecosystem for translating research outputs to measurable social and national outcomes has therefore been emphasised as one of the key elements in the approach paper of the XII Five Year plan.

To address above cited challenging tasks and to give a greater thrust and focus to health research, the new Department of Health Research (DHR) was created on the September 17, 2007 under the Ministry of Health & Family Welfare. The Department was formally launched on October 5, 2007. The Department of Health Research has been assigned 10 business of which 9 are new and their evolution is vital for addressing the health research agenda of the country, if we have to achieve the targets in a time bound manner.

A Working Group has been set up by the Planning Commission under the chairmanship of Dr. V.M. Katoch, Secretary, Department of Health Research & Director-General, ICMR with Professor M.S. Valiathan as Co-Chair with membership consisting of representatives from various scientific Ministries, educational institutions, State Governments and other stakeholders to deliberate on the strategies for the XII Plan for the Department of Health Research. The Working Group was briefed about the ongoing Schemes of the Department of Health Research and a Broad Frame work of activities proposed by DHR for the XII Plan. The Group was informed about the mandate of DHR which is as follows :

1. Promotion and co-ordination of basic, applied and clinical research including clinical trials and operational research in areas related to medical, health, biomedical and

- medical profession and education through development of infrastructure, manpower and skills in cutting edge areas and management of related information thereto.
2. Promote and provide guidance on research governance issues, including ethical issues in medical and health research.
3. Inter-sectoral coordination and promotion of public-private partnership in medical, bio-medical and health research related areas.
4. Advanced training in research areas concerning medicine and health including grant of fellowships for such training in India and abroad.
5. International cooperation in medical and health research including work related to international conferences in related areas in India and abroad.
6. Technical support for dealing with epidemics and natural calamities.
7. Investigation of outbreaks due to new and exotic agents and development of tools for prevention.
8. Matters relating to scientific societies and associations, charitable and religious endowments in medicine and health research areas.
9. Coordination between organizations and institutes under the Central and State Governments in areas related to the subjects entrusted to the Department and for the promotion of special studies in medicine and health.
10. Administering and monitoring of Indian Council of Medical Research.

The 10th business of the DHR pertains to administering and monitoring Indian Council of Medical Research (ICMR) which is in its 100th year of existence. Today, the ICMR stands out as a formidable structure having 32 national and regional institutes and more than 100 field stations. Yet, to face the new challenges elucidated above, the ICMR needs to be further strengthened by continuous modernization of its own institutions as well as by opening of new centres focused on the newly emerging non-communicable diseases, cutting-edge basic science like transplant immunology, genomics, proteomics *etc.*, strengthen infrastructure for animal experiments, clinical pharmacology, critical health policy issues, health system research, socio-behavioural research *etc.* The human resource within the ICMR is very small in terms of the numbers with many institutes/centres functioning with sub-critical scientific pool. It is absolutely essential to enhance the number of researchers and other workforce in the ICMR so that it continues to be the fulcrum of the new Department of Health Research, dedicated to taking the modern health technology to the people.

Simultaneously, support to medical colleges across the country needs to be strengthened as only a small proportion (about 20%) carry out serious research activity. As Medical Colleges form the backbone for both conduct of research in priority areas, a strong, focused and vibrant outreach support programme has been proposed by the DHR. This initiative is expected to bring a qualitative change in the working of medical colleges specially those in the public sector. Such an initiative for medical colleges across the country will also create a large number of good quality researchers who will be generating research projects in the areas of national priority for contributing to a strong base of knowledge, improve quality of education and health care in the country. Also, the development of new health products (diagnostics, drugs and vaccines) is a long and complex process and some specific systems are required to encourage innovation besides appropriate ethical and regulatory frame-works for pre-clinical work and clinical trials for bringing our health products to market.

In respect of the other nine business, the Working Group on Health Research noted that Department has already embarked upon path of improving research governance by developing appropriate policies; establishing authorities to implement the policies; initiating the process of creation of suitable infrastructure in medical colleges and other institutions; developing a special scheme to strengthen human resources in medical colleges and state structures; initiating the establishment of an extensive infrastructure encompassing all regions of the country to carry out research on various infectious diseases aimed at containing all future outbreaks/ epidemics. Lastly, DHR has also planned a major initiative in respect of establishing a vibrant and effective inter-sectoral co-ordination amongst science agencies in the country having the strength and mission of developing new products and processes or have overlapping areas of activity. Building of alliances and partnership for a vibrant innovation ecosystem for translating research outputs to measurable social and national outcomes would be one of the key elements in the approach paper of the XII Five Year Plan.

Of the work allocation given above, the work relating to ICMR was the only ongoing scheme to have been transferred to the Department at the time the DHR was established. There was almost no systematic work on the remaining areas allocated, although some *ad hoc* work was taken up during emergencies like the H1N1 outbreak. This has necessitated the taking up of new schemes in view of the major gaps in the ongoing health programmes and the infrastructure that exists today in respect of health research.

The Working Group was informed that since the creation of the Department, wide scale consultations have been initiated in order to finalize and strengthen the interventions and policies required for a vibrant, well functioning and relevant health research system.

Based on the consultations, the following four schemes the details of which are given in following chapters have been prepared during XI Plan for meeting the mandates of the Department.

- (1) Infrastructure Development for Health Research**
- (2) Establishment of a Network of Laboratories for Managing Epidemics**
- (3) Human Resources Development for Health Research**
- (4) Grant in Aid for Medical Research**

The Working Group noted that the aforesaid schemes have been formulated with a view to create necessary infrastructure for promoting Health Research in the country, to produce trained human resources in various critical areas of Health Research, support the trained personnel to pursue research in areas relevant to the nation and to promote translational research so that the scientific leads identified by different organizations could be translated into products and processes quickly for making health care affordable to all sections of our society. Initially the schemes were to be implemented for a project period of three years and thereafter to be scaled up during XII Plan. These programmes approved by the Planning Commission were initiated either on a pilot basis or restricted to the activities proposed to be taken in the first year of the project during XI Plan period, as resources for XII Plan period could not be committed by the Planning Commission. It was proposed to continue the activities initiated during the XII Plan.

In the current scenario, the Working Group endorsed the proposal of the DHR that while the ICMR would continue to focus on active research programmes for the generation of new knowledge, the DHR would concentrate on:

- Governance
- Develop infrastructure and manpower in medical colleges, state health systems, universities *etc.*;
- Promote the translation and implementation research through Central & State Govt Institutions through optimum use of knowledge management & National Knowledge Network backbone and by partnering with professional bodies, NGOs/ private sector and other stake holders
- Strengthen and augment international collaborations in health
- Create mechanisms for management of epidemics/ pandemics *etc.*

The above-mentioned strategy proposed by the DHR for the XII Plan was discussed by the experts of the Working Group. The critical ongoing activities of the DHR and the proposed activities described below have been finalized according to its recommendations and guidance provided.

Critical ongoing programmes

I. Upscaling of the four schemes viz.

- Infrastructure Development for Health Research
- Establishment of a Network of Laboratories for Managing Epidemics
- Human Resource Development for Health Research
- Grant in Aid for Health Research

II. Regulatory framework for research governance and other related aspects

New proposals for the XII Plan

I. Establishment of Specialized labs/set-ups

- Research Units/ Specialized laboratories
- Centre(s) for Clinical Research & Training on Ethics
- Centre for Research on Health issues related to disaster management
- Centre for Research on Vaccine preventable diseases
- Centres of Testing and Evaluation of Drugs and Devices
- Technology Assessment Board
- Technology Promotion Board
- Knowledge management and e-governance
- Forum for Intersectoral Coordination

Critical ongoing Schemes/ Programmes for upscaling

I. Current Schemes

- **Infrastructure Development for Health Research**

- **Establishment of a Network of Laboratories for Managing Epidemics**
- **Human Resource Development for Health Research**
- **Grant in Aid for Health Research**

II. Regulatory framework for research governance

The aforesaid schemes are formulated with a view to create necessary infrastructure for promoting health research in the country, to produce trained human resources in various critical areas of health research, support the trained personnel to pursue research in areas relevant to the nation and to promote translational research so that the scientific leads identified by different organizations could be translated into products and processes quickly for making health care affordable to all sections of our society. Initially the schemes were proposed to be implemented for a project period of three years and thereafter to be scaled up during XII Plan. These programmes approved by the Planning Commission were initiated either on a pilot basis or restricted to the activities proposed to be taken in the first year of the project during XI Plan period, as resources for XII Plan period could not be committed by the Planning Commission. It was proposed to continue the activities initiated during the XI Plan as described below.

I. Current Schemes

a) Infrastructure Development in Medical Colleges

There is a need to promote basic and applied research for the improvement in the health care services in the country. Medical Colleges form the back bone of both teaching and providing specialized services to patients in India. These Colleges are also expected to set the trends in the thinking process and innovations to improve our understanding of the diseases and their management. However, over the years it has been noticed that a majority of medical colleges have confined themselves to routine patient care and teaching based on conventional methods. Presently, Medical Research is largely confined to a handful of institutions and medical colleges in the country that too in few States.. The standard of papers published/ research projects largely undertaken by the students of post-graduate courses M.D./M.S./Ph.D. in most of the Medical Colleges is not very inspiring. This can be attributed both to the lack of appropriate facilities for conducting research and a lack of motivation and knowledge on the part of faculty and students in Medical Colleges for conducting research.

Consequently, the Medical Colleges are not pursuing newer methods of investigation for understanding the pathological diagnosis, treatment and management practices. This has not been perceived as a priority area for State government funded medical colleges or even for many Centrally funded medical institutes. Such lack of advanced knowledge/skills also affects the quality of clinical services being provided. There is, therefore, an urgent need to promote and encourage quality medical research in the country through competence building programmes for the faculty of Medical Colleges.

Though medical research is part of the medical education and animal house facility is a basic requirement for undertaking research by the undergraduate medical students, most medical colleges do not have well established animal house facility meeting the requirements of the regulatory authorities under the national guidelines as the CPCSEA. Since having a well established animal house facility is essential for promoting medical research in any institution, there is a need to provide support to the medical colleges for establishing a good animal house facility meeting the basic requirements of the regulatory authorities.

Similarly medical professionals in the public health system, especially those working in the periphery, lack access to current information on advances in a regular fashion in their settings. In addition, medical doctors working in the public health system do not get opportunity to get orientation on modern advances on a regular basis in their settings, the transfer of technology to the end users becomes very difficult. Further wide variations exist in the pattern of disease prevalence, the local conditions which require development of state/area specific, disease-specific strategies to provide better health care facilities through availability of modern technology to the general public.

There is, therefore, a need to create structures which function as interface between the new technologies developers (researchers in the medical institutions; State or Centre), health systems managers (Centre or state health services) and the beneficiaries (community rural, urban slums). There is need to create a structure in rural settings which would act as a model units to transfer the technology to the state health system where research under basic, applied and clinical disciplines could be undertaken to transfer the technology for use of rural population of that area. In reverse, this will lead to generation of new knowledge about epidemiology and impact of interventions which will serve as feed back for change in policies and also scope/need of new innovations.

Objectives: The objectives of the present scheme are to:

- Bridge the gap in the infrastructure which is impeding the health research in the Medical Colleges by assisting them to establish multidisciplinary research laboratory and animal house facility with a view to improving the basic as well as applied health research and health services.
- Create infrastructure for transfer of technology to the end users which would ensure an interface between the new technologies developers (Researchers in the medical institutions; State or Centre), health systems operators (Centre or state health services) and the beneficiaries (community rural, urban slums)
- To enlarge the outreach and ensure the geographical spread of health research infrastructure by selecting judiciously the institutions to be supported under the scheme.
- This scheme, with the components detailed below are essential since there are no other schemes at present, which address these issues either in the Ministry of Health & Family Welfare or in other Ministries.

Components:

- a) Strengthening of Central and State Government Medical colleges by providing one- time grant for the **establishment of Modern Biological Lab/ Multidisciplinary research facilities & Animal House facilities in Government Medical Colleges and institutions.**
- b) Developing of Model Rural Health Research Units (MRHRU) in States.

Details:

- a) **Setting up of modern biological labs/ multi-disciplinary research facilities & Animal House facilities in State Govt. medical colleges and institutes.**

At present there are about 300 medical colleges in the country of which 143 are in the Govt. sector. In order to revitalize Medical colleges as centers for bio-medical research, it was

proposed to support the State Govt. medical colleges for setting up of modern biological labs/ multi-disciplinary research facilities and establishment of Animal House facilities. Financial assistance up to ₹ 6 crores will be provided for setting up of modern biological labs/ multi-disciplinary research facilities and Animal House facilities for promoting medical research in the country. This will be a centralized facility in medical college available to all the faculty/ researcher. The facility will be established in the space provided by the State medical college. This will include funds for civil works for modification/ renovation, equipments and furniture for the multi-disciplinary research laboratory and will also include funds for establishing animal house facilities meeting the requirements of regulatory authority in India as per the requirement (CPSCEA).

Apart from the non-recurring grant, appropriate recurring grant will also be extended for a period of five years for engaging trained technical man power on contractual basis, for training, travel, consumables and contingency expenditure *etc.*

There has been an overwhelming response from the state govt medical colleges to the scheme. The Department of Health Research has *already received proposals from 57 colleges of which 31 colleges have been technically evaluated by the Committee set up for this purpose.* However, during XI Plan period it is proposed to support only 20 State medical colleges for establishing modern biological labs/ multi-disciplinary research facilities and Animal House facilities. These activities will be continued and upscaled during XII Plan and 250 medical Colleges supported by the Central/State Govt. and private colleges, will be supported in a phased manner for setting up of modern biological labs/ multi-disciplinary research facilities and Animal House facilities.

b) Setting up of Model Rural Health Research Units:

Public health system in India has a wide network of primary health centers at the periphery, other referral secondary and tertiary level hospitals at district, state and other levels. Over the last more than 60 years, preventive, diagnostic and therapeutic services have been provided through this network managed by States. It has been observed that a big gap exists between PHC/CHC and tertiary care hospitals with state-of-art- facilities created by centre and also by some of the state governments. The professionals and policy makers are of the view that modern methods of diagnosis and management cannot be practiced at peripheral level. There is a mental block in a large number of professionals and policy makers who think that modern methods of diagnosis and management can not be practiced at rural settings.

Medical doctors working in the State public health system do not get opportunity to get orientation on modern advances in a regular fashion in their settings and therefore, unable to utilize advances in medical science in their work. Because of this, the transfer of technology to the end users becomes very difficult.

Further wide variations exist in the pattern of diseases prevalent in different geographical areas, the local conditions which require development of state/area specific, disease specific strategy to provide better health care facilities ensuring that the modern technology is available to the general public. Transfer of research finding/technology at the rural level has been found to be major lacuna in the provision of quality medical services to rural population.

To bridge the gap, Department of Health Research (DHR), based on the experience of establishing a Model Rural Health Research Unit at Ghatampur under National JALMA Institute for Leprosy and Other Mycobacterial Diseases (ICMR), Agra and some of the medical

colleges, proposes to establish Model Rural Health Research Units where the methods of diagnosis and treatment as well as epidemiology are shown to be workable. These Units will function as an interface between the new technologies developers (Researchers in the medical/other institutions; State or Centre), health systems operators (Centre/state health services) and the beneficiaries (community).

The Model Rural Health Research Units would undertake the following functions:

- Develop state/area specific models depending upon the disease profile, morbidity patterns and local conditions for transfer of the technology for providing better health care services to the rural masses.
- Training the health professionals of State health system for the use of modern field adaptable methods and the model developed.
- To undertake various research projects in close coordination with the State Government institutions and others that are relevant and beneficial to the rural population.

The Units will develop State specific models depending on the disease profile, topography and the local conditions as per the priorities & location identified by the State Govt. in close coordination with State health authorities. Special focus will be given to tribal areas, hilly terrain, and remote areas. For example, in the State of Bihar the unit will be developed with special focus to tackle kala-azar, while in some of the coastal States like Kerala the focus would be on filariasis or leptospirosis *etc.* These priorities will however, change from time to time. These Units, to be set up in an operational research mode, would serve as model units to transfer the technology to the state system by showing its applicability and feasibility in the rural settings. These units will undertake/translate the research technology under the basic, applied and clinical disciplines for the use of population in that area.

Department of Health Research will establish these Model Rural Health Research Units at least one per state. In bigger States there could be more than one such Unit. They will function under the Department of Health Research and would continue to develop specific models for transferring the technology as the development of technology in the health system is a continuous process and there is a need for review and modify the models depending on the new available technology. They will also generate state/area/disease specific data, which would be a great input for improving the general health system. During the remaining part of the XI Plan period, it is proposed to start the activities to establish 10 Model Rural Health Research Units which will be made fully operational during the XII Plan period. The scheme is proposed to be scaled up during XII Plan with 50 Model Rural Health Research Units to be established across the country during the XII Plan.

Budget: The outlay projected for the Scheme “Infrastructure Development for Health Research”, for completing the XI Plan ongoing activities, upscaling XI Plan activities to effect better geographical coverage and to support for creation of infrastructure for promoting health research in specialized areas is ₹ 3000 crore.

2. **Establishment of a Network of Laboratories for Managing Epidemics (viral diagnostic and infectious disease laboratories)**
 - (i) **Regional laboratories**
 - (ii) **State Level Laboratories**
 - (iii) **District level Laboratories**

Viruses are one of the deadliest organisms known to cause large epidemic and pandemics in various parts of the world. Many a bacterial agents are also capable of causing outbreaks/epidemics. Majority of emerging-reemerging infections of concern worldwide are of viral origin. Of the 20 emerging-reemerging infections all over the world, 14 are of viral origin like Hanta, SARS, Monkeypox, West Nile, Ebola, Marburg, Yellow fever, Influenza (Avian/Swine), Chandipura, Chikungunya, Nipah, Dengue, Hendra and HIV. In India, during the last 30 years, 30 different outbreaks have been recorded, of which 21 have been due to different viruses. During the past 10 years, ICMR's National Institute of Virology at Pune has investigated and confirmed various outbreaks of new/exotic Nipah virus (2001), SARS(2003), H5N1 (2006-09), Chandipura (2005,06,08), Chikungunya (2006-09), Acute Encephalitis Syndrome/JE (2005 onwards), Hepatitis B outbreak in Gujarat (2008) and H1N1 pandemic (2009 onwards). These epidemics/pandemics have had a major impact on the health sector and also taken a huge toll on the economy of the country.

The ability of viruses to cause devastating epidemics in human societies has led to the concern that these organisms could be weaponised for biological warfare. Because viruses use vital metabolic pathways within host cells to replicate, they are difficult to eliminate without using drugs that cause toxic effects to host cells in general. Hence there are very few effective drugs for treatment of viral diseases. The only method to stop the spread of viral diseases, in most of the cases, is timely diagnosis and implementation of proper control measures. This can only be achieved by establishing proper surveillance and diagnosis facilities in each and every part of the country so that the outbreak due to any virus can be detected and aborted as soon as it begins.

Till date there is grossly inadequate infrastructure in the country for timely diagnosis and management of populations affected with viral diseases, in times of need. There are very few laboratories all over the country which have the potential to work on viruses. Entire burden of diagnosing diseases of suspected viral etiology all across the country is mainly borne by ICMR's National Institute of Virology, Pune and National Center for Disease Control, Delhi. These apex laboratories are involved in providing diagnostic services to patients, developing laboratory contingency plan, communication with government and public, providing support to SEARO countries, establishing new diagnostic centers in various parts of the country, training, Quality control, supply of reagents and kits and doing basic, applied and translational research. These laboratories with their limited manpower and resources are unable to cater to the needs of the entire nation, despite best possible efforts. Considerably large numbers of patients with diseases of suspected viral/ other infectious etiology go undiagnosed due to lack of proper surveillance and diagnostic tools available in different parts of the country.

The capacity for surveillance and diagnosis has to be strengthened at each level in every part of the country so that viral diseases are timely diagnosed and managed, cases are not missed and timely interventions can be made. Surveillance on commonly occurring viral diseases can help Government in planning proper strategies like vaccination. Thus the expenditure on these infrastructure and tool development will be evidence based. Capacity at different levels has to be developed for early and correct diagnosis, development of tools to predict viral disease outbreaks beforehand, continuous monitoring and surveillance of existing as well as new viral strains and handling viruses with a potential to be used as agents of bioterrorism.

Hence, this creates an immediate need to strengthen infrastructure and capacity for handling viral diseases in the country in terms of early and correct diagnosis, development of tools to predict viral disease outbreaks beforehand, continuous monitoring and surveillance

of existing as well as new viral strains and handling viruses with a potential to be used as agents of bioterrorism. The need for having well-established net work of laboratories and also to facilitate rapid mobilization of outbreak of disaster response (technology component) to infectious diseases has gained more importance in the context of biological terrorism / biological warfare. There is a need to facilitate focused research in dealing with emerging and re-emerging diseases identification of agents, development of diagnostic tests, formulation of case management modules & preventive strategies *etc.* Early adequate information and capacity to diagnose the viruses will lead to saving of many lives. **In view of this the Department of Health Research proposes to establish a network of laboratories across the country with capacity to handle all human pathogenic viruses as well as emerging-reemerging viral diseases and to develop tools for prevention.** This will also meet the mandates of the department for providing technical support for dealing with epidemics and natural calamities and investigation of outbreaks due to new and exotic agents and development of tools for prevention.

Objectives:

- Create infrastructure for timely identification of viruses and other agents causing morbidity significant at public health level and specifically agents causing epidemics and/or potential agents for bioterrorism.
- Develop capacity for identification of novel and unknown viruses and other organisms and emerging-reemerging viral strains and develop diagnostic kits.
- Provide training to health professionals.
- Undertake research for identification of emerging and newer genetically active/modified agents.

This scheme, with the components detailed below is essential since there are no other schemes at present, which address this issue of infrastructure development and these aspects either in the Ministry of Health & Family Welfare or in other Ministries. This will complement the Integrated Disease Surveillance Project and will strengthen the activity by capacity development and active research on these aspects.

Components:

- Establish a net-work of laboratories for diagnosis of the viral and other infectious diseases.
- Set up of revolving fund for facilitating a rapid mobilization of out-breaks/ disaster response (technology component) to infectious disease out-breaks or natural or man-made disaster.

Strategy:

As has been stated viral diagnosis today are a major health problem and outbreaks of new viral agents is a common phenomenon. The inadequacy of specialized laboratories in the country especially of secondary and tertiary level has been noticed in the past as also was evident during the recent H1N1 crises that gripped the nation. In the context of biological agents being used as weapons for man-made disaster and also outbreaks of new viral agents, it is considered necessary to establish a net work of laboratories for viral diagnosis. Such network and active research programme will be important to generate evidence for interventions for various viral infections which are endemic to the Country. For this purpose it is considered essential to

establish network of laboratories across the country, with NCDC and NIV, with bio-safety laboratory III, acting as the apex laboratories. These labs will supplement the activities of the Integrated Disease Surveillance Project coordinated by NCDC, Delhi with special focus on viruses and will also be expected to deal with all common viruses like:

- 1) Viruses transmitted by respiratory route: Measles, Rubella, Mumps, Influenza viruses (A, B and C), Parainfluenza virus, Adenoviruses, Respiratory Syncytial Virus, Rhinoviruses, Polio, Coronaviruses.
- 2) Viruses transmitted by intestinal route: Hepatitis A, E, Rotavirus, Astroviruses, Calciviruses, Norwalk viruses, Enteroviruses.
- 3) Vector Borne Disease Viruses: Dengue, Chikungunya, Japanese encephalitis, West Nile, Kyasanur Forest Disease, Chandipura.
- 4) Zoonotic viruses: Rabies, Nipah virus, Hanta virus
- 5) Viruses transmitted by body fluids: HIV, Hepatitis B and C.
- 6) Other non-viral pathogens

Priority will be given to develop infrastructure and expertise for diagnosis of viruses/ agents with a potential to cause outbreaks and/or which are responsible for significant disease burden like Measles, Influenza viruses (A, B and C), Respiratory Syncytial Virus, Polio, Hepatitis A, E, Rotavirus, Enteroviruses, Dengue, Chikungunya, JE *etc.*. These laboratories will be expected to develop expertise for diagnosis of specific viruses circulating in their geographic area.

At present, there are only two laboratories well equipped to deal with all kinds of viruses *viz.* NIV, Pune and NCDC, Delhi. These labs will continue to act as Apex laboratories. In addition, three levels of laboratories are proposed to be established.

- (i) Regional laboratories
- (ii) State level laboratories
- (iii) District level laboratories

(i) Regional laboratories:

It is proposed to establish 6 regional laboratories to deal with all kinds of viruses and other organisms causing infections, *i.e.* one each in North, South, East, West, Central and North-Eastern parts of India and preferably at ICMR institutes. They will be expected to carry out serology, RT-PCR, isolation, fluorescence microscopy, tissue culture and sequencing for viruses listed above or any other new viral pathogen. These labs will also be expected to develop capacity for identification of novel/unknown viruses and other organisms and emerging-reemerging viral strains *etc.* & develop diagnostic kits. They will receive unidentified samples from the State level labs for identification and characterization. These labs will also provide necessary training to those deployed in State level labs and support them in building capacity. They will be responsible to do research apart from providing diagnostic facility and training. In addition, they will be equipped with facilities to identify viruses and other organisms which have the potential of being used as agents of bioterrorism.

It is proposed to create state-of-art facilities in these Regional Labs so that it could achieve the objectives in research, continuous monitoring and surveillance of existing as well as new

viral and other strains and handling viruses *etc.* with a potential of being used as agents of bioterrorism, capacity building, diagnosis, development of diagnostic kits *etc.* An amount up to ₹ 15 crore per lab is proposed for the development infrastructure including civil works, furniture *etc.*

These facilities will be created in the identified institutions under the Ministry of Health and Family Welfare and will function directly under the Department of Health Research for better coordination and would undertake continuous monitoring, surveillance, focused research on emerging and reemerging agents and develop diagnostic kits. These laboratories will be manned by regular scientific/technical staff.

(ii) State Level Laboratories:

It is proposed to establish 28 State level labs, one lab in each State and Union Territory preferably in Govt. Medical College/hospital. These labs will be equipped with BSL2 facility and expected to carry out serology, RT-PCR, isolation, fluorescence microscopy, tissue culture and sequencing for all enlisted viruses. These laboratories are also expected to be involved in basic as well as applied research on viruses, development of kits and diagnostic reagents and identification of unknown/referred samples from the Sub-state level laboratories. For developing required infrastructure including civil works which is mainly for modification/renovation, furniture, equipments *etc.* an amount up to ₹ 5.0 crore per lab is proposed. In addition recurring grant for a period of 5 years for engaging trained technical human resources on contractual basis, training, consumables and contingency expenditure are proposed to be extended.

(iii) District level Laboratories:

It is proposed to create 200 district level labs. State Govt. will be requested to identify 1 such lab to cover a cluster of 3-4 districts depending upon their requirement preferably in Govt. Medical Colleges. These labs will be equipped with facility to carry out serology, PCR and fluorescence microscopy for the listed viruses. With the available infrastructure, these labs are expected to identify all common viruses by using immunological and molecular tools. The viruses which can not be identified by these labs will be referred to the state/regional labs for identification. These labs will also be involved in diagnosis of common diseases other than that of viral etiology, which are prevalent in their respective region. This will facilitate early diagnosis of all the identified viruses so that the intervention/treatment if available could be provided without losing valuable time. It will also strengthen the surveillance/monitoring of viral diseases. For developing required infrastructure including civil works which will mainly be renovation / modification, furniture, equipments *etc.* an amount up to ₹ 1.0 crore per lab is proposed. Apart from the non-recurring grant of up to ₹ 1 crore per District level Institution, recurring grant will also be extended for a period of 5 years for engaging trained technical man power on contractual basis, training, consumables and contingency expenditure.

During XI plan it is proposed to initiate action for establishing 6 Regional Laboratories, 10 State Level Laboratories, and 30 District level laboratories which will be completed during the XII Plan period. The remaining State Level and District Level Laboratories will be established during XII Plan period.

Setting up of revolving fund for facilitating a rapid mobilization of out-breaks/disaster response (technology component) to infectious disease out-breaks or natural or man-made disaster.

A revolving fund is proposed to be established to facilitate a rapid mobilisation of outbreak/disaster response (technology component) to infectious disease outbreaks or a natural or manmade disaster. The scheme will work in coordination with relevant departments of MOHFW and also agencies like National Disaster Management Authority (NDMA) *etc.* This programme will specially facilitate focussed research to assist in dealing with emerging and re-emerging diseases; identification of agent; development of diagnostic tests; formulation of case management modules and preventive strategies; establishment of laboratories to handle new, exotic and dangerous organisms.

Regarding the matters related to epidemics, natural calamities and development of tools to prevent outbreaks, DHR has already initiated action to establish coordination with the Department of Health & Family Welfare and the NDMA to develop management modules. In consultation with NDMA, two expert groups for this purpose have been constituted. The Apex Committee which will function under the chairmanship of Member of NDMA will identify the areas for the creation of these modules. The other action group will meet periodically to implement the guidelines suggested by the apex committee. The efficacy of this approach was established in the wake of the recent H1N1 episode where DHR succeeded in playing a leadership role in coordinating efforts to augment diagnostic capability, successfully partnering with other departments of MOH&FW and other Ministries to develop a national response, taking initiatives to develop indigenous diagnostic reagents, vaccines and indigenous production of raw material (shikimic acid) for production of oseltamivir. This Fund will also be used to train the personnel.

Budget: For establishing a network of laboratories for managing epidemics and for setting up of revolving fund for facilitating a rapid mobilization of out-breaks/ disaster response (technology component) to infectious disease out-breaks or natural or man-made disaster the outlay projected is ₹ 900 crore.

3. Human Resources Development for Health Research

Advances in the quality of health care and improvement of the health of people through research will require an accelerated expansion in the availability of human resource for health research. There is, therefore, an urgent need to support human resource development for health research in the country. The proposed support to biomedical and health research training includes institutional training grants, individual fellowships, training grants, research grants *etc.*

Objectives:

The objectives of the present schemes are to:

- Increase the availability of personnel for health research through scholarships, fellowships and career advancement scheme *etc.* thereby providing an incentive for people to take up medical and health research.
- Assist in the creation of a cadre of trained skilful researchers quality assurance in fields such as clinical trials; Toxicology; Good Clinical Practices (GCP); Good Laboratory Practices (GLP); Quality Control (QC) & QA; Genomics; Proteomics; Geriatrics; Biotechnology; Stem cells; Genetics; Drugs chemistry and other specialized areas of medical research.
- Create and support multidisciplinary and multi-sectoral teams of researchers working in medical colleges, universities, research institutes and NGOs.

This scheme, with the components detailed below is essential since there are no other schemes at present, which addresses the above specific needs either in the Ministry of Health & Family Welfare or in other Ministries. To create synergy, an Expert group has been constituted to identify the areas in which the DHR will complement the efforts of other science agencies in order to avoid any duplication of effort.

Components:

- Programme to create researchers in high focus, high skill areas.
- Programme to promote medical research as a career among young scientists and medical students.
- Programme to promote research in young and mid career faculty of medical colleges.
- Creation of a national initiative in partnership with relevant stakeholders to attract and retain the young to a career in health research.
- Development of human resource policy with focus on career development scheme for young researchers.
- Strengthening research through the establishment of online courses and web portal on health research for students, faculty and other researchers.

Strategy:

Development of researchers in critical and high focused areas: This would be done through the adoption of a multi pronged strategy.

- **Through the identification of institutions working in identified areas,** and by providing access to researchers to work in frontline areas in such state- of- the- art facilities. Under this programme, selected researchers would be placed in state-of-the-art facilities both within and outside India, as required in cutting edge areas, so as to enhance their skills and knowledge and to ensure a core group with skills in important areas. In order to implement this scheme, the DHR would identify state of the art facilities within and outside India. It will provide funds to the institutions in India for up gradation of facilities and consumables *etc.* and to the researchers; to develop core teams in selected areas.

Objectives:

- **Provide technology support to investigators** who plan to work on frontline areas of medical and health research, mechanisms will be built to make such facilities available to them locally or anywhere within the nation.
- **Programme to promote medical research as a career among young scientists and medical students:** This will be ensured through the provision of fellowships and scholarships as follows:
- **Fellowships for training:** Researchers in identified advanced fields would be provided fellowships so as to enhance their skills in deficit areas. The DHR would provide fellowships for trainings in frontline and emerging areas for training within India and abroad. These fellowship trainings will be preferably for relatively young investigators who are working on health related areas and where the plans for utilizing the training are well focused and concrete.

- **Provide scholarships at the Postgraduate level:** Support for producing man power in newer areas which are essential for development of health research like Postgraduate degrees in clinical research, health technology, Regenerative Medicine, Ethics in medical research, patents relating to health, *etc.*
- For the creation of a national initiative in partnership with relevant stakeholders to attract and retain the young to a career in health research.
- **Institution of young Researcher Training Programme:** The Young Researcher Programme is designed for highly qualified and motivated individuals skilled in areas relevant to bio-medical research, who wish to take up medical research as a career option. The programme would be open for potential researchers who have completed their undergraduate medical degree or post graduate degrees in medical and biomedical fields. This is proposed to be achieved by providing special training programmes.
- Selected researchers would participate in specially designed orientation and given an opportunity for on-the-job learning and mentoring. They would be provided an opportunity to participate in seminars, short trainings and workshops and also provided specialized training.
- At the end of their training/ fellowship, selected researchers would be provided **start-up grants** to enable them to take up projects based on their training.

As highlighted, this programme would identify **young and mid career researchers in medical colleges and other health/medical research institutions** and then provide support through fellowships and subsequently a start up grant so as to attract and retain the young in a career of health research. Focused attention will be provided for development of human resource in medical colleges supported for creation of infrastructure (Multidisciplinary research Laboratory under the Scheme for Infrastructure Development for promotion of health research) so that the facilities created are put to use effectively.

For this purpose Department of Health Research propose to:

- Support selected domestic institutions having facilities for training and provide one time grant of about ₹ 50 lakh to 1.00 crore for up gradation of facilities and about ₹ 10 lakh per year for five years for consumables *etc.*
- Fellowships for training abroad in identified areas (6 to 12 months) upto 25 persons per year at an approximate expenditure of about ₹ 15 lakh per person.
- Long term training fellowships at Indian Institutions for 50 persons per year at an approximate expenditure of about ₹ 5 lakh per person.
- Specially designed orientation training (1 to 3 months) for 50 persons per year at an approximate expenditure of ₹ 2.5 lakh per person.
- Short term training (1 to 3 months) to 50 young researchers per year at an approximate expenditure of ₹ 2 lakh per person.
- Three years fellowship in newer areas for 50 young postgraduate students per year at an approximate expenditure of ₹ 5 lakh per person per year.
- Start up fund of about ₹ 30 lakhs per person (₹ 10 lakh per year) for 50 persons per year.

In addition to above, open to all the institutions, **there will be a special focused programme for human resource development in medical colleges** receiving support for establishment of multidisciplinary research facilities. This would be done through special training Programmes and through mid-career research fellowships so as to expose the medical faculty in these institutions to the newer technology and research. Through this fellowship, the faculty in various medical colleges will also be exposed to training in a number of emerging fields like clinical trials, toxicology, genomics, stem cell research, drug chemistry, etc. This would enable them to focus on research, when they join/ go back to their respective institutions.

It is proposed to support two medical faculties per medical college per year for the long term mid-career fellowship programme and four medical faculties per medical college per year for short term mid career fellowships. In addition, two such trained medical faculties per college per year will be supported with Start-up grant of about ₹ 30 lakh (₹10 lakh per year) to start research so that the facilities created and the trained manpower are effectively put to use for promoting health research in the country.

During XI Plan period, in view of the observation of the Planning Commission that the Scheme may be restricted to the XI Plan period as the resources for XII Plan cannot be committed at this juncture it is proposed to support the following activities in 2011-12.

Mid-career research fellowships: Faculty development-one medical faculty per medical college per year for a long term mid career fellowship programme and two medical faculties per medical college per year for short term mid career fellowships and support 10 medical colleges during 2011-12 for long term (one per college) and short term (two per college) courses. In addition one such trained medical faculty per college will be supported with Start-up grants of about ₹ 30 lakh (₹ 10 lakh per year) to start research.

During XII Plan period, the activities will be scaled up and the Department of Health Research will support fellowship/ training programmes for around 3500 persons in medical colleges/ other Institutions in identified areas relevant to the nation.

Programme for health research personnel serving abroad: To attract health research personnel (NRI, PIO, OCI) serving abroad in critical areas to come back to India for undertaking research in identified areas by extending financial support through formulation of suitable schemes.

Programme to establish an online teaching and learning facility for the promotion of bio-medical research: Much of the biomedical research being carried out in the country today is confined to few medical colleges/institutions of the country. It is important that this research is encouraged in all parts of the country, especially rural and remote areas. One of the reasons for the limited outreach has been the lack of easy access to knowledge and support for research. On the other hand, the strong IT network and programme to connect different institutions through NKN is developing. This programme will help prospective institutions and individuals to access resources- both financial and technical on research and promote research across the country. This facility will include the following facilities:

- Online courses along with contact Programmes/ placements in relevant institutions
- On line resource material for researchers
- On line mentoring for young researchers
- Interactive forums and e groups for researchers

The scheme is proposed to be started in a small way within the allocated Plan Budget during XI Plan and would be scaled up during the XII Plan.

During the XII Plan Period, the specific and specialized training and skill development needs as also the medical colleges/institute where such human resources development are needed will be identified. A total of about 1000 mid-career and senior people and about 2500 young investigators will be imparted the training.

Budget: The outlay projected for Human Resource Development for continuing the activities started in the XI Plan, up scaling the activities is ₹ 1000 crore which will enable the Department to create about 1000 mid-career and 2500 young investigators, about 2/3 from medical colleges.

4. Grant in Aid for Health Research

The broad contents of the scheme are :

- a) Programme for Research studies
- b) Support to Scientific/Professionals/Association/Bodies:
- c) For Participation in Conferences Abroad for non-ICMR researchers
- d) Programme for Gender and Health
- e) Programme for Health Research Personnel Serving Abroad

At present a number of Institutions/Universities are undertaking projects in Health Research relating to basic, clinical, operational areas. Some of the leads do get translated into products/processes. However, these research projects are being taken up in isolation and there is no coordination between these researchers in basic, clinical disciplines and the community clinician, clinical practitioners, professional society, industries *etc.* so that the research undertaken is focused, broader and with an aim to develop products and processes for the benefit of society. A bench-to-bedside approach to translational research is really a two-way street. Basic scientists provide clinicians with new knowledge about biology and tools for use in patients and for assessment of their impact, and clinical researchers make novel observations about the nature and progression of disease that often stimulate basic investigations.

Accordingly there is an immediate need to bridge the gap between various stakeholders involved in Research/Services so that there are coordinated efforts to accelerate the development of appropriate technologies/innovations in the health field. Further there is no collated data available in respect to the research undertaken in the country, number of research institutions and the researchers in various fields and evaluation of research projects to ensure that they are aligned to National Health Policy, National Health Research Policy, National Science technology policy *etc.*

The main aim of scheme is for supporting (to create a mechanism/platform) for collection of data of research undertaken in various medical fields, evaluate them to identify the leads unattended due to want of resources or otherwise and take them to logical conclusion for development of products by fostering link with industries, support for additional information/data required in identified areas leading to development of leads and ensuring that the basic/clinical research in future is more focused and towards development of leads for translating them into products/processes for benefit of society by bringing together the academic and Industry. For this purpose a mechanism/ platform/ agency will be created which will support various activities for achieving these objectives.

Objectives: The objectives of the present scheme are to:

- i. Assist institutions to forge an integrative academic home for Clinical and Translational Science that can synergize multi-disciplinary and inter-disciplinary clinical and translational research and researchers to catalyze the application of new knowledge and techniques to clinical practice at the front lines of patient care.
- ii. Capture, advance, and nurture a cadre of well-trained multi- and inter-disciplinary investigators and research teams.
- iii. Support and encourage clinical and translational science by catalyzing the application of new knowledge and techniques to clinical practice and public health; knowledge management.
- iv. Support studies addressing the problems of technology access to marginalized and underprivileged groups by focusing on issues pertaining to gender and health, tribal health, maternal and child health.
- v. Create synergy among various stakeholders – national and international agencies, investigators, institutions, regulators, NGOs and civil society for acceleration of knowledge generation, its translation and implementation.
- a. **Programme for Research Studies:** Financial support will be extended to researchers to pursue research in areas which are very relevant to our country with special focus on knowledge management, technology access to marginalized and under privileged section of society. Projects requiring intersectoral coordination, international cooperation, and translation as well as implementation will be given priority. Research on mechanisms for efficient knowledge management and e governance will have special focus under this scheme. Strategies could be inter-institutional as well as public private partnerships or also industry.
- b. **Support to Scientific/Professionals/Association/Bodies:** Financial support to scientific societies/associations *etc.* will be provided to create expert groups, to develop guidelines, to evaluate any technology that the specialty field important and provide developmental grants for implementing the recommendations, emanating from these expert groups/workshops. Support will also be extended to print the proceedings, guidelines and recommendations emerging to that scientific events as well as specially constituted expert groups.
- c. **For Participation in Conferences Abroad for non-ICMR researchers** for presenting research papers, chairing the session or delivering a key note address in international scientific events (conferences, seminars/symposia/workshop) for promoting the research activities and researchers for sharing of experiences of scientists from various countries and for organizing international conference/seminars/symposia/workshop in India for sharing of knowledge and expertise of developed and developing countries for transfer of technology, for dealing with various emerging/remerging challenges.
- d. **Programme for Gender and Health:** The vulnerability of women to various situation and circumstances are different as compared to men. A gender based analysis on a continuing basis is critical to establish gender based issues like vulnerability to disease, access to testing and health services, mobility, care and support. There is therefore a need to understand these differences and respond with public health interventions that

are specific to the situation of women, which includes access to services including testing, adherence to treatment, expenditure on treatment, differences in biological vulnerability, socio-cultural factors like education and access to information, mobility, and care & support services. Under the scheme the project will be supported for analyzing existing data, studies to cover the gap, vote to examine the current situation and changes over time on gender specific issues relating to women and health.

During XI plan period the activities are proposed to be supported within the allocated budget and it is proposed to upscale them during XII Plan. Further, in the new plan, it is proposed to focus on such areas and fund projects where synergy is expected to bring better results. It is of paramount importance, in this regard, to create synergy among various science agencies/ departments – those mainly involved in basic science and or innovation on one hand (*e.g.*, DST, DBT, CSIR/DSIR, DRDO *etc.*) to those with major application on epidemiology, public health (*e.g.*, ICMR).

Thus, the effort should be on i) establishing mechanisms to evaluate technologies for improving health care at individual & public health level; ii) fostering academia-industry link: creating processes and a Cell/Unit to link developers with industry for translation of leads into products/processes; and iii) establishment of a rapid clearing house mechanism for evaluation of health research technologies including the commercial applications. In addition agencies/ departments having with complementary activities with DHR such as, DIT, ICAR/ DARE, Social Justice, Environment and Forests, Women and Children; Water Resources; other user departments of MOH&FW *etc.* are proposed to be engaged in the process. It is also proposed to launch an Inter-departmental mission of biomedical and health research around medical / health priorities such as Tuberculosis, Viral infections with potential for outbreaks, zoonotic diseases, Maternal and Child Health including gender issues in health, Nutrition and Food safety, Diseases preventable through measures like vaccines, environmental interventions, public health education *etc.*, diabetes, cardiovascular, mental and chronic neurological disorders, Affordable health care technology (diagnostics, therapeutics, devices *etc.*), innovation in health care delivery, rural healthcare *etc.*

Programme for Translational Research

Translation of innovations/technologies for public health is the main function of DHR. The translational research activity of the ICMR has also gained momentum in recent past and during last two years, the Council has embarked upon a programme to translate several leads for development into products/processes.. There are other agencies which are also involved in creation and promotion of new technologies. Intersectoral co-ordination, where more than one department is involved in the said activity is therefore is the mandate of the DHR. It is planned to take these technologies to logical conclusions by proper validation and refinement. Efforts have also been initiated to identify leads from extramural programme so that the knowledge generated can be harvested for public good. In the down stream process, the DHR will synergize and coordinate its effort with other science agencies so that potentially useful leads obtained by support from those organizations can also be considered for further translation and implementation through joint projects. These activities will be further scaled up during the XII five year plan as given below:

- **To evaluate the health research undertaken by various scientific departments including ICMR.** A Unit will be established for evaluating and recommending

technologies for improving the health care. Critical funding will be provided in the identified areas for further development

- **To establish a mechanism for coordination between the academic and the industry** so that the leads could be translated into products and processes fast. Start up funds, when required, will also be provided for encouraging Public Private Partnership mode by focusing on proposals which have a promise of developing a product or process.
- **To support translational research programmes** under this component of the scheme and start up fund will be provided to various scientific departments, institutions, industry in either in isolation or academia, individuals including NRI, PIO, OCI, institutions *etc.* for development of leads, translation of leads/product development.
- **Institution of National awards:** In order to promote/encourage translational research National awards in various fields relating to translational research will be instituted.
- **Programme for funding joint projects:** To develop and fund Projects jointly developed in coordination with other Agencies like DST, DBT, DARE/ ICAR, DSIR/CSIR, Department of Space, Ministry of Environment & Forests, National Disaster Management Authority, DRDO, National Knowledge Network, Department of Information Technology, *etc.* in identified areas. For example, joint projects with DBT would be on diagnostics and vaccine development, development of guidelines for application of new generation technology *etc.*; with DARE/ ICAR on zoonosis, nutrition, food safety *etc.*; with Department of Space on technologies like use of GIS and remote sensing in relation to human health; with Department of Environment would be on climate change and health as well as impact of transgenic/ recombinant technology; with DSIR/CSIR on drug discovery and technology development; with DST be for developing basic technology/ knowledge in areas pertaining to basic biology, polymers, devices, bioinstrumentation and other life science related areas, nanotechnology *etc.* While the DHR will coordinate and fund the application component of the projects with special focus on human health, the other relevant components could be funded by these agencies.
- **Programme for comparative/ cost effectiveness analysis for public health choice and to develop and establish guidelines for prevention, diagnosis and treatment of diseases:** While the profile of disease burden in the country is changing over time, the treatment especially in the primary and secondary sectors has not kept pace. It has therefore become critical to study the existing practice and to evolve suitable protocols and systems in order to have more evidence based treatment and diagnosis which is practicable at different levels within the country. Financial support will be extended for undertaking such studies and for devising, diagnosis and treatment protocols. Various scientific professional associations/societies/bodies will also be involved.

During the Plan period, all the five programmes will be initiated. For the Programme for Research studies the critical areas specially focused on lead generation for new technology will be identified and support will be provided with well laid down outcome parameters. About 100 projects will be supported during the Plan period Specific support to Scientific/Professionals/Association/Bodies will be tailored to the policy needs and initiatives of the DHR. About 100 proposals will be supported during the Plan period. The support for participation in conferences abroad for non-ICMR researchers will be targeted to national/DHR needs. About 500 young and middle

level scientists will be provided support to participate in international meetings for both upscaling of knowledge and/or for knowledge sharing for mutual benefit and for potential collaborations. About 100 projects in the area of gender and health will be supported. The strategy and needs of the type of overseas medical & biomedical /researchers needed to be brought back to India will be identified through a broad consultation process and appropriate schemes will be started to develop sustainable programmes.

Budget: The projected outlay for the Scheme during XII plan is ₹ 2000 crore.

II - Establishment of Regulatory framework for research governance.

Programme for promotion and guidance on research governance issues, including mapping of health research institutes:

Research governance is one of the major tasks allocated to the Department. Working Group was informed that during the last two years, the Department has already developed a National Health Research Policy, Knowledge Management Policy and also prepared a draft Bill on Ethical Issues pertaining to Biomedical Research. Department is also perusing Assisted Reproductive Technology Bill as well as a Bill on Alternate System of Medicine. During the XII Five Year Plan, all these policies are to be implemented. Department proposes to establish an authority, systems and extracting evidence generation through model projects for improving the research governance in health in India. Further mechanisms are being built to create systems/administrative structures for recognition of health research institutions and for the identification and promotion of affordable technologies for improved diagnosis, treatment and prevention of various relevant diseases. Appropriate mechanisms will be put in place for carrying out the activities.

To summarize, DHR plans to improve governance by -

- a) Putting in place appropriate Guidelines, Acts, through appropriate regulatory authorities and structures to evaluate and recommend technologies, programmes, studies *etc.* for introduction into the public health system.
- b) Enactment of an Ethics Bill and the establishment of the National Bioethics Authority.
- c) Creation of National Health Research Forum for implementing National Health Research Policy.
- d) Establishment of mechanisms for mapping, accreditation of health research institutions.
- e) Research for establishment of mechanisms for Knowledge Management for better service, education and research.

Development of a robust ethical programme and its implementation was considered as a top priority by the Working Group. The Group also suggested that the existing loopholes emerging from the current experience should be plugged and used to develop regulatory framework.

Budget: ₹ 100.00 crores under the Head: Governance and Departmental Expenses.

NEW PROPOSALS

III. 1. Establishment of Specialized Research Units including laboratories

- a. Research Units/Specialized laboratories
- b. Centre for Clinical Research & Training on Ethics
- c. Centre for Research on Health Issues Related to Disaster Management
- d. Centre for Research on Vaccine preventable diseases
- e. Centres of Testing and Evaluation of Drugs and Devices
- f. Technology Assessment Board
- g. Technology Promotion Board
- h. Knowledge management and e-governance
- i. Forum for Intersectoral Coordination

III.2. Creation of a dedicated research cadre

1. Establishment of Specialized Research Units including laboratories

a. Research Units/specialized labs

Considering the importance and emergence of cutting edge science and technology like stem cells in treating diseases, it has become necessary to create infrastructure in medical colleges for pursuing research in this area. Similarly for harvesting the fruits of investment/advances in development in nanotechnology in medicine dedicated specialized centres need to be opened in medical and other life science institutions in which such applications in diagnostics and therapeutics are tested and identified for applications in clinical medicine. Research units/set ups as Nano Medicine, Clinical Research & Training on Ethics, Centre for Research on Health issues related to disaster management, Centre for Research on Vaccine preventable diseases, Centres for testing and evaluation of Drugs and Devices, Technology Assessment Board, Technology Promotion Board, Forum for Intersectoral Coordination *etc.* would be established either in identified institutions or independently.

Various government science departments have been investing in the development of new health products through tools as nanotechnology for various applications. The conversions of such leads into products and processes is sub-optimal. For this purpose, dedicated specialized centres need to be set up in medical and other life science institutions in which such applications in diagnostics and therapeutics are tested for applications in clinical medicine. The DHR plans to establish a sound coordination mechanism with other science agencies to stimulate the growth and open such centres for providing required infrastructure as well as human research base for achieving these targets.

b) Clinical Research & Training on Ethics: During XI Plan, there have been good emphasis on clinical research using the desired ethical standards. However, it is often felt that the need, opportunities are not being addressed adequately due to lack of knowledge, proper training infrastructure and fine tuning of ethical procedures. The Department of Health Research will be shortly introducing a legislation on this aspect. The DHR/ICMR will continue to play the active role of providing training and carrying out research to review these procedures in an operational research mode. A dedicated Centre on this aspect will serve as a national focal

point of this programme. The objectives and activities of this Centre will be done in close consultation and coordination with the Medical Council of India and other stakeholders.

c) Centre for Research on Health Issues Related to Disaster Management : The Department of Health Research has established a coordination mechanism with the NDMA and Deptt. of Health & Family Welfare for the management of biological disasters. While the preparation of the guidelines, their implementation remain the main objectives of the DHR, the ICMR through its project support system will focus on knowledge generation about such pathogens, their detection and scientific methods for their containment. The DHR also plans to establish a National Centre as well as Advanced Centres to accelerate research efforts on various aspects of the management of disasters (natural disasters such as epidemics, pandemics or man-made such as bioterrorism *etc.*). Coordination mechanisms with other science agencies like the DRDO engaged in similar mandate will be strengthened through this Centre.

d) Centre for Research on Vaccine Preventable Diseases : Current immunization programme of the country is based on mass immunization using only half a dozen vaccines. On the other hand, many new vaccines are available and/or being developed for several infections such as rotavirus diarrhoea, pneumococcus, gram negative and many other infections as also polyvalent vaccines. In the absence of credible data, about the disease burden and disease dynamics, it becomes very difficult for the Health Ministry agencies such as NTAGI to take informed decisions on the introduction of new vaccines. The ICMR has already initiated action to establish a special Expert Group to debate the vaccine preventable diseases, available vaccines, need to develop new, affordable and effective vaccines and issues relating to their introduction. The DHR plans to strengthen this effort by creating a national Centre to understand and debate these issues with all stakeholders to suggest appropriate research and development of new vaccines and formulate balanced, pro-public vaccine policies that are driven by public health needs and not by commercial and other extraneous interests.

e) Centres for Testing and Evaluation of Drugs and Devices : Different science agencies and the industry in India are engaged in the development of new drugs and medical devices. So far the efforts are scattered, not properly focused as the needs are not clearly identified and the industry finds it difficult to introduce medical devices in the absence of clear regulatory policies. The DHR/ICMR plan to partner with other S&T agencies and with the industry (preferably public sector) for the development and field testing of such drugs and devices which are current and future needs of the public health system. Thus, a public health-centred approach would be the focal point of action of ICMR/DHR. For this purpose, DHR will establish a coordination mechanism with other science agencies and through the establishment of this dedicated Centre will encourage the development of pathways for testing and evaluation, set up robust regulatory structure of global standard (GMP, GCP) for drugs and devices. Such efforts would ensure both the development and introduction of affordable and safe drugs, devices and other health products to the Indian people.

f) Medical Technology Assessment Board: Currently in our country, the introduction of different technologies including instrumentation is not based on sound analysis by independent and neutral experts. It is often based on recommendations/suggestions of end users who may not be well versed on the comparative usefulness of different technologies/equipments. This results in incurring unjustified expenditure without adequate proof of advancement and is also harmful to the growth of industry aimed at production of affordable tools. As per the recommendations of the Task Force, it is proposed to establish a Medical Technology Assessment Board in the DHR which will carry out the review of such technologies on a continued basis. Recommendations

would be available to the end users in a transparent manner and will be of immense help to the government system.

g) Medical Technology Promotion Board: Different govt agencies have been making efforts to promote the development of new diagnostics, therapeutics including drugs, medical devices and other health products as vaccines. The Deptt. of Health Research plans to focus on those technologies which have wide public health application. The efforts will be coordinated with the other science departments as well as the three Departments of the Ministry of Health & Family Welfare to enable identification of promising leads/technologies that could be translated into products for their further development and mass application. For this purpose, establishment of the Medical Technology Promotion Board is envisaged.

h) Knowledge management and e-governance: The Department would set up a strong Information Technology-based, user-friendly electronic project management system for the entire process of seeking, evaluating and processing grant applications from investigators both from within and outside the ICMR system. Also, a strong and vibrant and user-friendly e-governance system would be put in place for public dealing. A repository storing the entire data generated through the DHR support will be set up with appropriate retrieval systems to facilitate use of the data and other information generated by scientists and other users. Further model projects to demonstrate the impact of knowledge management through NKN will be also be a special priority. These initiatives have been endorsed by the Working Group.

i) Forum for Intersectoral Coordination: The DHR has established co-ordination mechanisms with the Department of Agricultural Research and Education (DARE) through the development of the ICMR-ICAR Joint Panel on Zoonoses wherein joint evaluation of projects submitted by scientists from both medical and veterinary institutions is carried out on programmes of national importance that concern both the Departments. There is also a vibrant ICMR-ICAR Program on Nutrition co-chaired by the Secretaries of DHR and DARE. Also, a meeting of the Secretaries/representatives of nine departments of the government *viz.*, DBT, DST, DSIR, *etc.* engaged in areas related to health was held on 11th February 2011 wherein it was decided that joint committees may be formed among the Departments to work on important emerging issues in the health sector. Similarly, a meeting was recently held on 23rd August 2011 in which the main thrust of the invited Departments (a subset of the earlier group) was to work towards the development of technologies with potential application in public health. As recommended by the Working Group, the DHR proposes to set up all the above Research Units/specialized labs to address specific concerns on policy formulation as also take up specific niche areas of health research that need special focus and attention of the Department. Units with focus on implementation research will be given special attention.

- The budget for this initiative will be met from the 'Infrastructure development' Head.

2. Creation of a dedicated Research Cadre:

The DHR, which is created to provide impetus to health research in the country, is initiating number of activities to promote health research in the country like creating infrastructure in medical colleges across the country like establishing Model Rural Health Research Units for promoting health research, establishment of Net work of Laboratories for Managing Epidemics, establishment of other specialized labs/set-ups to work on stem cells, molecular medicine, nano medicine, mental health, molecular & transplant immunology, drug testing laboratories *etc.* The DHR also proposes to provide short/long term Fellowships/training/mid career training to medical college faculty to promote health research. For the purpose of mentoring, monitoring

and evaluating various research activities, providing leadership to the research activities to be initiated in various medical colleges, institutions, initiating in institutions having adequate infrastructure and manpower important health research studies pertaining to epidemiology, epidemics, outbreaks, any new emerging/reemerging diseases, research in frontline/ cutting edge areas it is extremely important and necessary to create a dedicated research cadre in the DHR consisting of 210 scientists of levels from Scientist C and above and 400 technical staff. These technical staff of appropriate level will be trained to deal with the instrumentation, infectious pathogen, handle new generation technology for various communicable/non-communicable diseases and will work in close coordination with other scientist within and outside the ICMR structure. This Research Cadre will also provide basic support to the the DHR & other Departments of the Ministry of Health & Family Welfare.

The Working Group has emphasized the need for the creation of a strong dedicated scientific and other staff for the proposed activities of the DHR and strongly recommended the creation of a dedicated Research Cadre. This will be implemented in XII Plan.

HUMAN RESOURCES REQUIREMENT FOR THE XII PLAN

1. In order to provide for smooth functioning of Department of Health Research to fulfill its mandate already, the proposal was made for 77 regular posts in different categories. Apart from this, 24 Peons and 11 Data Entry Operators will be required which will be outsourced. Recently, Ministry of Finance out of the 77 posts has already approved 16 posts. The balance 61 posts are required to be sanctioned in the first year of XII Plan so that work can pick up and schemes be got approved and implemented as planned.

2. **Manpower Requirement for the Net work of Virology Laboratories**

A total of 234 virology laboratories will be established under DHR that will include 6 regional labs, 28 State level labs and 200 district level labs in different parts of the country. To run these 234 laboratories 120 regular and 1196 project posts in different categories are required as given in the Plan. Project posts will end with five year of Scheme after which it will be the responsibility of states/ institutions to run these state/district level labs.

These 120 regular posts will be used deployed at six regional laboratories of DHR attached to ICMR structure and will be used both by DHR as well as ICMR.

3. **Manpower Requirement for Multidisciplinary Laboratories and MRHRUs**

As a part of major initiative to build and strengthen research infrastructure in medical colleges, a total of 250 multi-disciplinary labs are to be established in different medical colleges. Further 50 Model Rural Health Research units (MRHRUs) are to be established in the XII Plan for transfer of technology to end users and empower states to increase their capability to conduct research on epidemiology and operational aspects. It is proposed to run these MRHRUs as permanent outreach units of DHR and as such regular positions will be required for the same.

A total of 250 regular and 1000 project posts in different categories would be required for establishing Model Rural Health Research Units as shown in the Plan

4. **Creation of dedicated Research cadre:**

The DHR, has been created to provide impetus to health research in the country, is initiating number of activities to promote health research in the country like creating infrastructure in medical colleges across the country, establishing Model Rural Health Research Units for promoting health research, establishment of Net work of Laboratories for Managing Epidemics, establishment of other specialized labs/set-ups to work on stem cells, molecular medicine, Nano medicine, drug testing and evaluation laboratories *etc.* It is also to provide long term/ short term Fellowship/ training / mid career training to medical college faculty to promote health research. For this purpose of mentoring, monitoring & evaluating various research activities, providing leadership to the research activities to be initiated in various medical colleges, institutions, initiating in institutions having adequate infrastructure and manpower important health research studies pertaining to epidemiology, epidemics, outbreaks, any new emerging/reemerging diseases, research in frontline/ cutting edge areas it has become necessary to create a dedicated research cadre in DHR consisting of 210 scientist of levels from Scientist C with GP from ₹ 6600 and above & 400 technical officer with GP ₹ 4600 and ₹ 5400. These Scientific and technical staff of appropriate level will be trained to deal with the instrumentation, infectious pathogens, and new generation technology for various

communicable/non communicable diseases and will work in close coordination with the Scientist. The Research Cadre will also provide basic support to the DHR & other Departments of the Ministry of Health & family Welfare. The Expert Committee has emphasized on the need for a strong Career development & strongly recommended for creation of a dedicated Research Cadre. The 48th Standing Committee of Rajya Sabha has recommended creation of 210 scientist posts and 400 technical posts urgently so that DHR starts functioning as per the mandate.

5. Manpower for Medical Technology Development Board, Technology Assessment Board, Bioethics and Knowledge Management Authority

It is proposed to establish Medical Technology Development Board, Medical Technology Assessment Board, Bioethics Authority and Knowledge Management Authority to improve the research governance as well as transfer of technology. For smooth functioning of these Boards and Authorities there would be requirement of following staff:- Chairperson, PS, relevant Administrative Staff *etc.* In addition, 4 Peons and 4 Data Entry Operator posts would be required which will be outsourced.

Financial implications for the above posts would be about ₹ 150 crores for 5 years.

INDIAN COUNCIL OF MEDICAL RESEARCH

XI PLAN ACHIEVEMENTS INSTITUTE-WISE

Intramural research efforts of the Council are carried out currently through 32 disease / discipline specific research institutes/centres/units. These include: 26 mission-oriented national institutes located in different parts of the country addressing to research on specific areas such as tuberculosis, leprosy, cholera and diarrhoeal diseases, viral diseases including AIDS, malaria, kala-azar, vector control, nutrition, reproduction, immunohaematology, oncology, medical statistics, *etc.* Six Regional Medical Research Centres that address regional health problems, and also aim to strengthen or generate research capabilities in different geographic areas of the country. Field Units Centres dealing with food and drug toxicology, viral diseases, vector borne diseases, handling microorganisms of highly infectious nature, prenatal diagnosis for neonatal retardation *etc* and supply of various animal models and feeds for research purposes. The achievements in the XI plan and the proposed activities are follows:

Centre for Research in Medical Entomology (CRME), Madurai

Basic Research

- Detection of JE virus antigen in desiccated vector mosquitoes.
- The isolates of JE virus from mosquito larva and humans using *Toxorhynchites splendens* mosquito immuno-fluorescence assay (Toxo-IFA system) in place of the use of suckling mice, developed.
- Dengue virus antigen detected in desiccated specimens of *Aedes aegypti*.
- Detection, isolation and serotyping of dengue virus from Aedes vectors by using Toxo-IFA system in various States of the country.
- *Aedes albopictus* was identified as the only vector of dengue in Kerala, and DEN-2 isolated for the first time in this State.
- Confirmed the Prevalence of chikungunya virus affecting humans in Lakshadweep islands which belonged to Central/East African origin.
- Lesser known vector species as well as their aquatic stages of development like *Heizmannia (Heizmannia) chandi* Edwards (Diptera: Culicidae) was described.
- Detected JE virus infection in *Culex tritaeniorhynchus*, along with *Cx. epidesmus* and *Cx. infula* from eastern Uttar Pradesh.

Clinical Research

- Validated that annual single dose mass drug administration (MDA) of diethylcarbamazine (DEC) and albendazole combination therapy has an edge over DEC alone in the lymphatic filariasis (LF) elimination.

- Established that the combination therapy of DEC and albendazole for filariasis resulted in enhanced efficacy against other geohelminths as well.
- Detected dual and multiple viral infections (dengue and chikungunya as well as chikungunya and JE viruses) from various parts of the country.
- Dual infection of malaria parasite (*P. vivax*) and Dengue detected.

Operational Research

- Community based control of dengue carried out by exercising the principle of eco-bio-social components of human ecosystem in Chennai City.
- Evaluated JE vaccination programme of Tamil Nadu.
- Evaluated Dengue, JE control programmes of National Vector Borne Disease Control Programme in the country.
- Established JE surveillance network to monitor JE virus activity in Tamil Nadu.

Translational Research

- Developed some new products/processes and/or mechanisms like the *Cymbopogon sp.* related mosquito repellent, multi-angular viewer for mosquito taxonomic studies, and ELISA based antigen detection system for both the JE and Dengue mosquitoes.
- Developed an *Aedes albopictus* breeding preventer for latex-collecting cups.

Human Resource Development

- Identified as one of the three TDR/WHO training centres across the world for genetically modified vector (GMV) : control of dengue and malaria vectors, imparting bio-safety/bio-security related training to scientists from Asian countries.
- Guided PhD registrants for their dissertation research.
- Facilitated MSc students for their dissertation work.
- Participating in teaching programmes for the ICMR Schools of Public Health.

Miscellaneous

- Centre identified by the Tamil Nadu Government to evaluate their JE Vaccination programme.
- Centre identified by NVBDCP, Delhi to evaluate Dengue and JE control programmes in the country.

Desert Medicine Research Centre (DMRC), Jodhpur

Basic Research

- Showed that blood agar slants may be good substitutes of LJ medium for rapid detection of *Mycobacterium tuberculosis* from sputum which reduces the period of culture by 7 days.

- Showed presence of transovarially transmitted virus as possible maintenance mechanism of dengue virus in nature and that 200 kDa protein in mosquito ovaries could block occurrence of transovarial transmission to prevent dengue.

Epidemiological/Operational Research

- Control of transmission of dengue could be achieved with elimination of micro foci of infected mosquitoes.
- A study of association between socio-economic factors and transmission of Malaria in desert indicated statistically Significant effect of malaria on low socio-economic group (LSEG) of the community as compared to HSEG. LSEG used fewer preventive measures.
- A software with special reference to malaria was developed and implemented in 8 CHCs/ PHCs in Jaisalmer district to collect real-time malaria data using existing infrastructure and through health workers at DMRC, Jodhpur.
- A suitable intervention study was implemented to minimize the period of delay in diagnosis and treatment under the DOTS programme and observed 7-35% reduction in delay for the diagnosis and treatment.
- The prevalence of musculoskeletal disorders reported as 9.5% in population 18 years above. The prevalence was higher in rural than in urban areas.
- The prevalence of Rheumatic Fever and Rheumatic Heart Diseases in school children of 5-14 years age of Jodhpur district was 0.9/1000 children.
- A study showed that prevalence of diabetes in the Raika community of Rajasthan is very low.
- The supplementation of electrolyte products (tender coconut water and Ashgourd juice along with mineral water) had positive effect on mineral profile *i.e.* serum K and serum Na in rural adults residing in desert areas of Rajasthan.
- A study to assess the nutritional status of women in Rajasthan revealed the prevalence of anaemia to be 88.2% and 83.2% in pregnant and lactating women respectively. Overall 80.0% of women were found to consume salt having inadequate iodine content *i.e.* less than 15 ppm.
- The effect of supplementation on micronutrient deficiency disorders were studied in school age children of Jodhpur district. The study revealed that the supplementation of pearl millet products reduced anaemia from 79.4% to 61.8%.
- Survey under National Nutrition Monitoring Bureau Survey in Rajasthan revealed that 49.8% and 59.5% of pre-schoolers were underweight and stunted respectively. Around 33% of the adults had chronic energy deficiency.
- Evaluated immunization coverage of vaccine preventable diseases in 12-23 months old children in rural and urban areas of Jodhpur and Barmer districts showed lower coverage in urban than rural areas. The major reason of non-immunization was lack of knowledge about vaccine preventable diseases among parents.

- The source of outbreak of typhoid fever in a remote village of desert district Pali in Rajasthan was found to be contaminated drinking water from the overhead tanks.
- Meta Analysis of Micronutrient Deficiency Disorders and their mapping in western Rajasthan showed that interventions improved the heterogeneity among the studies and gave valid conclusions.
- A statistical study of behaviour of Mantel-Haenszel estimator under different sampling schemes to sample the controls in case-control study showed that systematic sampling is better than cluster sampling.

Translational Research

- A software predictive of desert malaria epidemic in desert has been developed and submitted to the programme for possible public health use.
- The locally wild grown shrub, *Calotropis procera* has been shown to have anti larval use against dengue vectors. The product has been submitted for Indian Patent.

Infrastructure & Human Resource Development

- A virological laboratory for the molecular diagnosis of H1N1 viruses has been established. The laboratory has tested about 2000 swab samples. Research on the genomic epidemiology of H1N1 viruses has also been started.
- DMRC has been recognized by the Jai Narayan Vyas University, Jodhpur for guiding the studies supplicating to the award of Ph. D. degree from department of Zoology of this University. Some scientists have been recognized as the Ph. D. supervisor and Co-supervisor from JNV University, Jodhpur and Maharaja Ganga Singh University, Bikaner.
- Out of 12 students registered for Ph. D., 4 students have been awarded Ph. D.
- Imparted post graduate training to more than 50 students of M. Sc.

Enterovirus Research Centre (ERC), Mumbai

Basic Research

- Wild poliovirus type 1 and type 3 transmission pathways were explained by phylogenetic analysis of genomic sequences.
- Complete genome sequences of wild type 3 polio viruses generated and used for molecular epidemiology for enterovirus developed.
- Characterized polioviruses of Sabin OPV origin isolated from acute flaccid paralysis cases to understand reversion of attenuation sites and recombination with other enteroviruses.
- Genomic characterization of type 2 polioviruses of Sabin OPV origin led to a change in the definition of type 2 VDPV.
- A multiplexed SNP detection assay was developed to detect mutations at attenuation sites in the Sabin OPV viruses at AFP cases. The assay has been validated by genomic sequencing.

- A SNP assay has been developed for detection of polymorphism in the human poliovirus receptor (CD155).
- Studies showed differential innate immune response of human neuronal cells to wild and Sabin attenuated vaccine polioviruses.

Epidemiological/ Operational Research

- Acute flaccid paralysis cases (~20000) reported in Maharashtra, Madhya Pradesh, Chhattisgarh and Goa were investigated for presence of wild and vaccine polioviruses and Enteroviruses.
- All polioviruses, isolated in India and Bangladesh were characterized to report wild poliovirus detection. Molecular epidemiological studies provided evidence of wild poliovirus importation and consequent outbreak of polio due to WPV3 in Bihar in 2007 and WPV1 in western UP in 2008 from Bihar.
- Immunization strategies for migrant, transit and underserved populations based on the detection of wild virus importation in several States in India were developed by the polio programme to reduce risk.
- Confirmation of WPV importations from India into Nepal resulted in cross-border immunization campaigns to stop transmission of WPV across the two countries.
- Type 2 vaccine derived polioviruses (VDPV) outbreaks detected for the first time in India. A small number of VDPV were also isolated in paralytic cases and immunodeficient children.
- Outbreaks of Hand foot and mouth disease in children were virologically investigated for the first time. Coxsackie virus A6 (in Thane, Maharashtra; and Tripura) and A16 (in Tamil Nadu) were isolated in separate outbreaks.
- Epidemiological investigation and molecular characterization of virus isolates from outbreaks of acute hemorrhagic conjunctivitis showed evidence of Coxsackie virus A24v genetically similar to those isolated in China and Taiwan in previous years indicating importation.
- Evaluation of population immunity to polioviruses in 25 districts of western Uttar Pradesh revealed immunity gaps for type 2 and type 3 poliovirus in infants.
- Wild type 3 and type 2 VDPV outbreaks reported from western UP.
- Environmental surveillance for wild poliovirus detection, by collection and testing of sewage samples in Mumbai provided evidence of circulation of wild poliovirus in the absence of paralytic polio cases or before their occurrence. Molecular characterization of the isolates revealed importation from high risk endemic areas in Bihar and UP.
- Hospital based surveillance of rotavirus disease and strains in Mumbai documented the dynamics of rotavirus genotypes over a 4 year period. Increasing incidence of rotavirus genotype G12 indicated it as an emergent strain of rota virus in the country.
- Detection of wild poliovirus transmission by testing sewage samples from high risks areas in Mumbai provided guidance for conducting supplementary immunization activities.

- Environmental surveillance system for wild and vaccine derived poliovirus detection is being replicated in high risk areas in Delhi and in Bihar.

Translational Research

- Developed and evaluated an algorithm for testing of clinical samples for rapid detection of poliovirus infection and assisted WHO in implementing the new algorithm in the global polio laboratory network. This improved wild poliovirus reporting from previously 42 days to 21 days.
- Assisted WHO in testing and validation of PCR and real time PCR assays for poliovirus intratypic differentiation and incorporation of these assays in global polio laboratory network through training program.
- Evaluation of immunogenicity of newer formulations of OPV (mOPV1, 2 and 3 and, bivalent 1 and 3) in collaboration with WHO led to licensing of the vaccines in India.
- Evidence base to show that type 2 VDPV transmissions can be stopped quickly by mass immunization using trivalent OPV.

Food and Drug Toxicology Research Centre (FDTRC), Hyderabad

Basic Research

- A microbiological risk assessment of street foods revealed that the *Staphylococcus aureus*, *Bacillus cerues* and *Salmonella* were the major pathogens detected, especially in poultry products.
- Commonly consumed foods in Andhra Pradesh were analysed for presence of pesticides residues, heavy metals, fluoride and mycotoxins. Risk assessment considering the average food intakes revealed that except cadmium, the estimated intakes of contaminants through food was lower than Acceptable Daily Intake (ADI) or Provisional Tolerable Weekly Intake (PTWI).
- Pathogens from paediatric diarrhoeal infections isolated, identified and characterized to enhance understanding the emergence of drug resistant and newer strains of bacteria like *E.coli* 0517: H7
- Primers to various microbes like *E. coli*, *V. cholerae*, *V. parahaemolyticus*, etc used and PCR based uniplex detection method developed.
- Exposure to lead in iron deficiency suppressed the immune system and had adverse effect on intestinal pro-biotic organisms in rats. The effects could be mitigated by providing thiamine.
- Anti Human Papilloma Vaccine, Genoep I (for use as anticancer agent against prostate cancer) VNJN-21, a synthetic peptide for treatment against AIDS have been tested.
- Development of PCR and RT-PCR based diagnostic kits for detection and identification of food and water borne pathogens.

Epidemiological/ Operational Research

- A study conducted in *Uchapally* Village of Nellore district, Andhra Pradesh indicated high levels of fluoride, silica and strontium in drinking water.

- For the 'Sevottam' scheme of the GOI, risk assessment of Transfat, Melamine, Caffeine was done as also scientific validation of health claims (e.g. Amaze-brain food).

Translational Research

- The first database of the country on knowledge, attitude, behaviour and practices with reference to food safety and quality of drugs was created. Based on the findings of the report, intervention measures adopted by GOI.
- Studies carried out to aid in the release of a rice variety PAU 201 developed by PAU, Punjab that was held up in rice mills due to non-acceptance by FCI for commercial release. These studies showed that black spot on the variety is not due to fungus and linked to toxins.

Genetic Research Centre (GRC), Mumbai

Basic Research

- Identified cryptic chromosomal translocation in couples with bad obstetric history, validated expression of FMRP in lymphocytes as a screening test for Fragile X syndrome.
- Development and validation of ELISA for HbA2 for novel screening method for beta thalassemia carriers.
- Ascertained chromosome 22q11.2 micro deletion in cases of non-syndromic congenital heart disease.
- Identified genes responsible for sex development in patients with disorder of sex development. Sex determining genes SRY, DHH, SF1, DAX1, WNT4, CYP19, CYP17, AR analysed for presence of mutation in patients with disorder of sex development.
- Initiated genetic testing using techniques like karyotyping, fluorescence *in situ* hybridization (FISH), telomere FISH, multicolour FISH, sperm FISH, DNA sequencing for common genetic disorders.
- FISH technique found to be more sensitive than classic cytogenetics for confirmation of various other microdeletion syndromes, recurrent first trimester abortions and idiopathic mental retardation.
- Developed a rapid simple and inexpensive test using validity of expression of FMRP in lymphocytes as a screening test for Fragile X syndrome (common cause of mental retardation in males) with sensitivity of 100 % and specificity of 97.5 %.
- Derived test for IVF Programmes after aneuploidies detected in sperm FISH test.

Clinical Research

- Found various types of cryptic chromosomal rearrangement in couples with 3 or more recurrent abortions: Five hundred couples with 3 or more recurrent abortions were karyotyped after ruling out all other causes of abortions.

Epidemiological/Operational Research

- Identified common genetic disorders prevalent in our country and strengthened the facilities for its prevention.

Human Resource Development

- Trained students in Biotechnology (M.Tech) in methods of genetic testing.
- Trained students of Nursing (B.Sc) in genetic counselling techniques.
- Organized seminars in Medical Genetics as a part of Continued Medical Education (CME) activity for practicing physicians, medical residents and research students.

Institute of Cytology and Preventive Oncology (ICPO), Noida**Basic Research**

- Developed a HPV detection kit for the field testing.

Clinical Research

- Participated in phase-I clinical trial of polyherbal Neem cream and tablet-Praneem in women with HPV infection, results awaited.
- Participated in a multi-centric trials for studying the anti HPV properties of Curcumin, results awaited.
- Evaluated test characteristics of screening modalities for cervical cancer.
- Molecular screening for cervical cancer: developed multiplex PCR to detect various HPV types in one PCR reaction.

Epidemiological/Operational Research

- Two community based projects for cervical cancer detection initiated at Dadri (UP).
- Development of first ever Cervical Cancer Gene Database.

Translational Research

- Developed clinical base and colposcopic networking for screening of cervical and oral cancer.
- Developed visual aided tests for cancer screening.
- Developed a magnifying device (Magnivisualizer) with an inbuilt source of light for use in the field conditions for detecting HPV.
- A battery of cellular and molecular tests developed for diagnosis of different types of cancers.

Infrastructure and Human Resource Development

- WHO's Regional HPV Reference Laboratory (HPV LABNET Programme in South East Asian region) was established.

- In-service training, summer training, PhDs, and MD/MS/DM/DNB programmes.
- Development of Cellular & Molecular Diagnostic Laboratory at ICPO, Noida.

Microbial Containment Complex (MCC), Pune

Basic Research

- Generated data about the sequence of various viruses.
- Phylogenetic studies of dengue viruses.
- Molecular characterization of Bunya virus isolated from India.
- Molecular markers for insecticide resistance and vectorial capacity in mosquitoes.
- Establishment of diagnostic capabilities for Buffalo Pox viruses, Hanta virus, Nipah virus, Crimean Congo haemorrhagic fever, Ebola and Marburg viruses.
- Full genome analysis of KFD and related viruses.

Epidemiology

- Investigations of SARS, H5N1 in birds and animals, Nipah virus in West Bengal, Crimean Congo Haemorrhagic Fever in Gujarat.
- Survey of highly pathogenic zoonotic pathogens from Bats and domestic animals.
- Major support provided in important national emergency situations for handling/analyzing the samples obtained during epidemics of high risk group of viruses.

Translational Research

- Development of ELISA and PCR diagnostics and transfer to Karnataka state for identification of KFD viruses.

Human Resource Development

- Teaching and training for biosafety within National and also for countries in SEAR region.

Infrastructure

- Establishing BSL-4 laboratory for handling high-risk group of viruses with better biosafety and biosecurity for providing diagnosis for all known and unknown highly infectious emerging viruses at Microbial Containment complex, Pune.

National AIDS Research Institute (NARI), Pune

Basic Research

- Established reference ranges of CD4 T-lymphocyte counts for adult Indian population.
- Development and cryopreservation of EBV transformed B cell line and generation of DNA bank has been completed for Long Term Non-Progressors (LTNPs).

- Found majority of the HIV strains circulating in India belong to subtype C. A very small proportion of recombinant viruses (B/C and A/C) also detected indicating need for continued surveillance.
- Explored the role of gag and vpu on HIV-1 envelope assembly in T cells and macrophages; Role of host factors such as DDX3X on viral RNA transport by different pathways in HIV-1 nuclear export and replication; receptor biology and tropism of HIV-1 envelope of India clade C in different disease stages.
- Characterized biological properties in T cells and monocyte-derived macrophages, cellular tropism of Indian HIV-1 Clade C viruses and construction of genetically engineered chimeric HIV-1 envelope protein modulating virus neutralization.
- Studies to understand the role of Natural killer cells and dendritic cells in different stages of disease progression in HIV infection.
- Platform for *in vitro* anti-HIV screening developed and used for screening anti-HIV activity of new synthetic molecules, herbal products and preparations from alternative system of medicine.
- Full length sequencing of more than 75 viruses from different HIV disease stages and transmitted viruses isolated from year 1998 to 2011 done.

Clinical/ Epidemiological/ Socio-Behavioural Research

- Two Integrated Behavioral and Biological Assessment (IBBA) surveys conducted in 29 districts in six high prevalence states.
- Completed HIV vaccine Phase I clinical trial to test the safety and immunogenicity of prime and boost regimen using DNA vaccine from priming and MVA vaccine for boost.
- The human clinical trial was complemented with Multi-centre socio behavioral and qualitative studies, conducted for vaccine trial participation and male circumcision.
- Two vaccine concepts based on a multi-epitope vaccine and a DNA vaccine based on Indian subtype C viruses tested in mice.
- Cohorts of HIV infected persons who have controlled their HIV infection successfully for long time 'Long Term Non Progressors' (LTNP) and persons recently infected with HIV 'Recent Converters' established for conducting studies on HIV immunopathology.
- First institute in India to initiate non-pharmaceutical driven Phase III/ IV ARV drug trials for prevention and treatment of HIV.
- Studies to optimize the diagnosis and management of tuberculosis in HIV infected subjects carried out and efforts to determine the optimum time to initiate ART and the best ART regimen to be used in HIV-TB patients is on-going.
- Undertook other clinical studies on HIV and co-infections including HPV, low cost screening modalities for cervical cancer diagnosis, H1N1, PCP (*P. jirovecchi*) etc.
- Initiated studies to evaluate the neurocognitive impairments in PLHIVs.
- Anxiety and depression among Voluntary Counselling and Testing (VCT) attendees reported for the first time in India.

Translational Research

- Contributed to NACO Programme by establishing CD4 External Quality Assurance Schemes (EQAS) as an Apex Laboratory, Act as a secretarist of Consortium National Reference Laboratories for Quality testing (NRLonQ). Regional Institute (RI) for western part of India for HIV Sentinel Surveillance programme.
- HSS implementation manuals and training modules developed by NARI were adapted nationally.
- Helped the NACO Programme in capacity building at national level.
- Successfully engaged community in research through Community Advisory Board and NGO partnership.
- Developed evaluation tool for ART counsellor training.
- Feasibility of matching two different databases to look at the association between HIV and Cancers at population level done.
- National virtual repository created for researchers willing to share their reagents or viruses with other researchers. The repository can be accessed at and is in public domain. in India. (www.hiv-vkrc.org)
- NARI has largest collection of Indian HIV strains and has generated national resources for HIV research that is providing base for molecular studies of HIV and HIV strains.
- Adolescent Reproductive and Sexual Health module developed for implementation.
- 'Mental Health Needs Scale' of the mental health needs of the People living with HIV/AIDS (PLHAs) developed and is already being used by National AIDS Control Organization.

Infrastructure & Human Resource Development

- Accredited for CD4 count estimation and serological assays by National Accreditation Board of Laboratories (NABL).
- A facility to conduct studies in vaginal microbicides and female condom has been established.
- As a recognized WHO collaborating centre for HIVDR, testing sustains NACO/ WHO initiated threshold and monitoring Surveillance for HIV-1 Drug Resistance in different regions of India.
- 'Evidence for Action', an international Research Consortium to maximize benefits and equity of HIV treatment and care systems has extended collaboration to NARI to initiate and conduct research to understand and influence the delivery, access and utilization of HIV and related services in India.
- Ph.D degrees in Health Sciences, Microbiology, Biotechnology, Epidemiology, Anthropology and Medicine.
- Regular training programmes for clinicians, counsellors, microbiologists, laboratory technicians that are engaged in National AIDS Control Programme.

- Participated in Training M.Sc. Virology students from NIV and M.Ph. students from NIE.

National Centre for Disease Informatics and Research (NCDIR), Bangalore

- As a part of programme of earlier National Cancer Registry Programme, made several contributions.

Epidemiological/ Operational Research

- Identification of geographic areas for site specific research on cancer.
- Identification of variation in sites of tobacco related cancers vis-à-vis geographic areas.
- Provided Patterns of Cancer Patient Care and Survival through Cancer Registries - National Cancer Registry Programme (NCRP).
- Strengthened network of 27 population based, 9 hospital based cancer registries and 17 centres collaborating in the study on Patterns of Care and Survival Studies.
- Opened the entire North Eastern states for cancer registration and research and laid a foundation for studies in molecular epidemiology.
- Identified deficiencies in cancer patient care in the Indian setting in terms of standardised recording of clinical information, compliance to treatment and follow-up *etc* for framework towards clinical evaluation and multi-centre trials.

Translational Research

- NCDIR developed a national electronic data-base on diabetes, CVD and stroke for aetiological, epidemiological and clinical research in these areas.
- Development of Software Applications Programmes for systematically providing actual incidence (not estimates) as per international standards.
- Published cancer atlas that helped mapping patterns of cancer.

National Centre for Laboratory Animal Sciences (NCLAS), Hyderabad

Clinical Research

- Studied obese mutant rats models for identification of the gene responsible for obesity.
- Long term exercise in WNIN obese rats showed that the exercise improved glucose tolerance and reduced insulin resistance, body weight, LBM, total body sodium, plasma triglyceride level and water.
- Studies on Central regulatory mechanism underlying obesity showed low expression neuropeptide like Agouti related protein (AGRP) and CART (Cocaine and amphetamine regulation transcript) in the parent compared to obese mutants with no change for POMC (Pro-opiomelanocortin) in the hypothalamus.

- Estimation of body composition of rodents using TOBEC and DEXA vis-a-vis chemical analysis showed that for hamsters and guinea pigs, DEXA is the only reliable non-invasive method for carcass analysis.

National Institute of Cholera and Enteric Diseases (NICED), Kolkata

Basic Research

- Developed immunochromatographic dipstick kit for the rapid diagnosis of cholera with sensitivity and specificity of 92% and 73% respectively.
- Showed the involvement of intact actin cytoskeleton was responsible for the translocation of PKC- α from cytosol to membrane in the mechanism of action of *Escherichia coli* heat stable enterotoxin (STa).
- Showed that the mature *Vibrio hemolysin* oligomer (65 kDa), a pore-forming toxin, is a molecule with C7 symmetry and has ring-like, arm-like and bowl-like structures with a central channel.
- A three dimensional structure of the membrane-inserted form of the VCC oligomer by cryo-electron microscopy modelled.
- Demonstrated the conversion of viable but non-cultivable (VBNC) to the cultivable state of vibrios by co-culture of the pathogen with eukaryotic cells.
- Established that other El Tor variant strains evolved through stepwise events of acquisition and deletion of genes by the then existing prototype El Tor strains.
- Identified a novel 59 kDa serine protease from a hapA deleted *V. cholerae* strain, a novel reactogenic factor.
- While the oligomer form of the pore forming toxin of *V. cholerae* hemolysin (HlyA) was found to up regulate TLR2 involving signaling molecules MyD88, TRAF6 and NF- κ B, the monomer form failed to do so rather it led to apoptosis of cells.
- 100% protection was shown for the first time by oral administration of heat killed *Shigella flexneri* 2a in rabbit model of shigellosis. The responsible immunogen was a 34 kDa outer membrane protein with all the properties of becoming a subunit vaccine.

Clinical Research

- Demonstrated better efficacy of reduced osmolarity ORS in young children and adults in dehydrating diarrhea compared to that of standard ORS.
- Probiotic drink containing *Lactobacillus casei* showed 14% protective efficacy in acute diarrhoea in children.
- Zinc supplement was found to play a significant role in management of diarrhoea.
- Rotavirus vaccine trial showed the candidate vaccine (rotarix) was safe and immunogenic in children.

Epidemiological/ Operational Research

- The majority of HIV-1 transmission in Manipur, North Eastern States, has shown to be linked with sharing of needles and syringes among the injecting drug users. Overall 11.8% HIV sero-prevalence reported from Darjeeling.

- C type (C4 subtype) is the most prevalent subtype among blood samples from HIV-1-seropositive female sex workers in Kolkata.
- A bivalent whole cell killed oral cholera vaccine in a Phase III randomized control trial among 110,000 urban slum populations in Kolkata showed protective efficacy of 67% in all age groups at the end of two years and 65% at the end of three years post vaccination.
- Estimation of the burden of diarrhoeal diseases among children under 5 years (in collaboration with University of Maryland) shows higher rate of rotavirus and Shigella in cases than in controls.
- Surveillance for dengue fever in eastern Kolkata revealed a high incidence of 2.3% similar to the other high endemic regions of world.
- Diarrhoeal disease surveillance study revealed an increase in *Vibrio cholerae* O1 infection among <2 years age group, resistance of *V. cholerae* O1 to tetracycline, rise of untypable *S. flexneri*, higher proportion of atypical EPEC and *G. lamblia* and polymicrobial etiology.
- Patented the recombinant live oral cholera vaccine, Va1.3.
- Preparation of holey / lacey film for electron microscopy.
- Under hospital surveillance the characterization of *V. Cholerae* strains revealed.
- Ogawa serotype was completely replaced by Inaba serotype in 2005 and was perpetuated upto 2006 due to immune pressure at the community level.
- Among children below five years, the major causal agent of diarrhoea in hospital was found to be Rotavirus; the other virus of interest was Norovirus.

Translational Research

- Identified new pathogenic strain of *Giardia* and *Cryptosporidium* in Kolkata (Available in Genbank).
- The first Indian HIV vaccine using Indian HIV-1 strain was constructed which underwent Phase I human clinical trial at NIRT (TRC), Chennai and NARI, Pune.
- Diarrhoeal disease surveillance with emphasis on cholera set up in urban slums of Kolkata in preparation for a Phase III trial of a live oral cholera vaccine (VA1.4) developed by Indian scientists.

Human Resource Development

- Ph.D., summer training for M.Sc/ M.Tech, training of graduate and postgraduate medical students and medical personnel, paramedical staff, etc.

National Institute of Epidemiology (NIE), Chennai

Clinical and Epidemiologic Research

- Conducted 2 rounds of large scale, field-based post-leprosy vaccine trials surveys to study leprosy incidence, prevalence and relapse rates and generated data relevant for NLEP.

- Conducted WHO sponsored clinical trials on efficacy of single dose ROM treatment among single lesion and 2-5 lesions of pauci-bacillary leprosy patients.
- Coordinating an international multi-centric trial to assess the effectiveness of uniform multi-drug therapy for all types of leprosy patients.
- Spearheaded the effort to identify epidemiological research priorities related to HIV/AIDS and identified as Technical Resource Group for Epidemiology of HIV by NACO.
- Carried out Integrated Biological and Behavioural Assessment [IBBA] among high risk populations for HIV in Tamil Nadu and participated in data analysis at the national level.

Translational Research

- Validated the tool for identification for Cause of Death by Verbal Autopsy to know the disease burden and associated mortality in India which was later fine-tuned by ICMR.
- Modified Lot Quality Assurance [MLQA] Sampling to monitor and assess leprosy elimination programme in the Country.
- Operational research related to immunization programs in Tamil Nadu and Himachal Pradesh led to policy changes.
- Over 100 outbreaks investigated by the MPH scholars of NIE generated evidence that led to appropriate recommendations to the policies and programs.

Human Resource Development

- Trained over 100 'in-service' medical officers from 18 States of India in field epidemiology, public health. They form state level technical force for outbreak investigation, surveillance, program monitoring and evaluation.
- Facilitated networking within ICMR for research, teaching and training in epidemiology, biostatistics and research methodology. Short-course training programmes were also conducted for Medical Doctors, Research investigators *etc.*
- Introduced the Master of Public Health program [Epidemiology and Health Systems].
- Identified as Regional Institute for 8 states in South India for the Annual HIV Sentinel Surveillance Programme of NACO, carried out training at state levels for surveillance sites and testing laboratories using modified protocols.

Infrastructure

- Set up the ICMR School of Public Health (ICMR-SPH) and initiation of ICMR partnership for Schools of Public Health.

National Institute of Immunohaematology (NIIH), Mumbai

Basic Research

- Described various hemoglobin variants of pathologic importance like Haemoglobin M Ratnagiri, (causing Methaemoglobinemia), Haemoglobin Showa Yakushji (thalassemic

hemoglobinopathy extensively detected in Agri community), Hemoglobin Sallanches (cause of hemolytic anemia and Hemoglobin H disease), Hemoglobin Koln (unstable hemoglobin), Hemoglobin Jackson (associated with polycythemia) and hemoglobin Sun Praire (causing hemolysis).

- Detected novel mutations causing red cell enzymopathies with pathologic population genetics importance *e.g.* G6PD – Namoru, G6PD Nilgiri, several novel mutations in pyruvate kinase deficiency.
- Defined large series of NADH MR Deficiency causing methemoglobinemia and its association with mental retardation delineated and prenatal diagnosis offered.
- Described novel anion channel mutation in patients with hereditary elliptocytosis with distal Renal Tubular Acidosis (dRTA).
- Delineated JAK2 mutations in thrombophilia in Indian population, Thromboelastographic classification of severe hemophilia developed.
- Provided one of the mechanisms for thrombocytopenia in Dengue virus infection by selectively wiping out CFU – MYC colonies *in vitro*.
- Described novel mutations in factor VII, VIII, IX, X deficiency and Glanzmann's Thrombasthenia including Fibrinogen.
- Modified simple flow cytometry based technique for PNH diagnosis and establishment of flow cytometry technique for tyrosine kinase activity.
- Standardized flow cytometry based techniques for detection and classification of HLH.
- Development of monoclonal antibodies for following antigens - Blood groups B, H, N and hemoglobin A2.

Clinical Research

- Found thrombophilia as important cause of idiopathic recurrent fetal loss. Both standard and LMWH were found to be highly effective in managing these pregnancies for providing live births.
- Established molecular basis of Bombay phenotype in Indian population.
- Diagnostic facilities for various disorders like the thalassemias, red cell enzyme deficiencies hemophilias *etc.*, as well as few Primary Immunodeficiency Disorders (PID) provided to approximately 10,000 patients every year.
- Established hospital and field based newborn screening for sickle cell disease in tribal and non tribal population of Valsad and Nagpur to raise a cohort of babies for understanding the natural history of the disease in the early years of life which will have important implications in management and prevention programmes.
- Described founder mutation in moderate hemophilia B in Gujarat.
- Shown that proportion of cases of aplastic anemia in MDS has genetic instability like Fanconi anemia.
- Some of the disease associations of HLA with malaria, HIV and, leprosy were described.

- Detected high prevalence of tuberculosis in SLE patients before the diagnosis of SLE.
- Showed that FLT 3 mutations affect 24% of AML patients in India with a normal karyotype.
- Described a unique morphological subset of AML with a characteristic immunophenotype and a combination of FLT 3 and JAK 2 mutation.
- Provided prenatal diagnosis for Hemoglobinopathies, coagulation disorders and red cell enzymopathies.
- Demonstrated very low level of microfilaremia by routine karyotyping method.

Translational Research

- Established very cheap, fast and accurate flow cytometric technique for evaluation of osmotic fragility in hemolytic anemias.
- Developed microtitre plate based cheap and affordable technique for detection of pyrimidine 5' nucleotidase deficiency in red cells.
- Established second trimester prenatal diagnosis for different hematological and immunological disorders-(hemoglobinopathies, bleeding disorders, immunodeficiencies, red cell enzymopathies).
- Establishment of CGH technique for studying hematological malignancies with small chromosomal imbalance.
- Quick detection of severe Glanzmanns thrombasthenia by using a hybrid protein of bioengineered disintegrin (recombinant) and alkaline phosphatase.
- Established a mismatch primer PCR for detection of a common founder mutation in hemophilia B, Developed a simpler, cheap semiquantitative technique for factor XIII deficiency.
- Established ABO and RH D molecular genotyping, which have potential application in isoimmunization and forensic medicine in addition to saving Rh D immunoglobins.
- Developed non - invasive prenatal diagnostic technique (84% accuracy) for hemoglobinopathy *i.e.* detection in the 10 to 15 week fetus.

Human Resource Development

- 105 individuals from different blood banks mostly from remote parts of the country trained in serological techniques to run a Blood Bank.
- Trainees from Myanmar, Sri Lanka, Bangladesh, Nepal, N. Korea trained under WHO or WFH Fellowship programmes.
- Tailor made training through workshops in flow cytometry, ELISA based techniques, molecular biology techniques, coagulation techniques, cytogenetics given on a regular basis 3 – 4 times in a year.
- Through strong hand holding programme centres for prenatal diagnosis of hemoglobinopathies being established at Nagpur, Valsad, Kolkata, Bangalore and Ludhiana.

- Training given to doctors and laboratory technicians in molecular and prenatal diagnosis techniques in hemoglobinopathies from 20 medical colleges.
- Nine students received Ph.D & five received M.Sc in Applied Biology, eight clinicians received DM at center & Post Doctoral Fellowships abroad in Clinical Hematology.

National Institute of Malaria Research (NIMR), New Delhi

Basic Research

- Studies on genetic characterization of the X- chromosome of malaria vector, molecular phylogenetics of Indian malaria vectors, comparative genomics of insecticide resistance gene families and population genomics of an Indian malaria vector from northeastern India provided new knowledge about genetic architecture of vectors in North east.
- Various new species of mosquitoes found while studying ecological succession of anopheline and other mosquitoes in North- Eastern States.
- Comparative genomic studies on the evolutionary understanding on several human genes; Duffy gene responsible for *P. vivax* infection, TNF- α gene responsible for severe malaria, CD36 gene responsible for malaria susceptibility and HBB gene responsible for sickle cell anaemia initiated.
- Indigenous production of monoclonal antibodies PfHRP2 and pLDH achieved.
- Simple PCR-based molecular diagnostic assays developed for kdr genotyping in *An. culicifacies* and *An. stephensi*. These assays can be used for monitoring of knockdown resistance in field populations.
- Micro-PCR based RT-PCR method of malaria diagnosis showed better detection level than RDT and microscopy.

Clinical Research

- Studies on drug resistance in malaria in India including *in vitro* and clinical studies supported the therapeutic efficacy data from time to time. Efficacy of alternative regimens for *P. falciparum* including artemisinin based combination therapies (ACTs) also studied.
- Study on treatment practices revealed irrational use of artemisinin including monotherapy and this led to ban on use of oral artemisinin monotherapy in the country by regulatory authorities. Pharmaco-vigilance programme for antimalarials launched.
- Mixed infection of *P. vivax* and *P. falciparum* up to the tune of 46% (*P. falciparum* and *P. vivax*) detected from various parts of the country.
- Characterization of the *P. falciparum* strains prevalent in North eastern region revealed that among artemisinin-based combination therapies (ACTs), the AS+SP combination found safe and effective in achieving rapid parasite clearance well within 48 hours with less possibility of development of gametocytemia.

Epidemiological/Operational Research

- Evaluation and quality assurance of rapid diagnostic tests (RDTs) for malaria.

- Conducted in-depth review of malaria and independent assessment of new tools such as rapid diagnostic kits, insecticide treatment of community owned nets *etc.* in Orissa.
- Study on estimation of malaria morbidity burden in India revealed that if we increase the Annual Blood Exam rate (ABER) matching with fever rate, the estimated malaria burden will be close to actual burden.
- Role of *An. stephensi* in transmission of malaria in rural area of North Gujarat established.
- Evaluation of Biodart (an aqueous Indigenous strain of Bti) and pyriproxifen, an IGR compound was undertaken in multicentric mode which proved very effective for larval control.
- Insecticide resistance against malaria vectors studied at 46 sites in the country.
- Temephos and fenthion (both, larvicides) for vector control in different areas re-evaluated and consequently fenthion withdrawn from the vector control programme due to development of resistance.
- Phase III trials on Olyset nets, Interceptor nets, Icon Life net and PermaNets completed in different regions/eco-climatic zones in India for personal protection against mosquitoes.
- Phase III trial on DuraNets sponsored by WHOPES (WHO Pesticide Evaluation Scheme, Geneva) is in progress.
- Therapeutic efficacy and drug trials for complicated falciparum malaria undertaken in multicentric mode.
- Completed field evaluation of Zero Fly, an insecticide incorporated plastic sheeting for vector control.
- Completed field evaluation of biolarvicides (TACBIO) for mosquito larval control in urban area.
- Results of health impact assessment of Narmada Valley undertaken by NIMR adopted by NVDA and state government. The project extended to Narmada basin and Jalore (Rajasthan).

Translational Research

- Malaria Parasite Bank serving as a national resource for Plasmodium isolates in the country. Till now a total of 1075 isolates of human malaria parasites (*P. falciparum*, *P. vivax*, and *P. malariae*) collected and cryopreserved in parasite bank.
- Technologies transferred to National Programme: (1) Introduction of ACTs in National Drug Policy for malaria; (2) Introduction of Rapid Diagnostic Tests (RDTs) in National Programme and (3) Regulation of ban of marketing of artemisinin monotherapy in India.
- Olyset and permanet introduced in the vector control programme at national level for personal protection.
- Developed climate based model for impact of climate change on malaria by the year 2030.

- Developed village level risk map of malaria in problematic districts of southern and northern Karnataka using satellite remote sensing.
- Identified rainfall and satellite derived vegetation index as important indicators for early warning of malaria in desert.
- Using Remote Sensing (RS) and Geographical Information system (GIS), the vector *An. culicifacies* reported to be invading the deforested areas while the vector *An. minimus* found receding from these areas.
- Operational feasibility, social acceptance and sustainability of an indigenous larvivorous fish, *Aphanius dispar* for malaria control under the vector-borne disease control programme demonstrated in semi-arid area of Kutchh, Gujarat. Scaling-up use of this fish and capacity strengthening initiated in 2008 in collaboration with state Health Department, Gujarat.
- Completed studies on development of a field site for malaria vaccine trials at Rourkela (Orissa).
- Patents filed: 1) antimalarial activity of fractions isolated from *Artemesinin roxburghiana*; 2) insecticidal activity of essential oil of *Psoralea corylifolia* against mosquitoes and 3) an immunodiagnostic reagent for the detection of *P.vivax* antigen: Ref. IP01699.

Others

- Provided free diagnosis and treatment facilities to the public and on an average about 15,000 patients screened every year through Malaria clinics.

Human Resource Development

- 12 Candidates awarded Ph.D, 24 M.Sc students completed their dissertation; Trained 40 Indian Ph.D. and postdoctoral students on 'Molecular and Evolutionary Genetics of Malaria'. In addition regular trainings are conducted for technicians and medical officers from states and MCD.

Infrastructure

- NIMR has shifted to its own building at Dwarka, New Delhi and all laboratories are fully functional. Construction of Animal facility complex has begun.
- A new laboratory "Evolutionary Genomics and Bioinformatics" was established at NIMR.
- In view of threat of climate change in public health a new division of Environmental epidemiology was set up in 2009 at NIMR, New Delhi.
- International Centres of excellence: NIMR HQ and its 3 field units (Chennai, Nadiad, and Rourkela) have been identified for development of centres of excellence for malaria research by NIH.

National Institute of Medical Statistics (NIMS), New Delhi

Biostatistical/ Epidemiology/ Operational Research

- Developed mathematical models of HIV/AIDS epidemic to study the transmission dynamics of HIV/AIDS in the population.

- Models developed to estimate AIDS related deaths, Orphans and Vulnerable Children, patients requiring ART in the population.
- Managed data and analysed for NACO's HIV Sentinel Surveillance & HIV Estimation 2006-2012 and found that the epidemic is stable at the national level with regional disparities.
- Conducted Integrated Biological and Behavioural Assessment on Highway on over 2000 long distance truck drivers and found that they have first sex at the age of 18-20 years; had sex with paid female partner (42-58%), found consistent condom use increased in truckers with lowering of prevalence of Syphilis.
- Conducted IDSP-NCD Surveys in India for assessment of risk factors status in non-communicable disease in seven states. The study demonstrated that the percentage of current daily smokers varied between 9% to 42%. Those consumed alcohol in past 12 months ranged from 11% to 20%. The obesity of Grade II and above was between 2-5%.
- A qualitative assessment was made to evaluate the role of the adolescent friendly clinics (AFCs) as well as their feasibility and sustainability.
- Evaluated Immunization coverage for BCG, DPT, OPV, and Measles for children and TT for pregnant women in 9 districts which revealed low immunization coverage amongst Scheduled Caste/ Scheduled Tribe, Illiterates and people belonging to lower socio-economic status.
- Assessed Impact of fortified ICDS supplementary food on child health in Madhya Pradesh, Uttar Pradesh and Uttarakhand in children between 12-59 months. The study revealed that fortified *panjiri* is effective in improving anaemia, serum retinol and nutritional status.
- A comprehensive review of the RCH programme carried out to assess the impact of the first phase of RCH Programme using district level household survey (DLHS) data revealed that except the North-Eastern states where about 84% of the allocation could be spent, most of the other states spent 50% to 60% allocation.
- Conducted Health facility survey in demographically weak districts to take stock of existing of 4 states two-third of the PHCs found to have Labour room and 40% have operation theatres. PHCs without any Medical officer decreased considerably. Supply of electricity and water was not adequate and vehicles were not functional to tackle emergency.
- Evaluated *Kishori Shakti Yojna* to assess the impact of the programme in the community on 12,000 adolescent girls in 24 states of the country. About 80% of adolescent girls (beneficiaries) have been benefited for training.

Translational Research

- Developed "Health Sector Policy Reform Options Database" as an online database (www.hsprodindia.nic.in) and provided information about Indian good practices and innovations in health services management.

- Snowball sampling techniques was established as a cost effective method for the estimation of maternal mortality ratio (MMR) based on a pilot study in the selected states of India, namely, Delhi, Karnataka, Maharashtra, Uttar Pradesh and Uttarakhand.
- Evolved inverse sampling procedure to estimate the new case detection rate and diseases burden due to leprosy in India.

Establishment of National Clinical Trials Registry in India

- An online system for registration of all clinical trials (www.ctri.nic.in) in India. Established to serve as a platform registering all clinical trials on health products including drugs, vaccines devices herbal drugs. The DCGI declared trial registration to be mandatory w.e.f. 15th June 2009.

Human Resource Development

- Conducted model based HIV estimation- 6 workshops.
- Workshop on data collection methodologies for estimating Obstetric fistula.
- Consultation of Stakeholders on HIV estimation.
- Training of Trainer's Workshop for IDSP and NCD Risk Factors Survey.
- Capacity Building Workshops on Application of Multivariate Mixed Effects Models.
- Data Entry Workshops.
- Training Workshops on Clinical Trial and Statistical Computing.
- Summer Training Programmes in Medical Statistics.
- Dissemination Workshops for Clinical Trial Registry.
- Orientation Courses on Statistical Techniques and SPSS.
- Dissemination Workshops for IBBA-NH.

National Institute of Nutrition (NIN), Hyderabad

Basic Research

- Developed a robust model for screening of micronutrient bioavailability *in vitro* human intestinal cell line.
- Developed a rat model in WNIN/Ob (sumo rat) for obesity and certain biochemical and molecular parameters.
- Identified compounds like aldose reductase inhibitors and antiglycating agents from dietary sources against diabetic complications.
- A novel mutation (F71L) in α -crystallin associated with age-related cataract due to defective chaperone-like function identified for the first time.
- Studies on health effects of coconut (CO) and virgin coconut (VCO) oils showed that no adverse effects regard to lipid parameters, inflammatory and cardio-vascular markers in both healthy and over-weight subjects.

- Conducted studies on role of infiltrated T-cells in development of obesity and diabetes and found that stromal vascular fraction of the adipose tissue contributes significantly to the inflammatory milieu compared to that of adipocytes in the adipose tissue.
- Developed the Technology for estimation of Vitamin A in blood samples using Dried Blood Spot (DBS).
- Demonstrated the prophylactic effects of pyridoxal 5 Phosphate (PLP) towards the beta cell protection in diabetogenic mice due to its antioxidant function, Ductal epithelial cells (DEC) and nestin positive cells (NPC) with PLP and RA along with growth factors recreated physiological environment for beta cell expansion and increased *in vitro* generation of functional neoislets.
- *In vivo* transplanted neoislets rescued hyperglycaemia and process of regeneration/tissue repair in the pancreatic tissue of the diabetic mice.
- Showed beneficial effects of Cow pea derived Isoflavones's in rat bone mineralization/osteoporosis.
- Initiated new Indian food composition database preparation, documented nutrient composition of 250 most popular hybrid rice varieties, cultivar specific nutrient composition of 200 Mango varieties, 20 pearl millets, 24 sorghum, and 44 minor millets.

Clinical Research

- Studied effects of maternal micronutrient on the body composition, insulin resistance and macronutrient metabolism in albino rat models.
- A hospital based study on pregnant anaemic women highlighted the need to re-examine the management of anaemia during pregnancy in a population where undernutrition is more common and mean dietary intakes of macro and micro nutrients are low.
- The effect of lactobacilli preparation on local immunity in women indicated that in women with cervicitis or bacterial vaginitis (BV) IL-1 β , TNF α , and IL-6 cytokines remain elevated even after controlling for BV or vaginal candidiasis
- Weight gain, IGF-1 status and body composition changes of undernourished children during nutritional rehabilitation has shown accretion of lean body mass with higher rate of weight gain compared to fat deposition.
- Assessed the effect of dietary polyunsaturated fatty acids on obesity, insulin resistance and impaired glucose tolerance.
- Revealed that consumption of ultra-rice through MDM significantly improved the iron stores and reduced morbidities.

Epidemiological/Operational Research

- NNMB 2nd Tribal Repeat Surveys were conducted in 9 states of India to assess the diet and nutritional status of tribal population.
- Multi-component health and nutrition intervention studies resulted in a significant increase in the health and nutrition knowledge of the adolescents.

- Assessment of Current scenario of Food labelling in India indicated that the food labelling regulations in India are on par with those of the developed countries.

Translational Research

- Translated Technologies of double fortified salt (DFS) and fortification of wheat *atta* with iron and other essential nutrients to the industry.
- Released the revised Dietary Guidelines for Indians.
- Carried out revision of nutrient requirements and recommended dietary allowances for Indians.
- Initiated database development on the phenolic content of plant foods commonly consumed in India and their health beneficial effects including anti-oxidant activity (AOA).
- Nutrition component in the existing school science textbooks of India was assessed and the data will be baseline to improve the nutrition content in school textbooks during future revision of textbooks.
- IEC material for nutrition education were developed for different groups using diverse media and methods.
- Published “The Nutrition and Hydration Guidelines for Excellence in Sports Performance” and event and phase specific energy allowances as well as menu planning was done for Indian Athletes in Common Wealth Games-2010 especially for weight category sports like boxing, weight lifting and wrestling.

Human Resource Development

- Regular training programmes of the institute like M.Sc (Applied Nutrition Course), PG certificate course in Nutrition, Annual training course in Endocrinological Techniques *etc.*
- Ad-hoc training programmes of the Institute, conducted for organizations like Food and Nutrition Board, ICMR School of Public Health, WHO participants from Southeast Asian Countries *etc.*
- Workshops and seminars on nutrition research were organized

Infrastructure

- The computing and internet facilities were augmented substantially during the plan period at NIN, Hyderabad; a bio-informatics centre was set up in the Institute and the centre is now operational.

National Institute of Occupational Health (NIOH), Ahmedabad

Basic Research

- Effects of pan masala on hard and soft tissue of oral cavity of consumers – chewing material containing arecanut and tobacco manifested geno and cytotoxic potential, and adverse effects on oral tissues.

- Effect of arsenic on neurobehavioral functions, histopathological and biochemical changes in utero-treated rats showed a significant alternation in the activity of anti-oxidants. Arsenic exposure for longer duration enhanced lipid peroxidation.
- Haemolytic profile in arsenic exposed population through drinking water in West Bengal revealed skin pigmentation and keratosis in 6.1% and 3.9% subjects respectively. Parameters related to hemolytic anemia were all within normal limits.
- Bio-monitoring of urban air pollutants using of traffic policemen showed high level of 8-hydroxydeoxyguanosine in urine, a biomarker of oxidative DNA damage.
- Monitoring of indoor air pollutants (SO₂, NO_x, VOCs and RPM) in hairdressing saloons showed the presence of only p-xylene and few samples showed traces of toluene.
- Study on influence of seat feature and mode of sitting among call center operators reaffirms that the backrest and armrest have conjoint influence in reducing the load at seat, which in turn might help in mitigating the compressive and shear stress on the spinal and other paraspinal structures.
- Investigation of volatile organic compounds (VOCs) and urinary metabolites among petrol pump workers in West Bengal revealed that Air benzene level correlated with urinary trans-trans mucanic acid (tt-MA) and S-phenyl mercapturic acid (SPMA), and air-ethylbenzene, toluene and xylene with the urinary mandelic acid, hippuric acid and methyl hippuric acid.
- Male infertility can be partially attributed to environmental factors. Higher lead levels and DNA damage in oligozoospermic subjects observed.

Epidemiological/ Operational Research

- Retrospective analysis of nearly 7500 poisoning cases recorded highest number of incidences in the range of 20-29 years. Highest number of incidences of poisoning was contributed by the pesticides (66.9%) of which organophosphate pesticides contributed the highest.
- Diamond manufacturing workers (at Surat, Gujarat) revealed higher prevalence of hypertension (70%).
- Health status assessment of grain handlers (at Kolkata) reported musculo-skeletal pain and discomfort.
- Occupational morbidity among men and women reported due to multiple work stress.
- Neurobehavioural and toxicological studies in workers of pesticide formulation units indicated significant elevation in finger dexterity error test in exposed and maintenance workers.
- Environmental cum epidemiological study in copper smelting units with reference to exposure assessment of heavy metals showed a positive relationship between the serum copper and ceruloplasmin, the carrier protein of copper.
- Exposure assessment of poly aromatic hydrocarbon (PAH) and its metabolites showed the role of PAH and its metabolites and cytogenetic effects.

- Study on sheep breeding and wool shearing workers in rural Karnataka showed high respiratory morbidity, due to significant exposure to suspended particulate matter.
- Studies on health effects of workers exposed to organic solvents in synthetic resin manufacturing industry showed obstructive pulmonary function abnormality observed in 17% subjects and hearing loss of high frequency (~8%).
- Lead poisoning of workers in small scale lead battery manufacturing units revealed blood lead levels exceeding 80µg/dl in about 3% workers.
- Relationship between pro inflammatory cytokines and health hazards among solid waste disposal workers in Bangalore indicated increased health complaints *viz.*, respiratory, gastrointestinal, dermatological, musculoskeletal.
- Prevalence of silicosis and silico-tuberculosis in slate pencil workers were ~47%, and 19% in community residents. It was recommended to shift the units to isolated places.
- About 26% male and 11% female bidi binders had respiratory function impairments at the sub-urban areas of Kolkata.
- Studies on effect of chronic low-level exposure of phosgene to workers in the production of aromatic isocyanates, pesticide intermediates, *etc.* showed that 8.4% workers had respiratory function impairment.
- Environmental cum epidemiological study of population residing in and around waste sites allegedly containing non-recyclable solid waste chromium compounds revealed no specific health effects secondary to chromium exposure like perforation of nasal septum, dermatitis and spontaneous miscarriage among the local inhabitants.

Translational Research

- New Silica Dust control system designed and installed at Beawar, Rajasthan. Reduction in the total dust was 89% to 97% and for respirable dust varied from 77% to 85%.
- Environmental information services (ENVIS Centre) for collection, collation, storage, retrieval and dissemination of information related to occupational and environmental health.

Human Resource Development

- Training/fellowship to scientists, WHO sponsored fellowship programme, Associate fellowship in industrial health (3 months programme), Doctoral and short term dissertation programmes, Orientation programmes for industrial physicians, hygienists, safety officers, officers of State Pollution Control Board, engineers and NGOs.
- NIOH is consultant for Judiciary bodies like National Human Rights Commission (NHRC) in occupational and environmental health, Ministry of Environment and Forest, CPCB, GPCB, Poison Information Services, Ministry of Labour, CPCSEA, MCA, DST-GLP, Ministry of Agricultural-Insecticide Board *etc.*
- Training and Technical Material - Developed national human resources for occupational health activities, published reports and training manuals available at www.nioh.org; www.envisnioh.org.

National Institute of Pathology (NIOP), New Delhi

Basic Research

- Established two breast cancer cell lines, PCB20 and PCB36, using triple negative primary tumours from two Indian patients.
- Young breast cancer patients showed no significant contribution of BRCA 1 & 2 genes. However, the CYP17 A2 allele, VDR Poly AL allele and >20 CAG repeats identified as putative high risk alleles and women carrying genotype with three putative high risk alleles increased risk of developing breast cancer (OR=4.68) than those carrying one or two putative high risk alleles.
- The wide spread use of tobacco and fermented betel quid in north-east region found to contribute to the development and progression of ESCC in the patients by facilitating the amplification/up-regulation of genes involved in MAPK pathway, GPCR family and cation transporter activity and deletion/ down-regulation of genes involved in Wnt signalling pathway, apoptotic and focal adhesion pathway.
- Identified Betel quid chewing by MDR analysis as the single main risk factor for breast cancer in NE region.
- p53 codon72 polymorphism- Interaction with smoking was a significant risk factor for oral cancer and interaction with betel quid was significant risk factor for lung cancer.
- Higher risk for oesophageal and lung cancer-EPHX1 exon4, 139His/Arg and 139Arg/Arg genotypes.
- Completed Genome-wide analysis of chromosomal alterations and gene expression profile in familial and non-familial esophageal cancer (ESCC) case from high-risk region of India to elucidate molecular carcinogenesis.
- Germ-line sequence alterations in BRCA2 gene in familial ESCC patients from this high-risk area of India suggested that BRCA2 play a role in genetic susceptibility to familial ESCC.
- Up-regulation of genes involved in β -cell receptor signalling pathway and down regulation of genes in Natural Killer cell mediated cytotoxicity in familial ESCC suggested that immune response may influence the natural history of ESCC in high-risk area of India.
- Evaluated inflammatory and circulatory markers (heat shock protein 60) in *C. pneumoniae*-positive coronary artery disease patients.
- Identified several virulence related parasite genes by microarray analysis followed by functional characterization of selected genes. Centrin gene knockout parasite mutants were examined as attenuated live vaccine. The mutants conferred protective immunity *in vivo* in mice and hamster.
- Identified genetic determinants in SAG resistance using genomic microarray approach which included PSA-2 and H2A genes; their over-expression in the parasite altered the sensitive phenotype to resistant.

- Captured the comprehensive picture of immune parameters in the lesion tissue of PKDL patients using cDNA array technology, implicating the presence of effector (IFN- γ , TNF- α) and regulatory (IL-10, TGF- β) molecules together with apoptosis (FasL/TRAIL) and chemokines related genes (MIP-1 α , MIP-1 β and MCP-1).
- Technological strategies established on epidermal keratinocyte stem cells using a novel synthetic hydrogel, Mebiol gel.
- Standardized SOP for Extraction and Multi-residue analysis in human tissues (placenta) using GC/HPLC.
- Demonstration of specific phthalate esters (DMP, DIHP, DIBP, DIOP and BPBG) in idiopathic infertile group as compared to fertile group.

Clinical Research

- Identified androgen receptor as independent predictive marker in response to neoadjuvant chemotherapy in locally advanced breast cancer cases.
- A Th2 dominant host immune profile was shown to have association with recurrence of tumour in bladder cancer patients. Combination panel of immunohistochemical markers (p21waf1/VEGF/CD105) was more effective in predicting recurrence of bladder cancer than a single marker.
- Reported for the first time-downregulation of MMR genes in Indian patients with carcinoma prostate (CaP), Loss of hPMS2 expression serves as significant prognostic marker for CaP.
- Identified EMA, WT1, ezrin, claudin 1 & SPARC as potentially useful markers for differentiation of fibroblastic meningioma from schwannoma.
- Established the morphological criteria for localization of intracellular *C. trachomatis* inclusions in cervical smears, which has the advantage of being a rapid method of screening a large number of women in the field setting.
- Detected significantly higher lipid peroxide and low superoxide dismutase activity in *C. trachomatis* positive patients undergoing spontaneous abortion as compared to those with missed abortion.
- Developed molecular diagnosis for detection of *C. pneumoniae* in atheromatous plaques and blood of coronary artery disease patients.
- *In vitro* SAG susceptibility to miltefosine and amphotericin B significantly correlated of field isolates Kala-azar (KA) with SAG while paromomycin did not. Investigated the mechanism of miltefosine resistance using lab generated miltefosine resistant *L. donovani*.
- Evaluated the association between localized and circulating levels of immune-determinants in cutaneous leishmaniasis (CL) patients by RT-PCR.
- Established the association between parasite burden and IL-4 response in lesion tissues in patients of Indian CL.

- An innovative and cost-effective process of growth arresting feeder cells, proven to stimulate the *in vitro* proliferation of epidermal stem cells into constituting human epidermis for application in burns.
- Detected pesticides in placental extracts of exposed (Tea Garden Workers and Agricultural Workers) and unexposed groups.
- Observed significant higher concentration of lead and cadmium and low concentration of hormones, playing role in development of placenta and maintenance of pregnancy (Progesterone and Estradiol) in IUGR.

Epidemiological/ Operational Research

- Distribution of GST polymorphism in NE Indian population was found different from rest of India and similar to those reported from China. GSTT1 null genotype was found to be a risk factor for oral and gastric cancer in Assam.
- Established *Leishmania tropica* as the causative agent of CL in the disease endemic region of Rajasthan.

Translational Research

- Established repository of *Chlamydia trachomatis* isolates.
- Development of monoclonal antibody based indigenous diagnostic assay for diagnosing patients with *Chlamydia trachomatis* infection (Patent granted).
- DOT ELISA for diagnosis of sequelae to *Chlamydia trachomatis* infection in women using chlamydial heat shock protein (cHSP60).
- Developed and applied species-specific PCR for detecting *Leishmania donovani* which was tested in the endemic area and widely utilized in referral labs as a confirmatory test.
- Developed and applied real-time PCR assay to diagnose and simultaneously estimate parasite load in clinical samples of Visceral Leishmaniasis (VL) and Post Kala-azar Dermal Leishmaniasis (PKDL).
- Developed and applied immunological methods such as DAT, ELISA and rk39 based strip test for diagnosis of VL.

Human Resource Development

- Ph.D. and DNB Programs in Pathology, Summer Training, WHO Fellowship.

Infrastructure

- New state-of-the-art **Central Equipment Facility** was created for conducting genomic, molecular, immunogenomic and stem cell research studies.

National Institute for Research in Environmental Health, Bhopal

- This is newly created institute and has initiated epidemiological studies.

National Institute for Research in Reproductive Health (NIRRH), Mumbai

Basic Research

- Studies on the sexual transmission of HIV revealed the presence of distinct HIV variants in sperm/PBMCs and vaginal epithelial cells/PBMCs of the same individual.
- An accurate diagnostic tool developed to identify common CYP21 mutations in Congenital Adrenal Hyperplasia (CAH), the most common cause of ambiguous genitalia.
- Structural and functional determinants of the entire extracellular domain of follicular stimulating hormone (FSH) identified.
- Studies on the biomarkers of autoimmune ovarian disorders led to identification of several molecular and cellular targets of auto antibodies in Premature Ovarian Failure (POF) and women having repeated IVF-ET failures. A 90kDa protein (HSP90) found to be a major autoimmune target. Ten putative immunogenic epitopes of HSP90 were identified and peptide ELISA has been established.
- SsALF-24 (from the hemocytes of Indian mud crab, *Scylla serrata*), rabbit vaginal fluid hemoglobin alpha chain like peptide (RVFHb α P) (from rabbit vaginal fluid) and rabbit epididymis hemoglobin beta chain like peptide (REHb β P) (from rabbit epididymis) found to have anti bacterial and anti-HIV activities.
- Derived two well characterized pluripotent embryonic stem cell lines, KIND-1 and KIND-2 and established their differentiation propensity.

Clinical Research

- Study on the acceptability and continuation rate of 2-monthly injectable contraceptive-Norethisterone Enanthate (NET-EN), helped policy makers in devising the logistics of introducing injectable contraceptives in National Family Welfare Programme.
- Administration of mifepristone and misoprostol for termination of first trimester pregnancies revealed that the efficacy of the medical abortion decreases while side-effects (notably abdominal pain) increase with the gestational age.
- Genomic imprinting observed to play a decisive role as a paternal epigenetic factor in early embryo loss in rat model.
- Investigations on the genetic predisposition to ovarian disorders led to identification of specific genetic mutations in women with Premature Ovarian Failure (POF).
- Variants of the genes related to hyperandrogenemia, insulin resistance and obesity identified in women with Polycystic Ovarian Syndrome (PCOS).
- Anti endometrial antibodies (IgM and IgG) detected in the sera of women with endometriosis. A peptide based ELISA developed to detect these auto-antibodies against endometrial antigens.
- Established norms for bone turnover markers osteocalcin, bone specific alkaline phosphatase, C-terminal crosslinking telopeptide of type 1 collagen and deoxypyridinol.

Epidemiological/ Operational Research

- A multicentre study undertaken at 30 ART centres to assess proportions of patients and factors associated with ART drug adherence revealed that overall 75.5% of the interviewed 2924 participants in the study had optimal adherence (>95%).

Translational Research

- Developed National Guidelines on Prevention, Management and control of Reproductive Tract Infections including Sexually transmitted Infections (RTIs/STIs)
- A simple and cost effective Resazurin Reduction Test (RRT) developed to assess the quality and fertilizing ability of sperm in human and animals. The test is also useful to assess the improvement in the semen quality after treatment of subfertility in men. The test is being commercialized.
- Developed four fertility assessment kits (InduLISA, CorpuLISA, LuteLISA and FolliLISA).
- A sensitive and specific PCR method developed to detect *Chlamydia trachomatis* (CT) infection in cervical samples.
- Developed model for adolescent friendly service delivery at 8 public health care facilities in Maharashtra. The Government of Maharashtra has adopted the process of training, information education and communication strategies and Management Information System for institutionalizing Adolescent Reproductive and Sexual Health (ARSH) services in other districts.
- A study on reproductive health knowledge and practices among Self Help Group (SHG) women in Maharashtra contributed to the development of training programs for SHG women by *Mahila Arthik Vikas Mahamandal* (MAVIM) of Maharashtra state.
- A community based intervention model to promote communication between husband and wife on issues related to sex and condom use and to reduce STIs/HIV among couples developed.
- Developed training modules on RTIs/STIs for Doctors and Paramedicals, being used for the training in the NACP-3 and RCH-2 programmes under NRHM.

Infrastructure

- Establishment of a state of art National Center for Pre-clinical Reproductive and Genetic Toxicology to support the ongoing and future research activities at NIRRH, Mumbai.
- The National Center for Primate Breeding and Research (NCPBR) is being established to provide non human primates (Rhesus monkeys) for biomedical research.
- During the XIth five year plan, several core facility such as 1). Biomedical Informatics Center 2). Proteomics Facility 3). Confocal Facility Flow cytometry Facility have been established at NIRRH, Mumbai to support the research. During the XIIth five year plan some of these core facilities particularly proteomic and flow cytometry needs to be upgraded with new technology.

National Institute for Research in Tuberculosis (NIRT), Chennai

Basic Research

- Developed Luciferase reporter phage assay using recombinant mycobacteriophages, genetically engineered for both rapid diagnosis and drug susceptibility and tested in > 500 sputum samples.
- Investigated the role of cytotoxic cells Interferon γ release assay, regulatory role of HLA-DR, mannose binding lectin, vitamin D receptor and Cytokine gene variants in susceptibility to TB.
- A study to assess the Influence of HLA-DRB1 alleles on immune functions in PTB suggested that HLA-DRB1 alleles regulate the perforin positive cells, macrophage phagocytosis and Th1 and Th2 cytokine response to *M. tuberculosis* antigens.
- Cytokine +1188 polymorphism of IL-12B gene may regulate IL-12p40 production and or may play a major role on acquired immunity to TB.
- Frequency analysis of CD 209 promoter region revealed that 336 G/G genotype, VDR gene 3'UTR haplotype b-A-t was associated with susceptibility to TB in HIV-1 infected patients. However, VDR gene 3'UTR haplotype b-A-T was associated with protection against HIV-1.
- *Tuberculous pleuritis* (TP) showed a shift in immune response towards TH0/TH2 type. Chemokines in TP showed differential up-regulation and transmigration of these cells to the site of infection.
- Genotyping of CYP2B6 G516T in an ethnic south Indian HIV+ve cohort showed T allele polymorphism as 0.44, the highest reported world-wide. The ABCB1 C3435T polymorphism which may be associated with lower efavirenz levels, did not influence immune recovery after initiation of ART.
- Study to understand the interaction of the host with HIV-1 during active TB showed significantly decreased fraction of CD4+ T cells expressing CCR5 and CXCR4 in individuals infected with HIV.
- ATT preventive therapy can be safely administered in HIV and hepatitis co-infected patients.
- HLA-A*1101 and HLA-DPB1*1501 were associated with resistance to TB and HLA-B*4006 & HLA-DRB1*1502 were associated with susceptibility to TB HIV infected patients. Further, studies revealed that HLA-DQB1*050301 was found to be associated with susceptibility to HIV.
- Clinical isolates of *M. tuberculosis* inhibited the early activation of neutrophils leading to inhibition of killing mechanisms of neutrophils and differential maturation of dendritic cells for their own survival.
- Putative IclR type of regulatory protein Rv2989 of *M. tuberculosis* unlikely to be involved in the multi-drug resistance of *M. tuberculosis*.
- Deletion Microarray and deletion PCR used for Comparative Genomics of *M. tuberculosis* in India, for the first time.

- Vitamin D3 modulated TNF- α and IFN- γ positive T-cell subsets in PTB.

Clinical Research

- Investigated the potential of newer quinolones, *i.e.* gatifloxacin and moxifloxacin as agents that could shorten the duration of chemotherapy. Gatifloxacin therapy, found unsuitable due to unacceptably high relapse rates.
- Evaluated the efficacy of short-course chemotherapy for TB in HIV-infected patients - a 9-month intermittent regimen compared to a 6-month thrice-weekly regimen showed similar therapeutic outcome but significantly lower bacteriological recurrence rate observed in 9-month intermittent regimen.
- Using retrospective cohort survey, the prevalence of general mortality rates found to be similar in Andhra Pradesh (AP) and Orissa. However, TB mortality rate was higher in AP than in Orissa.
- Safety/ efficacy trial of nevirapine vs efavirenz along with ATT in patients with HIV-1 and TB, showed that once-daily nevirapine was inferior to the efavirenz-containing regimen, with higher virological failure and death rates.
- A study to determine the blood levels of nevirapine and efavirenz in HIV-infected children in India, showed that a combination of factors, such as, young age, stunting and CYP2B6 GG or GT genotype could potentially result in sub-therapeutic nevirapine concentrations. The study suggested that ART dosing recommendations for children should be reviewed in the light of these findings.
- A study to correlate plasma levels of immune activation markers (neopterin, beta-2 microglobulin, TNF α receptor) with the presence of TB in ART-naïve HIV-infected and uninfected individuals, showed that although ATT was effective in clearing *M. tuberculosis* infection, incomplete immunological recovery following six months of ATT in HIV patients was observed indicating that underlying immune activation persists despite TB treatment.

Epidemiological/ Operational Research

- Completed surveys demonstrated that DOTS implementation resulted in more rapid reduction in prevalence of TB compared to that in the pre-DOTS period.

Translational Research

- Identified sensitivity and specificity of combination testing algorithms developed to reduce time of testing of HIV & TB, ideal for use in settings like TB clinics or Primary Health Centres in resource-poor countries.

Human Resource Development

- Ph. D Completed: 8, Short term (3-6 months) training under Fogarty, AITRP: 10; Masters in Translational Research - 1.

National Institute of Virology (NIV), Pune**Basic Research**

- Demonstrated emergence of African genotype of chikungunya virus; association with increased epidemic potential and disease severity; association of co-morbidities with systemic complications and associated mortality.
- Developed a murine model for CHIK infection.
- Demonstrated venereal transmission of chikungunya virus in *Aedes aegypti* mosquitoes.
- Generation of infectious cDNA clone for hepatitis E virus and characterization of helicase and protease enzymes.
- Identification of a new "I" genotype of HBV among tribal population of Arunachal Pradesh. This recombinant virus found prevalent in these tribes since 1963.
- Pig livers sold in Indian markets shown to be positive for HEV RNA.
- Association of various host factors with the pathogenesis of hepatitis E established.
- Highly potent, recombinant G protein and whole virus-based killed vaccines developed. A combination vaccine containing DPT and recombinant G protein was equally immunogenic with respect to all the 4 components of the vaccine.
- Efficacy of siRNA in the treatment of Chandipura encephalitis shown in a murine model.
- Determined the genotypes of dengue viruses circulating in India.
- Switch in Dengue-2 genotype associated with increase in severity of outbreaks.
- Components of Cytoskeleton and inter-cellular trafficking of dengue viral proteins identified for development of intervention strategies.
- Dengue viruses shown to have direct binding affinity and activation potential for human blood platelets.
- Identification of human- animal reassortant and unusual rotavirus strains.
- Use of IgY antibodies against rotavirus infection established.
- Contribution of Noro, Adeno, Astro, Aichi and enteroviruses in causing diarrhoea determined.
- Coxsackie A-24V identified as the major agent causing outbreaks of Acute Hemorrhagic Conjunctivitis.
- Detection, diagnosis and molecular characterization of the highly virulent H5N1 viruses during 2007, 2008 and 2009 outbreaks in India.
- Identification, isolation and characterization of a unique H11N1 virus from a Eurasian Spoonbill from the Indian subcontinent.

- Recombinant HA protein alone or in combination with NP and Me2 proteins shown to be excellent vaccine candidates for H5N1 when used with different adjuvants.
- Evolutionary dynamics of Chikungunya, Hepatitis A and Dengue (type 2) viruses investigated to determine the evolutionary rates and ancestral time scales and extent of selection pressure existing in the different genes.
- Phylogenetic, diversifying selection analysis and molecular characterization of Avian Influenza H5N1 viruses between 2006-09; whole genome based characterization of the 2009 pandemic H1N1 Influenza viruses.
- Molecular modelling of the VP6 capsid protein of an avian Rota virus strain done.
- Carried out in-silico sequence and structure-based analysis of the proteins of the Chandipura virus in relation to pathogenesis.
- Molecular epidemiology of different viruses of public health importance leading to the identification of new genotypes/subtypes.
- Recombinant Avian influenza (H5N1) virus developed using reverse genetics technology in collaboration with the CDC and identified as prospective vaccine candidate by WHO.
- A candidate vaccine employing NS3 protein and peptide pool of hypervariable region 1 containing neutralization epitope of hepatitis C virus gave excellent results in mice.
- Real time RT-PCR useful for early diagnosis developed for detection of dengue viral RNA.
- Development of rapid real time assays for neuraminidase drug susceptibility.
- Recombinant HA-protein ELISA, comparable to conventional Haemagglutination Inhibition developed for the pandemic H1N1(09) influenza virus.
- A mouse model developed for pandemic and seasonal H1N1 influenza viruses.
- Highly efficacious recombinant HA protein-based vaccine candidates employing different adjuvants developed.
- Development of Real-time PCR for the detection and quantitation of CHIK-RNA and ELISA for the detection of IgG-anti-CHIK antibodies.
- Development of a recombinant hepatitis E vaccine and combination vaccine with hepatitis B as evidenced by challenge experiments in rhesus monkeys.
- Development of NE protein-based ELISA for HEV diagnosis.
- Real time PCR developed for the detection and quantitation of CHPV RNA.

Clinical Research

- Studies on the efficacy of attenuated vaccine against JE administered in the state of UP.
- Established salient epidemiological features and identified prognostic symptoms / markers for progression of Dengue infection to severe manifestations.

- An extensive study of a variety of host factors led to the identification of markers of severity of pandemic influenza leading to death in patients with or without co-morbidities.
- Measles Aerosol Vaccine Clinical Trial – Phase I successfully completed.

Epidemiological/ Operational Research

- Evaluation of domestic water purification units sold in Indian market showed that majority could not eliminate viruses necessitating an urgent need for the development of national standards for these units.
- Recurring epidemics of the virus was recorded in the states of Maharashtra and Gujarat, suggesting continued activity.
- Pandemic H1N1 2009 outbreak investigations in Panchgani and seroepidemiological surveys in Pune revealed wide transmission in community, especially in school-aged children, most infections being mild or asymptomatic.
- Associated Pre-core and Basal-Core Promoter mutants with high mortality during an unusual epidemic of hepatitis B virus in Modasa, Gujarat.
- Prevalence of HAV among high socio-economic group was reduced further matching to developed nations. Exposure of Middle socio-economic group also showed downward trend. Highlighted the need for the formulation of a national policy for vaccine preventable diseases.
- Carried out outbreak investigations of seasonal, H5N1 influenza and RSV.
- Molecular epidemiology of measles virus determined in various parts of the country.
- An intrafamilial outbreak with 100% mortality in 2007 in the Nadia district of West Bengal attributed to Nipah virus. Full genome sequence showed that Indian virus, though closely related to Bangladesh, had unique amino acids.

Translational Research

- JE kit was found to be as good as or better than the commercial kits available by the CDC, USA. 504 (JE) and 3573 (Dengue) kits supplied for the national program.
- Surveillance for Rotavirus disease and strains in children <5yrs contributed to provide the platform for introduction and evaluation of rota virus vaccines; Rise in Group B rotavirus infections shown.
- Outbreaks of Hand, Foot and Mouth Disease from different states of southern and eastern India associated with multiple enterovirus serotype.
- Establishment of virological surveillance in India contributing to 495 influenza strains to WHO for vaccine strain selection. Generated data on genetic and drug susceptibility profiles.
- Designated NIV as WHO H5N1 reference laboratory, WHO-SEARO Reference Measles Laboratory and the Bangalore unit as WHO laboratory for Polio and Measles for Karnataka and Kerala.

- Timely preparation of reagents for the diagnosis of Chikungunya infection leading to identification of entry of Chikungunya in India after a gap of 32 years. This was followed by country-wide supply of 1651 diagnostic kits to national program.
- Association of Chandipura virus with encephalitis outbreaks of encephalitis in children with high mortality, understanding the magnitude of the problem, development of diagnostics and recombinant protein/killed vaccine.
- Conducted numerous serological surveys to create background information on prevalence of viral diseases in India and risk factor analysis, leading to formulation of national policies for some diseases.
- Development of indigenous ELISAs for the detection of JEV, Dengue, West Nile, Hepatitis A, B, E, Rota and Measles virus infections.
- Monoclonal antibodies developed against JEV, Dengue, West Nile, Chikungunya, Influenza and respiratory syncytial viruses.
- Development of molecular diagnostics including real time PCR for several viruses of public health importance in India.
- Recombinant Hepatitis E vaccine developed with successful preclinical trial in monkeys.
- Highly efficacious recombinant proteins-based vaccines developed for pandemic H1N1 and H5N1 influenza.

Human Resource Development

- The NIV emerged as a global laboratory during the recent public health crisis such as SARS, H5N1 and pandemic H1N1 providing diagnosis, reagents, training and contributed towards pandemic mitigation.

Infrastructure

- Field Stations of National Institute of Virology, Pune at Allappuzzha, Kerala and Gorakhpur, UP

National Jalma Institute for Leprosy & Other Mycobacterial Diseases (NJIL & OMD), Agra

Basic Research

- Established a method of measurement of gene expression in paraffin embedded sections using *in situ* RT – PCR.
- Developed potential serological markers using CFP 10 alone or in combination with ESAT -6 protein and applied in monitoring therapeutic efficacy in leprosy.
- Identified the role of endoneural blood vascular endothelial cell in the peripheral nerve involvement in leprosy.
- RAPD, IS6110 and spoligotyping based DNA finger printing of mycobacteria adopted using random primer gene amplification to define molecular epidemiology.

- Explored cellular phenotype and chemokine markers of DTH in leprosy patients.
- Membrane associated calcium signaling channels are the major targets of *M. leprae* antigens for T cell activation.
- Toll like receptor polymorphism studies in mycobacterial diseases showed that one fourth of the patients were heterozygous while about 2% were homozygous.
- Identified molecular mimicry between *M. leprae* and host cytoskeletal proteins.
- Screening of drug resistant *M. leprae* using mouse foot pad and molecular methods in relapse cases of leprosy showed that no resistance was observed to any drug. However, some mutations were noted in folP locus for dapsone resistance.
- Study of biochemical markers in leprosy reactions showed serum beta glucuronidase and cholesterol levels to be useful markers for monitoring ENL reactions.
- Immunotherapy with Mw in combination with standard chemotherapy enhanced bacterial clearance and reduction of granuloma in borderline leprosy.
- Neurophysiological studies on peripheral nerves identified markers of early nerve damage in leprosy patients.
- MDR strains of *M. tuberculosis* have been observed to retain the capacity to infect through aerosol route as efficiently as sensitive strains.
- MALDI-TOF analysis established the relationship of certain proteins with Streptomycin resistance.
- Mycobacterial cell wall does not act as a significant barrier for the accumulation of some of the fluoroquinolones of *M. tuberculosis* isolates.
- Developed new rapid molecular method for detection of Rifampicin, Isoniazid and Ethambutol resistance in TB with the help of indigenously developed DNA chips.
- Developed procedures for application of direct *in situ* hybridization and PCR on tissue specimens for early diagnosis of leprosy and TB.
- Participated in a study to evaluate the protective efficacy and immune response to Mw/ BCG/other vaccines in animal models of tuberculosis. Protective efficacy of different candidates established.

Clinical Research

- Developed the concept and proof of common Multidrug Therapy Regimen which has been adopted by WHO as uniform MDT.
- Studies on female patients indicated recrudescence of the leprosy and that leprosy reactions correlate with the onset of puberty, menopause, pregnancy and lactation.
- Developed a new surgical procedure for restoration of volume of first web space in muscle atrophy associated with ulnar palsy in leprosy.
- Established posterior tibial neurovascular decompression procedure for plantar ulcer and closure of heel ulcers by skin stretching.
- Showed that single lesion patients and pauci-bacillary patients with 3 lesions have higher relapse rate when compared to standard MDT in ROM//CROM trials.

Multi-bacillary cases have a higher risk of relapse compared to those who are treated with MDT till smear negativity.

- Co-existence of filariasis and leprosy established in field areas.
- Monthly administration of Ofloxacin and Minocycline shown to be effective in the treatment of multi-bacillary leprosy.
- Higher doses of pulsed administration of corticosteroids found to be better to those treated with lower doses in terms of recovery and recurrences from reactions.
- Found no drug resistance in leprosy surveillance in 6 centers across the country. However, 2 cases observed to have mutation in the folP locus indicating moderate degree of Dapsone resistance.

Epidemiological/ Operational Research

- Established eradication of leprosy & continued epidemiological studies in leprosy at MRHRU, Ghatampur. Detected *M. leprae* using real time PCR of RNA and DNA from soil specimens and drainage water and suggested the need for continuous monitoring to understand the transmission dynamics.
- Observed prevalence of pulmonary TB collectively in UP districts to be 35.8 per 10,000 population and 3 % MDR cases were observed in Kanpur urban areas, and about 2 % in Agra estimated in new smear positive cases (Cat I) of pulmonary TB.
- Using high resolution markers in evaluating the tuberculosis control programme, it was noted that the predominant strain of *M. tuberculosis* prevalent is ST26/CAS1_Del family and not the Beijing strain.

Translational Research

- Designed a novel DNA chip for leprosy genome for studying the structural diversity and functional genomics, several genes exposing in humans identified.
- Using known and new targets such as RLEP, probes for reliable & rapid detection of *M. leprae* developed.
- Identified novel targets/genes involved in the persistence of *M. leprae* in human host using indigenously developed DNA chips.
- Participated in trials using Mw immunotherapy along with DOTS in pulmonary TB to improve the therapeutic efficacy of DOTS, results awaited.
- Evaluated a tool box for diagnosis of tuberculosis based on ELISA using PGL-TB, ESAT6 and CFP10 antigens in a multi-centric study and found not suitable because of the presence of high levels of antibody levels in healthy contacts of TB.
- APCR-RFLP technique targeting 16S-23S rRNA gene region developed for identification of pathogenic mycobacteria patented and transferred to several labs.

Human Resource Development

- Training of program managers, medical officers on drug resistance surveillance and EQA activities of the RNTCP programme of Government of India in 35 districts of western UP and Bundelkhand region.

- Training of paramedical workers and laboratory technicians in RNTCP methodologies, EQA and DRS activities of the above districts and of intermediate Reference Laboratories of Assam, Himachal Pradesh, Uttarakhand and Uttar Pradesh.
- Training and re-orientation of program managers, private practitioners and medical officers in post elimination leprosy situation, early diagnosis and drug resistance surveillance in leprosy.
- PhD guidance and dissertations -25 in the plan period.
- MD thesis dissertations -25 in the plan period.
- MSc project training –Approx. 400 in the plan period.
- Summer training for MSc students Approx. 500 in the period.
- ASHA and other health workers about 200 in the plan period.

Infrastructure

- AIDS Surveillance centre: Sero-surveillance of HIV in different population groups. The centre continues to provide latest information about the trends of HIV seropositivity in different risk groups.
- Mycobacterial Repository Centre including establishment of a new BSL-3 laboratory during 11th plan.
- BSL-3 for Animal Experiments. This laboratory has already been established during 11th plan and serving two major national projects.
- Microarray Laboratory. This laboratory has already produced DNA chips for *M.leprae* & *M.tb*.
- Proteomic Lab: It is actively involved in rural projects.
- Model Rural Health Research Unit. Besides completing 8 extramural studies funded by various agencies, 12 extramural projects are ongoing in addition to providing treatment to more than 5000 leprosy and 1500 TB patients of the area. It has served as a model for bringing technology to the people and in partnership with the state health facilities

Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata

Basic Research

- Established that Indian HBV isolates have very low prevalence of HBx mutations; absence of C-terminal deletions in HBx; and absence of p53 codon 249 mutations, found in the regions that are highly endemic for hepatocellular carcinoma.
- Detected that few HBsAg-ve/ anti-HBc+ve blood donors have occult HBV infection, with possibility of transmission of hepatitis B in recipients of blood components derived from them.
- Identified genotype C (Southeast Asian sub genotype Cs) in one fifth of the Eastern Indian patients in addition to genotype D and A.
- Molecular studies indicated introduction of HBV/Cs through overland drug Trafficking routes via Manipur.

- Studies showed that male with age above 25 years, high HBV DNA levels, presence of T1762/A1764, C1753 and A1899 mutations are critical factors for clinical advancement while age above 25 years and C1753 are significant predictor for cirrhosis in comparison with chronic liver disease.
- Identified respiratory syncytial virus group B genotype BA-IV strains among children with acute respiratory tract infection.
- Standardized the virus culture protocols and isolated four HSV isolates from cases of genital herpes.
- Evaluated rapid immuno chromatographic assay for the detection of TB antigens in pulmonary samples from HIV+ve & compared with conventional methods.
- Established considerable antibacterial activity of an ethnomedicinal plant (*S. robusta*) against *S. typhi*, *V. cholerae* and *Shigella species*.
- Selection and compartmentalization of viral variants with immune escape G145R mutation in peripheral blood leukocytes of Hepatitis B Virus carriers was shown for the first time.

Clinical Research

- Showed that significant differences in risk factors and disease manifestation do exist among patients infected with different HBV genotypes in eastern India.
- Showed that Genotype A and C are frequent among chronic liver disease patients, while genotype D among inactive HBeAg-negative carriers.
- Differential pattern of mutations, liver injury and occult HBV infection was prevalent among sub-genotypes of Hepatitis B Virus Genotype D (D1,D2,D3 and D5).

Epidemiological/ Operational Research

- Identified endemic zone of Arboviruses in West Bengal through Institutional surveillance programme, especially for Japanese Encephalitis, Dengue and Chikungunya.
- Surveillance for dengue fever revealed DEN-1 was the most prevailing strain followed by DEN 4, DEN 2 and DEN3.
- The prevalence of HBV/C was found to be higher in urban population than in rural population (20% vs 6.7%).
- Identified spectrum of opportunistic infections like multiple herpes virus infection in HIV +ve patients.
- Showed a very high rate of exposure to HBV infection and occult HBV infection among the blood donors of Behrampur, Ganjam of Orissa. Ganjam district with very high rate of migration in search of livelihood had the highest HIV prevalence.
- Outbreak investigation confirmed Dengue activity and re-emergence of Chikungunya virus in west Bengal after several years.

Translational Research

- Patented two herbal formulations: polyherbal Mouthwash and herbal vaginal contraceptive.

Others

- Establishment of networking with the state medical colleges and the District Health Authorities for diagnosis of Japanese Encephalitis, Dengue and Chikungunya.

Human Resource Development

- Ph.D. programme, Summer training programme for M.Sc./ M.Tech Microbiology and Biotechnology students of different universities of all over India, Training of graduate and postgraduate medical students of medical colleges and from All India Institute of Hygiene and Public Health in viral diseases.

Infrastructure

- **Apex Referral Centre for Japanese Encephalitis, Dengue and Chikungunya viruses in the Eastern India:** The ICMR Virus Unit has been selected as the “Apex Referral Centre” for Japanese Encephalitis, Dengue and Chikungunya viruses in the Eastern India by the National Vector Borne Disease Control Programme (NVBDCP), Govt. of India.

Regional Medical Research Centre (RMRC), Belgaum**Basic Research**

- Generated data about chemoprofiling, antimicrobial and antioxidant activities of the essential oils of the medicinal and aromatic plants of Western Ghats.
- Preliminary screening of phytoconstituents and screening of biological activities.

Epidemiological/ Operational Research

- Generated information on delivery, access and utilization of HIV services in Belgaum and Goa.
- Prepared Directory of Traditional healers in Belgaum region.
- Investigation of outbreak of enteric diseases in Belgaum.

Translational Research

- Preparation of directories and publication of IEC Materials -Booklets “*HIV service providers in Belgaum*”, “*Common Medicinal plants for Home remedie*”, “*Spices, Herbs and Trees for treatment of Common Ailments*”, Brochures on Herbal garden for Medicinal Plants of Western Ghats Region, RET/Endemic Medicinal Plants, Herbarium: Techniques and Importance and Museum of Ethnomedicinal Plants of Western Ghats.

Others

- Provided services to other research institutes and NGOs on identification and authentication of medicinal plants/drugs as well as information on collection, cultivation and utility of medicinal plants.

Regional Medical Research Centre (RMRC), Bhubaneswar

Basic Research

- Developed a multiplex PCR for detection of *An. annularis* species complex and their vectorial attributes.
- Studies on immune markers of morbidity in Hydrocele and elephantiasis indicated association of endothelin1 gene polymorphism with lymphoedema and TNF receptor-II with hydrocele.
- Cord blood of new born delivered from CFA +ve mothers had significantly high levels of inflammatory cytokines IFN and decreased levels of IL-10; T-regulatory cells could down regulate inflammatory responses and facilitate parasite survival.
- ABCA1 gene in cerebral malaria found to produce high levels of micro particles (MPs) from platelet and RBCs those are of pro-coagulative and pro-inflammatory in nature. The -477C/T and -320 G/C polymorphism of ABCA1 promoter region found to be associated with uncomplicated malaria and low production of MPs.
- Molecular studies showed *An. annularis* and *An. culicifacies* to be resistant to DDT but susceptible to synthetic pyrethroids, while *An. fluviatilis* was found susceptible to DDT.
- Studies on prevalence of 76Tcrt / 86Ymdr1 *Plasmodium falciparum* isolates showed chloroquine resistance evolved de novo in 70% of *P.falciparum* infections, indicating chloroquine treatment failure.
- Characterized pathogenic *E. coli* and Shigella species in Orissa. Commonest species reported was *E. coli*, followed by Shigella and *V. cholerae*. Molecular analysis exhibited EPEC -6%, ETEC-7.8% and EAggEC-3.7%.

Clinical Research

- For the first time, reported that Lymphoscintigraphy and ultrasonography for adult parasite conducted in young children with *W. bancrofti* infection established presence of lymphatic pathology that reverses with annual dosage of MDA.
- Developed vector transmission indicators for impact assessment of MDA against filariasis. Rate of reduction of microfilaraemia with MDA -100mg, 200 mg & 300 mg dosages found to be comparable with reduction in transmission, therefore low dose can be used in program.
- Newer anti filarial drug like moxadectum and its adulticidal effect showed more side reactions and hence not found suitable.
- Clinical trial with anti filarial drug indicated higher efficacy of double dose of albendazole (800mg) with DEC (300mg) administered biannually than existing regimen of (400 Albendazole + 300 mg DEC annual) in adult worm clearance.
- Treatment with tetracycline (0.2 mg/lit) right from egg to pupae cleared Wolbachia infection in *Aedes aegypti* and found suitable to control human and animal filariasis.
- Artemisinin Combination Therapy (ACT) found to be most effective against *P.falciparum*.

- Study on pregnant mothers from Nayagarh district of Orissa followed prospectively shown poor compliance (34%) to chloroquine chemoprophylaxis. The study also revealed that 33% of *P. falciparum* infected mothers were resistant to chloroquine.
- *Cx. quinquefasciatus*, *An. stephensi* and *Ae. aegypti* colony maintained in the insectariums and used for mosquitocidal property and measurement of potency of insecticides and larvicidal oils.
- 5-arm regimen trial with iron, folic acid, vitamin B12, de-worming and nutrition education shown greater efficacy in improving the degree of anemia in adolescents.
- Higher rates of HCV infection (8-14%) in two primitive tribes compared to national average of 1 to 2% identified, primarily due to practices of sharing of blade, multiple injection and tattoo. Further, Genotype D of Hepatitis B virus reported for first time as the circulating strain of HBV in these primitive tribes.

Epidemiological/ Operational Research

- Followed cohort of children below 5 years for Bancroftian filariasis up to 18 years revealed that most of the children (48%) in endemic areas are infected. While Mf prevalence rises with advancement of age, the CFA level does not, emphasizing the need for mass drug administration (MDA) in children to curtail transmission.
- Mapping of anti-malarial drug sensitivity in 14 endemic districts of Orissa, revealed 54% to 100% of CQ resistance in *P. falciparum* infection.
- Four different mutations of β thalassaemia genes among different populations of Orissa were detected, not reported earlier.

Human Resource Development

- Training, Malaria Technical Supervisors Training-250 participants, Summer Training (Biotech)-80, Training BMC & CMC for Vector control-230, Professional Dev. Course for Doctors-250, M. Phil/M.Sc. Project work-120, Ph.D registered-35, Ph.D Awarded-7, Library Apprentice trainee-4.

Regional Medical Research Centre (RMRC), Dibrugarh

Basic Research

- Established genetic polymorphism in relation to hypertension in North East, studied correlation of salt sensitivity and hypertension.
- Developed a ELISA kit for identification of Paragonimiasis after characterization of Paragonimus species in NE India.
- Developed a rodent model for Paragonimiasis for drug testing and other work.
- Demonstrated a fish borne trematode infection in NE.
- Established culture sensitivity and molecular diagnostic facility for MTB and orphan spoligotypes detected in NE.
- A new genotype of hepatitis B virus described.

- Mapping of the sibling species of *Anopheles dirus* complex, the major malaria vector in north-east India.
- Discovered, described and named three new mosquito species viz. *Uranotaenia dibrugarhensis*, *Verrallina assamensis* & *Armigeres mahantai*.

Clinical Research

- Postulated familial aggregation of oesophageal cancer in Assam and its relation with environmental and genetic polymorphism.
- Population based cancer registry in different states of NE established and estimated the disease burden, morbidity due to musculoskeletal disorder in Dibrugarh (since 2003) in NE states.
- Studied artesunate and SP drug combination in Myanmar bordering areas of Arunachal Pradesh, Effect of malaria on pregnancy.
- Documented risk factors of stomach cancer in Mizoram.

Epidemiological / Operational Research

- Established Registry for diabetes to estimate the disease burden in young.
- Detected focus of visceral leishmaniasis in Assam.
- Demonstrated dengue, chikungunya virus activity in north-east India.
- HIV: Integrated bio-behavioural assessment of IDUs and FSWs in Manipur and Nagaland using RDS technique, a new sampling method suitable for hidden population such as IDUs Influenza including swine flu diagnostic facility established

Translational Research

- Haemoglobinopathy: module for community control of thalassaemia tested and feasibility documented for Assam.
- Developed an early warning system for Japanese encephalitis in Dibrugarh district.
- Indian patents applied for antimalarial property in an indigenous plant extract, and for mosquito larvicidal property in an indigenous plant extract.

Human Resource Development

- M.Sc. (Biotechnology) and M.Sc. (Bioinformatics) courses in collaboration with Dibrugarh University.
- Trainings of Malaria Technical Supervisors, Malaria Laboratory Technicians and other paramedicos of state health services.

Infrastructure

- Establishment of new laboratory at IDSP building, Rayagada district by RMRC Dibrugarh.

- Setting up of a nodal molecular virology laboratory dedicated to HIV, Hepatitis and influenza viruses at RMRC, Dibrugarh initiated and Molecular biology infrastructure upgraded by adding sophisticated equipments like sequencer, MALDI TOF-TOF *etc.*

Regional Medical Research Centre for Tribals (RMRCT), Jabalpur

Clinical Research

- Prepared a field site for testing of intervention & strategies for prevention.
- Tested 1606 samples for H1N1 and found 414 positive for H1N1 P virus.

Epidemiological/ Operational Research

- Studies on malaria in pregnancy revealed that there was a substantial burden of anaemia among pregnant women with malaria. Further, low birth weight was commonly encountered in babies borne by malarious pregnant women.
- Studies showed prevalence of TB in tribal population and the highest prevalence reported in Saharia primitive tribe.
- Socio-behavioural studies and IEC on Tribal men revealed that tribal men were least concerned about the reproductive health of their partners.

Translational Research

- Bivalent malaria kits tested by RMRCT for two most prevalent forms of malaria and approved by the Centre successfully inducted into the national program for rapid diagnosis at field level.
- An intervention model was tested through the combination of “*Safe drinking water and Nutrition supplementation*”, mainly with calcium, vitamin C, iron and vitamin D₃. Five year follow up revealed complete reversal of bone deformities caused due to fluorosis both in mild and moderate cases and only partial reversal in severe cases. The model inducted into the “National Programme for Fluorosis Prevention and Control”.
- Majority of tribal areas of Madhya Pradesh mapped for sickle cell anaemia wherein preliminary studies in Panika tribes indicates presence of very high incidence of haemoglobinopathies (28.6%) among them. In general sickle cell disease patients show presence of high levels of fetal hemoglobin (10-15%). Based on these recommendations, state government is establishing facilities for screening of haemoglobinopathies for prevention.

Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Developed & evaluated Latex Agglutination test and an ELISA test system for the diagnosis of leptospirosis, using broadly reactive antigens with sensitivity of 95% and specificity of 85%.
- Recombinant proteins Lip132, protein Omp11 and Lip141. The test systems showed sensitivity and specificity of 89.3% and 89% respectively.

- Developed and evaluated multi locus sequence typing (MLST) of Leptospire using six genes viz., secY, LipL41, adk, icdA, rrs2. Currently, this technique is being utilized on the isolates recovered from Gujarat and Andaman & Nicobar Islands to study the molecular epidemiology and geographic genomics.
- Detected higher frequencies of HLA class I diversity viz., KIR2DL2 ligands among Jarawa indicating that this tribe is probably more susceptible to infectious diseases and cancer.
- Showed the role of macrophages and cytokines IL6, IL1RA, MIP1 and MCP1 in the pathogenesis of chronic arthritis following chikungunya virus infection.
- Identified two leptospiral proteins viz., DNAj and LipL45 as highly immunogenic and responsible for long lasting immunological memory. Developed codon optimized DNA constructs using these two proteins to be used as in the development of DNA vaccine against Leptospiral infection.
- Developed codon optimized DNA constructs that elicited protective antibody response in animal models as candidates for DNA vaccine against chikungunya.

Clinical Research

- Identified acute flaccid paralysis (AFP) as a complication of chikungunya infection.
- Revealed that chronic arthropathy in chikungunya is inflammatory erosive in nature similar to rheumatoid arthritis but different from rheumatoid arthritis as rheumatoid factor and anti-CCP found to be negative among the patients with chronic sequelae.
- Detected the first ever upsurge of dengue, dengue haemorrhagic fever and dengue shock syndrome. Identified circulation of DEN1 and DEN2 serotypes.
- Completed whole genome sequencing of leptospiral isolates, identified many new genes potentially responsible for severe clinical outcomes such as acute respiratory distress syndrome (ARDS), pulmonary haemorrhagic pneumonitis and Weil's syndrome.
- Detected emergence of fluoroquinolone & cephalosporins resistance among enteric pathogens, found multiple mutations in quinolone resistance determining region (QRDR) genes and plasmid mediated quinolone resistance (PMQR) as possible mechanism of antibiotic resistance in Shigella.

Epidemiological/Operational Research

- Participated in National Virology Laboratory Network, Rotaviral Diarrhoea Surveillance Network, Leptospirosis Laboratory Network and National Vector Borne Diseases Control Programme (NVBDCP).
- Participated in Integrated Disease Surveillance Programme (IDSP).
- Identified and intervened on very high prevalence of hypertension, low HDL cholesterol levels, child hood obesity/overweight among Nicobarese who were found to have high risk for chronic NCDs.
- Identified and intervened for high prevalence of alcohol consumption and hazardous drinking.

- Identified and participated in the containment of outbreak of Hand Foot & Mouth Disease (HFMD) caused by -Cocksackie virus A16 among school children of Andaman Islands.
- Investigated and participated in the containment of several outbreaks of leptospirosis in Andaman and other parts of the country including Kerala, Maharashtra and Gujarat.
- Detected hepatitis B infection among those who were vaccinated and had protective antibodies indicating the possibility of vaccine escape mutants.
- Established the state of art diagnostic facilities for the diagnosis of novel H1N1 influenza.
- Investigated outbreaks in Port Blair, Car Nicobar and Chowra. Timely diagnosis provided to the health authorities helped in containment of the outbreak.

Translational Research

- Successfully demonstrated control of *Aedes* spp. using temephos and environmental management in a peri-urban area through involvement of community volunteers in association with an NGO in these islands.
- Delineated vector dynamics of diurnally subperiodic *W. bancrofti* filariasis in Nancowry group of islands and formulated strategy for elimination through the use of DEC fortified salt.
- Community biodiversity registers documenting traditional health care practices for Car Nicobar developed.
- Generated traditional knowledge on usage of 160 medicinal plants used by Indigenous tribes and collected 16 medicinal plants, 2 sponges, two seaweeds and one sea grass for antimicrobial potentials.
- Developed IgM ELISA and Latex Agglutination Test for the rapid diagnosis of leptospirosis.

Infrastructure and Human Resource Development

- PhD programme-currently there are 13 scholars pursuing PhD programmes from different parts of the country.
- Several scientists/technologists from different parts of the country and abroad (SEAR) and Sweden have undergone Training in laboratory methods in leptospirosis.
- Conducted several hands-on National training workshops on laboratory methods in leptospirosis that helped in developing a pool of scientific and technical manpower for diagnosis, surveillance and research on leptospirosis.
- Established state of art diagnostic virology (Grade I) laboratory. Diagnostic facilities are being extended to the whole territory of A & N islands with particular reference to Dengue, Chikungunya, HFMD, viral conjunctivitis, acute respiratory haemorrhagic syndromes, rota viral diarrhoea and hepatitis.
- The centre is accredited as an Intermediate Reference Laboratory (IRL) for performing drug sensitivity testing for the patients suspected with MDRTB. Laboratory support is being extended to the ongoing RNTCP in these islands.

- Following facilities were established at RMRC Port Blair:
 - Establishment of Grade I virology laboratory with BSL 3 facilities
 - Establishment of facilities for novel H1N1 Influenza A diagnosis
 - Field station at Car Nicobar
 - Field station at Nancowry
- Leptospira repository at RMRC Port Blair, which is one of the largest collections of leptospiral strains in the world. It needs to be maintained as it is the source of strains for the country and region.

International Roles

- WHO identified RMRC as a nodal laboratory for networking leptospira laboratories in SEAR. As a part of this network, the centre facilitated to establish reference laboratories in Sri Lanka and Indonesia.

Rajendra Memorial Research Institute of Medical Sciences (RMRIMS), Patna

Basic Research

- PCR-based diagnostic tool for leishmaniasis using peripheral blood samples established. PCR-based diagnosis found to have higher sensitivity (about 92%), while it was less sensitive (about 44%) with microscopy examination of skin-slit smear/ biopsy.
- Showed that TGF- β has a role in apoptosis of T- cell population in VL.
- Observed reduction in absolute circulating CD4⁺ and CD8⁺, with up regulation of IL-10 and down regulation of IFN- γ during active PKDL.
- Expression level of Natural T-reg cells found to be significantly high and co related with persistence of *Leishmania donovani*.
- In acute VL both LDL and HDL down regulated, whereas VLDL, TG and Apo A1 were up regulated.
- Observed that CD2 boost up of protective Th1 response is also beneficial in enabling SAG to induce leishmanicidal molecules in macrophages to control the VL infection.
- Developed a freeze dried plant extract, justifying its potentiality to replace FBS/blood in culture media even at very low inoculum size (1x10² parasites/ml).
- Cloned 3 recombinant fusion proteins of Fe-S clusters assembly and six proteins involved in thiol metabolism of *L. donovani* parasites and purified. One of the proteins in thiol metabolism pathway was over expressed in drug resistant cases which can be assessed for its potentiality to develop immuno-diagnostic for VL patients in future.
- Developed a novel non-invasive method for diagnosis of VL with rK-39 strip test using sputum sample.
- Nested PCR of skin biopsies of hypopigmented macular cases of PKDL revealed significantly increased positivity (92.5%) as compared to the conventional method of microscopy (44.4%).

Clinical Research

- Evaluated the dose-defining study of Miltefosine as first line drug in the LD elimination program.
- Phase II clinical trial of oral Sitamaquine in VL patients in hospitalization set up revealed that Sitamaquine is a safe and efficacious anti Kala-azar drug.
- Clinical trial to assess the safety and efficacy of injectable Paromomycin, showed 95% efficacy rate with no major side effects. This drug may be the drug of choice to treat SAG unresponsive cases and VL cases co-infected with other diseases like T.B. and HIV.
- Clinical trial of oral Miltefosine in PKDL patients with longer duration of doses (8 and 12 weeks) revealed 12 weeks treatment is better than 8 weeks.
- Combination therapy using Miltefosine and Ambisome, Paromomycin and Ambisome found to be a better alternative in reduced duration of treatment.

Epidemiological/Operational Research

- For surveillance of kala-azar, Camp approach was found with higher case yield than house-to house survey.
- Observed that asymptomatic cases in VL endemic population are a major threat for VL control strategies.

Translational Research

- Application of remote sensing and GIS as an “Epidemic predictor” established.
- Long-lasting impregnated bed net (LLIN), evaluated on experimental basis found effective for vector control.
- “Monitoring and evaluation toolkit” developed for spray activity. Usefulness of compression pump was compared with stirrup pump based on the logistics and operational observations compression pump was found better than stirrup pump.
- Initiative to control the Indian kala-azar by genetic changing of the symbiotic bacteria of the vector, *P. argentipes* is ongoing, Twenty different morphological colonies of symbiotic bacteria isolated from the wild caught sandflies from the endemic regions were established.
- Software package (85% accuracy) developed to forecast the disease: Wet fallow land and water body are endemic for sandfly, the non-endemic districts were covered by forest and agricultural fallow land.

Infrastructure and Human Resource Development

- Different isolates and strains of Leishmania parasite and the specimens maintained in repository of Leishmania parasite and sera bank.
- World Bank/NVBDCP sponsored training to six batches (about 25 per batches) of Kala-azar Technical Supervisors (KTS) conducted.
- Two-round of workshops on HIV/AIDS profiling at district and sub-district level were organized.

- Vector borne disease consultant (VBD) training programme.
- Training imparted to Medical officers, district malaria officers for diagnosis and treatment of VL.
- Training given by VBD division to DDT spray men for proper spraying of DDT for control of kala-azar vector.
- Ph.D. programme started from Calcutta/TM Bhagalpur University.

Vector Control Research Centre (VCRC), Puducherry

Basic Research

- Characterized calreticulin gene of *Wuchereria bancrofti* and *Wsp*, *Gro El* and *FtsZ* genes of its endosymbiont, *Wolbachia* as good targets for development of antifilarial drugs/vaccines.
- Macrophage Migration Inhibitory Factor (MMIF) of the filarial parasite found to be a good target for immunomodulator development.
- Identified 3 Single Nucleotide Polymorphisms (SNPs) in the genes of arachidonic acid metabolic pathway as biomarkers for the detection of non-responsiveness to DEC.
- Susceptibility regulating humoral factors of *Culex quinquefasciatus* against *W. bancrofti* infection like defensin, serpin, transferrin, actin and lipophorin identified, which may lead to the development of xenomonitoring tools.
- Developed a new rDNA-ITS2 PCR assay for separating the 5 members of the malaria vector *An. culicifacies* complex into two groups.
- Found East Central South African (ECSA) genotype of CHIKV with the “A226V” mutation during a renewed outbreak of chikungunya, which implicated to provide a higher efficiency in replication and dissemination for the virus in the vector species, *Aedes albopictus*.
- Characterized *Culex tritaeniorhynchus*, the vector of JE by DNA barcoding.
- Isolated and identified two mosquitocidal proteins with MW 55 & 35 kDa from *Pseudomonas fluorescens* (VCRC B426).
- Around 399 specimens from 12 States and 2 Union Territories comprising of 30 anopheles species and 144 other species barcoded, preserved and maintained in the mosquito museum.
- Identified an epitope (P2) from L3 cDNA library of *Wuchereria bancrofti*, having potential in the xenomonitoring of LF.

Epidemiological/Operational Research

- For the Lymphatic Filariasis (LF) elimination programme, co-administration of albendazole with DEC found to be operationally feasible, safe for community use and has an edge over DEC alone and accepted and implemented by the National Programme; DEC fortified salt has been demonstrated to be a potential supplementary strategy to MDA of annual single dose DEC.

- Estimated Disability Adjusted Life Years (DALY) and Health Related Quality of Life for filariasis in India.
- During chikungunya outbreak, in Pondicherry co-infection with respiratory syncytial virus (RSV) found in 87% and with influenza in 9% cases, indicating parallel outbreak of mixed infection.
- Evaluated long lasting mosquito nets (LLINs), viz., Netprotect, PermaNet, DuraNet, Olyset Net and Interceptor in experimental huts for their efficacy against *An. fluviatilis*.
- Vector resistance maps for the insecticides used for malaria control in India updated.
- Information generated on resting behavior and response to insecticide of the reappeared malaria vector, *Anopheles minimus* in Singhbhum hill areas for planning vector control strategies.
- Assessed MDA programme implementation in six districts of Tamil Nadu and four districts of Pondicherry and provided feedback.
- During an outbreak in North Kerala, chikungunya virus isolated in wild caught mosquitoes.

Translational Research

- Using a GIS based geo-environmental risk model, a filariasis transmission risk map for India created.
- The technology developed for the production of mosquito larvicide, *Bacillus thuringiensis* var. *israelensis* transferred to a total of 4 firms during the plan period.
- Risk analysis was done in the chikungunya infected areas in the rubber plantation belt of Kerala and accordingly, an action plan prepared jointly with the Rubber Research Institute of India (RRII) for the implementation of IVM for prevention and control of dengue / chikungunya vectors.
- Developed 3 types of fly ash based biopesticidal formulations, water dispersible powder (WDP), briquette (BR) and granular (GR), for controlling mosquito vector breeding in polluted (*Culex quinquefasciatus*) and clean water (*Culicines/Anophelines/Aedes aegypti*) habitats.
- Developed an AS-PCR assay based on a non-synonymous nucleotide variation (G->T) in the VEGFR-3 gene (Vascular Endothelial Growth Factor Receptor-3) coding for a tyrosine kinase to differentiate primary lymphoedema from secondary lymphoedema cases.
- A prototype electrochemical sensor developed for detecting *W. bancrofti* infection (DNA) in vector mosquitoes.
- A Real-Time PCR assay developed to detect albendazole resistance in *W. bancrofti* from microfilaria carriers.
- Identified 14 analogues of 5-Hydroxy-2-methyl-1,4-naphthoquinone (lead molecule isolated from the root extract of *Plumbago indica / rosea*) as potential candidates for further development as macrofilaricidal drug out of 75 synthesized and screened for macrofilaricidal activity.

- Monoterpene derivatives with microfilaricidal activity isolated from the fruit extract of the plant *Trachyspermum ammi*.
- A cyclic lipopeptide from *Bacillus subtilis* subsp. *subtilis* (VCRC B471) with potential to control all the stages of mosquitoes was identified. The lipopeptide found to be safe to non-target organisms, mammalian systems as well as silkworms and honey bees.

Human Resource Development

- The HRD activities included: (i) a one year Post-Graduate Diploma Course in Medical Entomology (Diploma awarded to 16 students), (ii) Doctoral programme (Ph. D. degree awarded to 7 Scholars), (iii) Formal training for public health personnel from SEAR Countries (WHO sponsored: 16; In Country support: 76), (iv) Informal training for University Faculties & Researchers (25), (v) Students' Project (National: 65; International: 24) and Observational training for Students from various Educational Institutions (National: 2946; International: 46).

Others

- Provided technical expertise and assistance for effective implementation of intervention measures against VBDs & carried out need based man-power development.
- Demonstrated that construction of bed-dam with sluice gates across stream significantly reduced *Anopheles fluviatilis* breeding in the down-stream area.

ICMR HEADQUARTERS

INTERNATIONAL HEALTH DIVISION

The International Health Division (IHD) (formerly Indo-Foreign Cell) is primarily engaged in promoting collaboration in biomedical/health research between India and institutes/centre of other countries/international agencies. Typically, such international collaborations are sought under bilateral, multilateral or regional framework modes for facilitating and strengthening interactions among governments, academia, institutions and industries in the areas of mutual interest. The Council operates in close cooperation with the Ministry of Health & Family Welfare, Ministry of External Affairs, Indian missions abroad and foreign missions in India for the international collaborations. The Memoranda of Understanding (MoU)/Joint statements signed between ICMR and various collaborating global bodies are executed in a time-bound manner.

During the XI Plan period the following activities were done:

New Memoranda of Understanding/ LOI were signed with:

- University of California, Los Angeles, USA
- University of Sydney / George Institute for International Health, Australia
- Karolinska Institute, Sweden
- London School of Hygiene & Tropical Medicine, UK
- Medical Research Council, UK.

- Global Alliance for Chronic Diseases (GACD)
- Foundation for Innovative New Diagnostics (FIND)

MoUs of ICMR were renewed with Canadian Institutes of Health Research (CIHR), Canada, and HGF, Germany.

Letters of Intent (LOI) were signed between (a) ICMR and Boston University, USA; (b) ICMR-European Union; and (c) ICMR-INSERM. Areas identified under these LOIs included infectious diseases, oncology, family planning and reproduction, health for mother and child, prenatal medicine, traditional medicine with emphasis on natural products, environmental toxicology, drug development on tropical diseases/infectious diseases, bioethics, genetic susceptibility, vaccines & anti-infectives *etc.*

- Under the *Indo-German Science Centre for Infectious Diseases* (IGSCID) progress in respect of Genetic susceptibility, Vaccines & anti infectives and Viral diseases (HIV/ HCV) are progressing well. To provide detailed information to users about the IGSCID programme, a website was launched in 2009.
- Many collaborative research projects were approved under several bilateral programmes: ICMR-INSERM (France): 14; ICMR-BMBF (Germany): 22; ICMR- HGF (Germany): 4; ICMR- Indo-US HIV/AIDS: 29; ICMR- Maternal & Child Health: 14; ICMR- Environment & Occupational Health: 11; ICMR- CIHR (Canada): 3; ICMR- University of Minnesota: 3.
- Under the Health Ministry's Screening Committee, 466 projects involving foreign assistance and/or collaboration in biomedical/ health research were processed for approval of Govt. of India.
- Requests for Transfer of Biological Materials as per GOI guidelines were processed.
- Under the new ICMR International Fellowship Programme 35 Senior and 70 Young Indian scientists were awarded with fellowships.
- Activities under the WHO-Biennium Programme were co-ordinated.
- Workshops organized included: Indo-US Workshops on various topics of Environment & Occupational Health (2); Maternal & Child Health (2); HIV/AIDS (2) in USA and India, ICMR-University of Minnesota, USA workshop on Cancer & Diabetes in USA, Indo-German workshops on Cancer & Bioethics, Epidemiology of infectious diseases; Predictive assays and innovative technology in radiotherapy. Workshop (under ICMR-HGF programme) on Zoonoses and Animal Models of Infectious Diseases, ICMR-European Union workshop on Cancer & Neurosciences, Indo-French workshops on Translational Research and Pharmacogenomics, India-Canada Workshop on Childhood Obesity in India and Canada India Network Initiative symposium held in Canada, India-Australia workshops on Diabetes and Road Traffic Injuries.

HUMAN RESOURCE PLANNING AND DEVELOPMENT

The availability of adequate and appropriate human resources is essential for the growth and development of any discipline. The ICMR has put in place a strong Human Resources Development Plan that has constantly strived towards capacity building at all levels. But the

thrust and focus has been on younger scientists and doctors who would augment the national resource for doing high quality science and its translation into products and processes for public health. Several new training programmes were started during the XI Five Year Plan that have resulted in perceptible improvement of the research carried out as reflected by both the number and quality of publications. Some of these initiatives are described below.

- The total number of fellowships under the ICMR Junior Research Fellowship Programme recruited through a national competitive examination increased to about 150 per year.
- The MD-Ph.D. Programme is ongoing at the NIMHANS, Bengaluru, KGMU, Lucknow and Sri Ramachandra University, Chennai with about 25 slots per year.
- The scheme that offers financial assistance for MD/MS/MCH thesis has progressed well with support to about 50 thesis per year.
- Short-Term Training Scholarship Programme (100 per year) to provide opportunity to a scientist actually engaged in research in the field of biomedical sciences to learn advanced research techniques/ methods.
- International travel grants programme to non-ICMR scientist for attending conference/seminars in abroad to update knowledge at global level in the concerned areas of national interest started.
- ICMR Centenary Post-Doctoral Fellowship Programme –(50 slots per year) to promising fresh PhD holders in the cutting edge areas of basic science, communicable and non-communicable diseases, reproductive health including nutrition and other areas at ICMR Institutes/ Centers.
- ICMR Awards/Prizes to encourage and coordinate medical research in the country but also recognizes the contributions. The Council gives a total of 37 awards including the prestigious Dr. B.R. Ambedkar Centenary Award.

PUBLICATION, INFORMATION AND COMMUNICATION

- The Division of Publication & Information continued publication of the *Indian Journal of Medical Research* (IJMR), a peer reviewed monthly journal with enhanced coverage. The journal is now available full-text free on the journal website since inception (1913). The IJMR recorded the highest impact factor (IF) for an Indian journal of 1.880 in 2009.
- The journal has switched over to online web based e-editorial management system for the editorial processing of the IJMR articles.
- Special issues were brought out on Diabetes Research, Poverty and Human Development, Nutrition and Bone Health, Metal Toxicity and Health Implications, Human Papillomavirus, Maternal and Child Nutrition, Sleep Medicine and Cardiovascular Disease Research.
- Other publications like the ICMR Bulletin, Annual Report of the Director – General, ICMR *Patrika*, *Varshik Prativedan*, the Hindi versions of ICMR Annual Report and DHR Annual Report were brought out.
- The Hindi Publication Unit has brought out Hindi version of ‘Identification Key of Indian Anophelines’ of NIMR, New Delhi as ‘*Bhartiya Anophelese Machharon ki*

Sachitra Pahchan Kunji in 2007. The Council awarded ICMR *Puraskar* for popular medical books in Hindi for the biennium 2006-2007.

- Video films on activities and achievements of the ICMR and its Institutes and on 14 disease conditions have been prepared as also short films for scientists, policy makers and general public.
- The access to e-journals has been continued as also subscription to ProQuest Health & Medical Complete, JCCC@ICMR and ERMED of the National Medical Library under DGHS.
- A Manual of Procedures for Management of Library and Information Centres of ICMR was brought out to help librarians/libraries to stream line and standardize the procedures of various library activities like book purchasing *etc.*
- The Annual output of ICMR institutes has been brought out regularly with the research output analysis since inception of ICMR Institutes.
- A Global Database of Research Papers on Malaria During Last 50 Years and its Analysis was prepared with support of the DST.
- A Directory of Indian Science & Technology (including Medical) Journals was brought out with support from the DST.
- The 9 Biomedical Informatics Centres of ICMR at ICMR and non-ICMR institutes promoted awareness of Biomedical Informatics, supported Biomedical Informatics in medical research, develop databases of Biomedical and Clinical information besides publication of papers.
- The Management information System on Extramural Research activities of the Council has been upgraded in a major way and is now highly interactive and informative and made interactive with programme officers.
- The Data Repository and Business Intelligence Project has been initiated to create a data repository of all data generated by both intramural and extramural research, all data pertaining to completed projects *etc.*
- The Short Term Studentship (STS) programme has been fully automated, from receipt of applications to publishing of results. The web portal is available at <http://icmr.nic.in/shortr.htm>.
- An Indian National Database – MACE registry has been developed to track outcomes of patients with acute coronary syndrome, including unstable angina, myocardial infarction (both ST-segment elevation and non ST-segment elevation).
- The development and maintenance of the ICMR website with upgradation of software *etc.* A file movement and tracking system has been implemented in ICMR headquarters.
- Draft Knowledge framework policy for Health Service, Education and Research developed.
- Video conferencing facilities have been established between 8 ICMR institutes and the headquarters.
- Internet and Intranet Connectivity has been significantly enhanced with the establishment of 2X2 Mbps lines. The ICMR intranet has been established and applications are being developed.

- Two web based databases IndMED and MedIND were brought out under joint ICMR-NIC partnership. IndMED consists of 77 Indian Medical Journals, whereas, MedIND portal provides free full text access to 40 Indian Medical Journals.

INTELLECTUAL PROPERTY RIGHTS MANAGEMENT

- The IPR Unit continued to provide single-window support to inventions generated with ICMR support and took steps to commercialize such leads that have industrial application.
- A total of 24 patents were filed at the Indian Patent Office 20 generated with intramural support and 4 extramural patents.
- During the period, a total of 13 patents were granted - 8 intramural and 5 extramural.
- New Guidelines for Contract Research, Consultancy/ Technical Services were brought out to promote an integrated approach towards joint developmental activity with the industry.
- Steps taken to commercialize the ICMR leads include the document “Technologies for commercialization” cataloguing ICMR’s patented and non patented technologies generated from intramural or extramural research, signing an MOU with Biotech Consortium India Limited, New Delhi (BCIL).
- The agreement with National Research & Development Corporation (NRDC), New Delhi was renewed for commercialization of ICMR technologies.
- The Unit independently initiated technology transfer exercise with two technologies viz., Magnivisualizer a device developed by ICPO to visualize the cancerous lesion of uterocervix and RDB kit based on monoclonal antibody and nested PCR for parental diagnosis of hemoglobinopathies that are in advanced stage of development.
- The training of women scientists under women scientists’ of TIFAAC-DST Scheme at ICMR was continued.
- The following studies of national interest were : i). Study of relevance of technologies generated in India (1990-2004) vis-à-vis national/regional health priorities; ii.) Exportable Services in ICMR System; iii). A study on the R&D status and intellectual property rights profile of drugs for some selected non-communicable diseases; iv). Creating an effective supporting system for the collection, compilation and dissemination of IP-related information in the area of health with special reference to diseases of the poor; and v). The transfer of public domain science to patented technology: a case study with major inventions as reflected by patents:
- Supported extramural projects on i) identification and dissemination of IP related information in the areas of vaccine and diagnostics through a Newsletter. Vaccine and Diagnostics; and ii) Emerging IP issues in Cardiovascular and diabetes.
- The IPR Unit continued to provide inputs to Govt policies to promote access and equity for health care impacted through globalization and IPR issues through the national and international fora.
- The IPR Unit continued to examine all MoUs /Agreements entered into by the Council.

XI PLAN ACHIEVEMENTS: AREA / DISEASE-WISE

BACTERIAL DISEASES

TUBERCULOSIS

ICMR INSTITUTES WORKING ON TUBERCULOSIS

1. National Institute for Research in Tuberculosis (NIRT), Chennai*
2. National JALMA Institute for Leprosy and Other Mycobacterial Diseases (NJIL & OMD), Agra*
3. Desert Medicine Research Centre (DMRC), Jodhpur
4. Regional Medical Research Centre (RMRC), Dibrugarh
5. Regional Medical Research Centre for Tribals (RMRCT), Jabalpur
6. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Observed that blood agar slants may be good substitute of Lowenstein Jensen (LJ) medium for rapid detection of *Mycobacterium tuberculosis* from sputum.
- HLA-DRB1 alleles regulate the perforin positive cells, macrophage phagocytosis and Th1 and Th2 cytokine response to *M. tuberculosis* antigens.
- Cytokine +1188 polymorphism of IL-12B gene may regulate IL-12p40 production and/or may play a major role on acquired immunity to TB.
- Tuberculous pleuritis (TP) showed a shift in immune response towards TH0/TH2 type.
- Putative IclR type of regulatory protein Rv2989 of *M. tuberculosis* unlikely to be involved in the multi-drug resistance of *M. tuberculosis*.
- Vitamin D3 observed to modulate TNF- α and IFN- γ positive T-cell subsets in pulmonary TB (PTB).
- Toll like receptor polymorphism studies in mycobacterial diseases showed that one fourth of the patients were heterozygous while only 2% were homozygous.
- MDR strains of *M.tuberculosis* have been observed to retain the capacity to infect through aerosol route as efficiently as sensitive strains.

* Lead Institute/s

- MALDI-TOF analysis established the relationship of certain proteins with Streptomycin resistance.
- Mycobacterial cell wall does not act as a significant barrier for the accumulation of some of the fluoroquinolones of *M. tuberculosis* isolates.
- Developed new rapid molecular methods for detection of rifampicin, isoniazid and ethambutol resistance in TB.
- Identified new targets associated with drug resistance.
- Developed procedures for application of direct *in situ* hybridization and PCR on tissue specimens for early diagnosis of leprosy and TB.
- Participated in a study to evaluate the protective efficacy and immune response to Mw/ BCG/other vaccines in animal models of tuberculosis. Protective efficacy of different candidates established.
- Evaluation of certain phage constructs was completed for the development of rapid method for detection of latent TB infection (LRP- assay).
- While studying the modulation of immune response and apoptosis, a correlation between phagocytosis and apoptosis indicated a differential mode of infection by clinical strains and their adaptation to different survival strategies that may lead to immune suppression and pathogenesis of the disease.
- Chemokines in TB showed differential up-regulation and transmigration of these cells to the site of infection.
- Two putative peptide transporter *M. tuberculosis* operon have been identified in the genome and OppA and PPK2 could be useful as two novel drug candidates of *M. tuberculosis* (Deptt. of Chemistry, Bose Institute, Kolkata).
- Using PCR restriction fragment length polymorphism, RFLP-DNAPRA (Hsp 65) and novel restriction enzyme NruI was also found using bioinformatics which can be used as a rapid screening assay for differentiation between *M. tuberculosis* and non-tubercular mycobacterium (NTM) in sputum samples (V.P. Chest Institute, Delhi).

Clinical Research

- Investigated the potential of newer quinolones, *i.e.* gatifloxacin and moxifloxacin as agents that could shorten the duration of chemotherapy. Gatifloxacin therapy, found unsuitable due to unacceptably high relapse rates.

Epidemiological/ Operational Research

- Completed surveys demonstrated that DOTS implementation resulted in more rapid reduction in prevalence of TB compared to treatment used in the pre-DOTS period.
- Observed prevalence of pulmonary TB collectively in UP districts was 35.8 per 10,000 population and 3 % MDR cases were observed in Kanpur urban areas, and about 2 % in Agra estimated in new smear positive cases (Cat I) of pulmonary TB.
- Genotyping of *M.tb* isolates done by NJIL & OMD, NITR and RMRC, Dibrugarh showed predominant strain of *M. tuberculosis* prevalent are ancient east African and Central Asia varieties and not the Beijing strain.

- Prevalence of TB in tribal population with Saharia primitive tribe was found to be highest.

Translational Research

- Participated in trials using Mw immunotherapy along with DOTS in pulmonary TB to improve the therapeutic efficacy of DOTS, results awaited.
- A tool box for diagnosis of tuberculosis based on ELISA using PGL-TB, ESAT6 and CFP10 antigens was evaluated in a multi-centric study and found not suitable because of the presence of high levels of antibody levels in healthy contacts.
- APCR-RFLP technique targeting 16S-23S rRNA gene region developed for identification of pathogenic mycobacteria, patented and transferred to several labs.

LEPROSY

ICMR INSTITUTES WORKING ON LEPROSY

1. National JALMA Institute for Leprosy and Other Mycobacterial Diseases (NJIL & OMD), Agra*.
2. National Institute of Epidemiology (NIE), Chennai.

Basic Research

- Developed potential serological markers using CFP 10 alone or in combination with ESAT -6 protein and applied in monitoring therapeutic efficacy in leprosy.
- Identified the role of endoneural blood vascular endothelial cell in the peripheral nerve involvement in leprosy.
- Explored cellular phenotype and chemokine markers of DTH in leprosy patients.
- Membrane associated calcium signaling channels are the major targets of *M. leprae* antigens for T cell activation.
- Identified molecular mimicry between *M. leprae* and host cytoskeletal proteins.
- Study of biochemical markers in leprosy reactions showed serum beta glucuronidase and cholesterol levels/to be useful markers for monitoring ENL reactions.
- Immunotherapy with Mw in combination with standard chemotherapy enhanced bacterial clearance and reduction of granuloma in borderline leprosy.
- Neurophysiological studies on peripheral nerves identified markers of early nerve damage in leprosy patients.
- Polymorphism studies with Toll like receptors indicated that only 2% of the patients were homozygous.
- In situ based PCR methods established for detection of *M. leprae* in tissue biopsies as well as slit skin smears.
- Established a method of measurement of gene expression in paraffin embedded sections using *in situ* RT – PCR.

* Lead Institute/s

- Mouse foot pad technique could not identify any drug resistant *M. leprae* in relapsed cases of MB leprosy. However, some mutations were noted in fol P locus for dapsone resistance (NJIL & OMD, Agra, Bombay Leprosy Project, Mumbai, SIH-R & LC, Karigari, GRECALTES, Kolkata and RMLH, Delhi).
- The frequency of iNKT cells (expressing the invariant chain of TCR) was comparatively higher in the case of BL/LL patients as opposed to BT/TT patients of leprosy, confirming the fact that these iNKT cells are predominantly suppressive in nature. (AIIMS, New Delhi).
- A statistically significant increase in the frequency of IL1R allele C and IL12B allele A in lepromatous and tuberculoid leprosy patients respectively and decrease in the frequency of IL-33C and IL 10 allele A in leprosy patients as compared to healthy controls (AIIMS, New Delhi).

Clinical Research

- Developed the concept and proof of common Multidrug Therapy Regimen which has been adopted by WHO as uniform MDT and being evaluated in an international multi-centric trial.
- Studies on female patients indicated recrudescence of the leprosy and that leprosy reactions correlate with the onset of puberty, menopause, pregnancy and lactation.
- Developed a new surgical procedure for restoration of volume of first web space in muscle atrophy associated with ulnar palsy in leprosy.
- Observed that single lesion patients and pauci-bacillary patients with 3 lesions have higher relapse rate when compared to standard MDT in ROM//CROM trials.
- Multi -bacillary cases have a higher risk of relapse compared to those who are treated with MDT till smear negativity.
- Additional monthly administration of ofloxacin and minocycline shown to be effective in the treatment of multi-bacillary leprosy.
- Higher doses of pulsed administration of corticosteroids found to be better to those treated with lower doses in terms of recovery and recurrences from reactions.

Epidemiological/ Operational Research

- Conducted 2 rounds of large scale field-based post-leprosy vaccine trials surveys to study leprosy incidence, prevalence and relapse rates and generated data relevant for NLEP. Backlog of untreated cases found to be cause of pockets of endemicity.
- Detected *M. leprae* using real time PCR of RNA and DNA from soil specimens and drainage water and suggested the need for continuous monitoring to understand the transmission dynamics.
- Baseline information on current situation status of leprosy situation at Agra has been established.

Translational Research

- Modified Lot Quality Assurance [MLQA] Sampling to monitor and assess leprosy elimination programme in the Country.

- Designed a novel DNA chip for leprosy genome for studying the structural diversity and functional genomics, several genes exposing in humans identified.
- Using known and new targets such as RLEP, probes for reliable & rapid detection of *M. leprae* developed.
- A study carried out to assess the hormonal profile, menstrual function and fertility status in female patients of leprosy has shown significantly elevated mean levels of LH, FSH and prolactin indicating that leprosy affects female reproductive system (AIIMS, New Delhi).
- Molecular tools for detection of *M. leprae* DNA from soil and clinical samples have been established which can be developed in form of diagnostic kit (Stanley Browne Laboratories, Miraj, Maharashtra, NJIL & OMD, Agra, LEPR India-Blue Peter Research Centre, Hyderabad and CDFD, Hyderabad).

DIARRHOEAL AND ENTERIC DISEASES

ICMR INSTITUTES WORKING ON DIARRHEAL & ENTERIC DISEASES

1. National Institute of Cholera and Enteric Diseases (NICED), Kolkata*
2. Regional Infectious Disease Laboratory (ICMR Virus Research Unit), Kolkata
3. Food and Drug Toxicology Research Centre (FDTRC), Hyderabad
4. Regional Medical Research Centre (RMRC), Bhubaneswar
5. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Showed the involvement of intact actin cytoskeleton being responsible for the translocation of PKC-alpha from cytosol to membrane in the mechanism of action of *Escherichia coli* heat stable enterotoxin (STa).
- Showed that the mature *Vibrio hemolysin* oligomer (65 kDa), a pore-forming toxin, is a molecule with C7 symmetry and has ring-like, arm-like and bowl-like structures with a central channel.
- A three dimensional structure of the membrane-inserted form of the VCC oligomer by cryo-electron microscopy modelled.
- Viable but nonculturable (VBNC) *V. cholerae* appears to play an important role in the epidemiology of cholera.
- Established that other El Tor variant strains evolved through stepwise events of acquisition and deletion of genes by the then existing prototype El Tor strains.
- Identified a novel 59 kDa serine protease from a hapA deleted *V. cholerae* strain, a novel reactogenic factor.

* Lead Institute/s

- Importance of *V. cholerae*-intestine cross-talk through GbpA demonstrated which might lead to discovery of novel treatment options for the cholera disease in future.
- Developed immunochromatographic dipstick kit for the rapid diagnosis of cholera with sensitivity and specificity of 92% and 73% respectively.
- Established antibacterial activity of an ethnomedicinal plant (*S. robusta*) against *S. typhi*, *V. cholerae* and *Shigella* species.
- Primers to various microbes like *E. coli*, *V. cholerae*, *V. parahaemolyticus*, etc used and PCR based uniplex detection method developed.
- Development of PCR and RT-PCR based diagnostic kits for detection and identification of food and water borne pathogens.
- Composite analysis using both RAPD and ERIC-PCR allowed better discrimination than RAPD and ERIC-PCR individually in epidemiological investigations of non-typhoidal *Salmonellae* (NTS) serovars that cause food-borne infections (College of Fisheries, Mangalore).
- Studies showed that carbapenems, which include imipenem, ertapenem and meropenem, should be the drugs of choice for treating patients suffering from infections caused by AmpC producing isolates (V.P. Chest Institute, Delhi).
- Fimbrial proteins of *E. coli*. were purified in the presence of their natural chaperone and appear to have potential as candidate vaccine (CDFD, Hyderabad).
- *V. cholerae* O1 El Tor variant strains associated with many cholera outbreaks in India and other Asian and African countries were found to produce more cholera toxin (CT) than did prototype El Tor strains.
- An animal (chicken) model for Guillain Barre Syndrome (GBS) disease following *Campylobacter jejuni* infection was developed for the first time.
- Demonstrated the conversion of viable but non-cultivable (VBNC) to the cultivable state of vibrios by co-culture of the pathogen with eukaryotic cells.
- 100% protection was shown for the first time by oral administration of heat killed *Shigella flexneri* 2a in rabbit model of shigellosis.
- Patented the recombinant live oral cholera vaccine, Va1.3.
- Preparation of holey / lacey film for electron microscopy reported.
- Outbreaks of cholera of 2005 due to Ogawa serotype was found to be completely replaced by Inaba serotype in the year 2006 due to immune pressure in the community.
- Identified new pathogenic strain of *Giardia* and *Cryptosporidium* in Kolkata (Available in Genebank)

Clinical Research

- Demonstrated better efficacy of reduced osmolarity ORS in young children and adults in dehydrating diarrhea compared to that of standard ORS.

- Probiotic drink containing *Lactobacillus casei* showed 14% protective efficacy in acute diarrhoea in children.
- Zinc supplement was found to play a significant role in management of diarrhoea.
- Detected emergence of fluoroquinolone & cephalosporins resistance among enteric pathogens, found multiple mutations in quinolone resistance determining region (QRDR) genes and plasmid mediated quinolone resistance (PMQR) as possible mechanism of antibiotic resistance in *Shigella*.
- A large study on immunological response to a whole-cell killed oral cholera vaccine revealed that there are significant geographical differences in response and that O blood group individuals do not elicit a higher response.

Epidemiological/ Operational Research

- A bivalent whole cell killed oral cholera vaccine in a Phase III randomized control trial among 110,000 urban slum populations in Kolkata showed protective efficacy of 67% in all age groups at the end of two years and 65% at the end of three years post vaccination.
- Diarrhoeal disease surveillance study revealed an increase in *Vibrio cholerae* O1 infection among <2 years age group, resistance of *V. cholerae* O1 to tetracycline, rise of untypable *S. flexneri*, higher proportion of atypical EPEC and *G. lamblia* and polymicrobial etiology.
- A microbiological risk assessment of street foods revealed that the *Staphylococcus aureus*, *Bacillus cerues* and *Salmonella* were the major pathogens detected, especially in poultry products.
- Characterized pathogenic *E. coli* and *Shigella* species in Orissa. Commonest species reported was *E. coli*, followed by *Shigella* and *V. cholerae*. Molecular analysis exhibited EPEC -6%, ETEC-7.8% and EAaggEC-3.7%.
- About half of the non-typhoidal *Salmonellae* isolates analyzed harbored ESBL genes. Though several different serovars were identified, the great majority (90%) of ESBL producers belonged to the *Salmonella agona* serovar.
- Among children below five years, the major causal agent of diarrhoea in hospital was found to be Rotavirus; the other virus of interest was Norovirus.

LEPTOSPIROSIS

ICMR INSTITUTE WORKING ON LEPTOSPIROSIS

1. Regional Medical Research Centre (RMRC), Port Blair*.

Basic Research

- Developed & evaluated Latex Agglutination test and an ELISA test system for the diagnosis of leptospirosis, using broadly reactive antigens or recombinant proteins

* Lead Institute

Lip132, protein Omp11 and Lip141. The test systems showed sensitivity and specificity in the range between of 78% - 89.3% and 81%-89% respectively.

- Developed and evaluated multi locus sequence typing (MLST) of *Leptospire*s using six genes *viz.*, *secY*, *LipL41*, *adk*, *icdA*, *rrs2*. Currently, this technique is being utilized on the isolates recovered from Gujarat and Andaman & Nicobar Islands to study the molecular epidemiology and geographic genomics.
- Identified two leptospiral proteins *viz.*, *DNAj* and *LipL45* as highly immunogenic and responsible for long lasting immunological memory. Developed codon optimized DNA constructs using these two proteins to be used as in the development of DNA vaccine against Leptospiral infection.
- Completed whole genome sequencing of leptospiral isolates, identified many new genes potentially responsible for severe clinical outcomes such as acute respiratory distress syndrome (ARDS), pulmonary haemorrhagic pneumonitis and Weil's syndrome.
- Community biodiversity registers documenting traditional health care practices for Car Nicobar developed.
- Generated traditional knowledge on usage of 160 medicinal Plants, 2 sponges, two seaweeds and one sea grass antimicrobial potentials.
- Developed IgM ELISA and Latex Agglutination Test for the rapid diagnosis of leptospirosis.

Translational Research

- Successfully demonstrated control of *Aedes* spp. using temephos and environmental management in a peri-urban area through involvement of community volunteers in association with an NGO in these islands.
- Delineated vector dynamics of diurnally subperiodic *W. bancrofti* filariasis in Nancowry group of islands and formulated strategy for elimination through the use of DEC fortified salt.

CHLAMYDIASIS

ICMR INSTITUTE WORKING ON CHLAMYDIASIS

1. National Institute of Pathology (NIOP), New Delhi*.
2. National Institute for Research in Reproductive Health (NIRRH), Mumbai.

Basic Research

- Repository of *Chlamydia trachomatis* isolates established.
- Local and systemic biomarkers (IFN- γ , CRP, cHSP 60 antibodies) identified that can be used for prediction of women developing fertility disorders due to *C. trachomatis*.
- Endometrial curettage tissue of recurrent spontaneous aborters had 12.5% *C. trachomatis* positivity, which was significantly higher than *Mycoplasma hominis* and *Ureaplasma urealyticum*.

* Lead Institute

- Expression of tumor necrosis factor alpha as well as cyclooxygenase-2 was higher in spontaneous aborters with *C. trachomatis* infection in comparison to uninfected group.
- Significantly higher lipid peroxide and low superoxide dismutase activity was observed in *C. trachomatis* positive patients undergoing spontaneous abortion as compared to those with missed abortion.
- Molecular diagnosis for detection of *C. pneumoniae* in atheromatous plaques and blood of coronary artery disease patients.
- Evaluation of inflammatory and circulatory markers in *C. pneumoniae*-positive coronary artery disease patients led to identification of potential biomarkers.
- *C. pneumoniae*-positive CAD patients first degree relatives are at higher risk for atherosclerosis.
- Role of *Chlamydia pneumoniae* heat shock protein 60 in pathogenesis of coronary artery disease suggested.
- In-house tests have been developed for diagnosis of a *Chlamydia trachomatis* and Human papillomavirus (HPV).

Translational Research

- Development of monoclonal antibody based indigenous diagnostic assay for diagnosing patients with *Chlamydia trachomatis* infection.
- The first one in India to determine and publish the morphological criteria for localization of intracellular *Chlamydia trachomatis* inclusions in cervical smears, which has the advantage of being a rapid method of screening a large number of women in the field setting in our country.

VIRAL DISEASES

HIV

ICMR INSTITUTES WORKING ON HIV

1. National AIDS Research Institute (NARI), Pune*
2. National Institute for Research in Reproductive Health (NIRRH), Mumbai
3. National Institute for Research in Tuberculosis (NIRT), Chennai
4. Regional Medical Research Centre (RMRC), Dibrugarh
5. National Institute of Cholera and Enteric Diseases (NICED), Kolkata
6. Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata
7. Plus all ICMR Institutes serving as Voluntary Counselling and Testing Centres (VCTC) for HIV testing and counselling

Basic Research

- Established reference ranges of CD4 T-lymphocyte counts for adult Indian population.

* Lead Institute

- Found that among those who are infected by HIV-1, majority of the HIV strains circulating in India belong to subtype C. A very small proportion of recombinant viruses (B/C and A/C) also detected indicating need for continued surveillance.
- Explored the role of gag and vpu on HIV-1 envelope assembly in T cells and macrophages; Role of host factors such as DDX3X on viral RNA transport by different pathways in HIV-1 nuclear export and replication; receptor biology and tropism of HIV-1 envelope of India clade C in different disease stages.
- Platform for *in vitro* anti-HIV screening developed and used for screening anti-HIV activity of new synthetic molecules, herbal products and preparations from alternative system of medicine.
- Full length sequencing of more than 75 viruses from different HIV disease stages and transmitted viruses isolated from year 1998 to 2011 done.
- Studies on the sexual transmission of HIV revealed the presence of distinct HIV variants in sperm/PBMCs and vaginal epithelial cells/PBMCs of the same individual.
- SsALF-24 (from the hemocytes of Indian mud crab, *Scylla serrata*), rabbit vaginal fluid hemoglobin alpha chain like peptide (RVFHB α P) (from rabbit vaginal fluid) and rabbit epididymis hemoglobin beta chain like peptide (REHb β P) (from rabbit epididymis) found to have anti bacterial and anti-HIV activities.
- Genotyping of CYP2B6 G516T in an ethnic south Indian HIV+ve cohort showed T allele polymorphism as 0.44, the highest reported world-wide. The ABCB1 C3435T polymorphism which may be associated with lower efavirenz levels, did not influence immune recovery after initiation of ART.
- Development and cryopreservation of EBV transformed B cell line and generation of DNA bank has been completed for Long Term Non-Progressors (LTNPs).
- Pharmacokinetic studies to examine the drug interactions between nevirapine – rifampicin and efavirenz – rifampicin were undertaken.
- Adequate plasma concentrations of nevirapine, lamivudine and stavudine were not influenced by age, sex, body mass index and immune status.

Clinical Research

- A study to determine the blood levels of nevirapine and efavirenz in HIV-infected children in India, showed that a combination of factors, such as, young age, stunting and CYP2B6 GG or GT genotype could potentially result in sub-therapeutic nevirapine concentrations. The study suggested that ART dosing recommendations for children should be reviewed in the light of these findings.

Epidemiological/ Operational/ Socio-Behavioural Research

- In a large scale Integrated Behavioral and Biological Assessment (IBBA) survey conducted in two rounds in 29 districts in six high prevalence states to assess the impact of interventions implemented under “AVAHAN, AIDS India Initiative”, top line survey findings informed to the policy makers and programme managers within 45 days.
- Completed HIV vaccine Phase I clinical trial to test the safety and immunogenicity of prime and boost regimen using DNA vaccine from priming and MVA vaccine for boost.

- Cohorts of HIV infected persons who have controlled their HIV infection successfully for long time 'Long Term Non Progressors' (LTNP) and persons recently infected with HIV 'Recent Converters' established for conducting studies on HIV immunopathology.
- Identified spectrum of opportunistic infections like multiple herpes virus infection in HIV +ve patients.
- Integrated bio-behavioral assessment of IDUs and FSWs in Manipur and Nagaland using RDS technique, a new sampling method suitable for hidden population established.
- The majority of HIV-1 transmission in Manipur, North Eastern States, shown to be linked with sharing of needles and syringes among the injecting drug users.
- C type (C4 subtype) is the most prevalent subtype among blood samples from HIV-1-seropositive female sex workers in Kolkata.
- Sharing of epitope between HIV and *M.leprae*.

Translational Research

- Developed evaluation tool for ART counsellor training.
- Feasibility of matching two different databases to look at the association between HIV and cancers at population level developed.
- Adolescent Reproductive and Sexual Health module developed for implementation.
- 'Mental Health Needs Scale' of the PLHAs developed and is already being used by National AIDS Control Organization.
- Developed National Guidelines on prevention, management and control of Reproductive Tract Infections including Sexually transmitted Infections (RTIs/STIs).
- A community based intervention model to promote communication between husband and wife on issues related to sex and condom use and to reduce STIs/HIV among couples developed.
- Developed training modules on RTIs/STIs for Doctors and Paramedicals, being used for the training in the NACP-3 and RCH-2 programmes under NRHM.

HIV & TB

ICMR INSTITUTES WORKING ON HIV & TB

1. National Institute for Research in Tuberculosis (NIRT), Chennai*
2. Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata
3. National AIDS Research Institute (NARI), Pune

Basic Research

- Frequency analysis of CD 209 promoter region revealed that 336 G/G genotype, VDR gene 3'UTR haplotype b-A-t was associated with susceptibility to TB in HIV-1 infected patients. However, VDR gene 3'UTR haplotype b-A-T was associated with protection against HIV-1.

* Lead Institute

- Study to understand the interaction of the host with HIV-1 during active TB showed significantly decreased fraction of CD4+ T cells expressing CCR5 and CXCR4 in individuals infected with HIV.
- Anti Tubercular preventive therapy can be safely administered in HIV and hepatitis co-infected patients.
- HLA-A*1101 and HLA-DPB1*1501 were associated with resistance to TB and HLA-B*4006 & HLA-DRB1*1502 were associated with susceptibility to TB HIV infected patients. Further, studies revealed that HLA-DQB1*050301 was found to be associated with susceptibility to HIV.

Clinical Research

- Evaluated the efficacy of short-course chemotherapy for TB in HIV-infected patients - a 9-month intermittent regimen compared to a 6-month thrice-weekly regimen showed similar therapeutic outcome but significantly lower bacteriological recurrence rate observed in 9-month intermittent regimen.
- Safety/ efficacy trial of nevirapine vs efavirenz along with ATT in patients with HIV-1 and TB, showed that once-daily nevirapine was inferior to the efavirenz-containing regimen, with higher virological failure and death rates.
- A study to correlate plasma levels of immune activation markers (neopterin, beta-2 microglobulin, TNF α receptor) with the presence of TB in ART-naïve HIV-infected and uninfected individuals, showed that ATT was effective in clearing *M. tuberculosis* infection.

Translational Research

- Identified sensitivity and specificity of combination testing algorithms, developed to reduce time of testing of HIV & TB, ideal for use in settings like TB clinics or Primary Health Centres in resource-poor countries.

DENGUE

ICMR INSTITUTES WORKING ON DENGUE

1. Centre for Research in Medical Entomology (CRME), Madurai*
2. Desert Medicine Research Centre (DMRC), Jodhpur
3. National Institute of Virology (NIV), Pune*
4. Regional Medical Research Centre (RMRC), Dibrugarh
5. Regional Medical Research Centre (RMRC), Port Blair
6. Vector Control Research Centre (VCRC), Puducherry
7. Microbial Containment Complex (MCC), Pune
8. National Institute of Cholera and Enteric Diseases (NICED), Kolkata
9. National Institute of Immunohaematology (NIIH), Mumbai
10. Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata

* Lead Institute

Basic Research

- Dengue virus antigen detected in dessicated specimens of *Aedes aegypti*.
- Detection, isolation and serotyping of dengue virus from *Aedes* vectors by using Toxo-IFA system in various States of the country.
- *Aedes albopictus* was identified as the only vector of dengue in Kerala, and DEN-2 isolated for the first time in this State.
- Showed presence of transovarially transmitted virus as possible maintenance mechanism of dengue virus in nature and that 200 kDa protein in mosquito ovaries could block occurrence of transovarial transmission to prevent dengue.
- A comprehensive study on predictors and determinants of dengue in all the physiographic regions of Rajasthan, India undertaken showed that mosquito infectivity through vertical transmission was uniformly observed prior to any reports of human infections in the study areas indicating presence of transovarially transmitted virus as the predictor of disease.
- Determined the genotypes of dengue viruses circulating in India.
- Switch in Dengue-2 genotype associated with increase in severity of outbreaks.
- Components of Cytoskeleton and inter-cellular trafficking of dengue viral proteins identified for development of intervention strategies.
- Dengue viruses shown to have direct binding affinity and activation potential for human blood platelets.
- Phylogenetic studies of dengue viruses.
- Provided one of the mechanisms for thrombocytopenia in Dengue virus infection by selectively wiping out CFU – MYC colonies *in vitro*.
- Real time RT-PCR useful for early diagnosis developed for detection of dengue viral RNA.
- The locally wild grown shrub, *Calotropis procera* has been shown to have anti larval use against dengue vectors. The product has been submitted for Indian Patent.

Clinical Research

- Examination and analysis of symptoms of dengue infected persons suggested that the abdominal pain could be included in the list of diagnostic clinical symptoms for Dengue.
- Detected dual and multiple viral infections (dengue and chikungunya as well as chikungunya and JE viruses) from various parts of the country.
- Dual infection of malaria parasite (*P. vivax*) and dengue detected.

Epidemiological/ Operational Research

- Community based control of dengue by exercising the principle of eco-bio-social components of human ecosystem.

- Control of transmission of dengue could be achieved with elimination of micro foci of infected mosquitoes.
- Surveillance for dengue fever in eastern Kolkata revealed a high incidence of 2.3% similar to the other high endemic regions of world.
- Surveillance for dengue fever revealed DEN-1 was the most prevailing strain followed by DEN 4, DEN 2 and DEN3.
- Demonstrated dengue, chikungunya virus activity in north-east India.
- Identified endemic zone of Arboviruses in West Bengal through Institutional surveillance programme, especially for Japanese Encephalitis, Dengue and Chikungunya.

Translational Research

- 3573 Dengue kits supplied by NIV for the national program.
- Developed some new products/processes and/or mechanisms like the *Cymbopogon sp.* related mosquito repellent, multi-angular viewer for mosquito taxonomic studies, and ELISA based antigen detection system for both the JE and Dengue mosquitoes.
- Development of indigenous ELISAs for the detection of JEV, Dengue, West Nile, Hepatitis A, B, E, Rota and Measles virus infections.
- Monoclonal antibodies developed against JEV, Dengue, West Nile, Chikungunya, Influenza and respiratory syncytial viruses.
- Risk analysis was done in the chikungunya infected areas in the rubber plantation belt of Kerala and accordingly, an action plan prepared jointly with the Rubber Research Institute of India (RRII) for the implementation of IVM for prevention and control of dengue / chikungunya vectors.

CHIKUNGUNYA

ICMR INSTITUTES WORKING ON CHIKUNGUNYA

1. Centre for Research in Medical Entomology (CRME), Madurai*
2. National Institute of Virology (NIV), Pune*
3. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Demonstrated emergence of African genotype of chikungunya (CHIK) virus; association with increased epidemic potential and disease severity; association of co-morbidities with systemic complications and associated mortality.
- Developed a murine model for CHIK infection.
- Demonstrated transmission of chikungunya virus in *Aedes aegypti* mosquitoes.
- Showed the role of macrophages and cytokines IL6, IL1RA, MIP1 and MCP1 in the pathogenesis of chronic arthritis following chikungunya virus infection.

* Lead Institute

- Developed codon optimized DNA constructs that elicited protective antibody response in animal models as candidates for DNA vaccine against chikungunya.
- Found East Central South African (ECSA) genotype of CHIKV with the “A226V” mutation during a renewed outbreak of chikungunya, which implicated to provide a higher efficiency in replication and dissemination for the virus in the vector species, *Aedes albopictus*.
- Development of Real-time PCR for the detection and quantitation of CHIK-RNA and ELISA for the detection of IgG-anti-CHIK antibodies.
- Real time PCR developed for the detection and quantitation of CHPV RNA.

Clinical

- Identified acute flaccid paralysis (AFP) as a complication of chikungunya infection.
- Revealed that chronic arthropathy in chikungunya is inflammatory erosive in nature similar to rheumatoid arthritis but different from rheumatoid arthritis as rheumatoid factor and anti-CCP found to be negative among the patients with chronic sequelae.

Epidemiological/ Operational Research

- During chikungunya outbreak, co-infection with respiratory syncytial virus (RSV) found in 87% and with influenza in 9% cases.

Translational Research

- Timely preparation of reagents for the diagnosis of Chikungunya infection leading to identification of entry of Chikungunya in India after a gap of 32 years. This was followed by country-wide supply of 1651 diagnostic kits to national program by NIV.

JAPANESE ENCEPHALITIS

ICMR INSTITUTES WORKING ON JAPANESE ENCEPHALITIS

1. Centre for Research in Medical Entomology (CRME), Madurai*
2. National Institute of Virology (NIV), Pune & its regional units at Alappuzha and Gorakhpur
3. Regional Medical Research Centre (RMRC), Dibrugarh
4. Vector Control Research Centre (VCRC), Puducherry
5. Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata

Basic Research

- Established JE surveillance network in Tamil Nadu to monitor JE virus activity in vector mosquitoes.
- Detection of JE virus antigen in desiccated vector mosquitoes.

* Lead Institute

- Developed isolates of JE virus from mosquito larva and humans by using *Toxorhynchites splendens* mosquito immuno-fluorescence assay (Toxo-IFA system) in place of the use of suckling mice.

Clinical Research

- Detected JE virus infection in *Culex tritaeniorhynchus*, along with *Cx. epidesmus* and *Cx. infula* from eastern Uttar Pradesh.
- Studies on the efficacy of attenuated vaccine against JE administered in the state of UP.

Epidemiological/Operational Research

- Developed an early warning system for Japanese encephalitis in Dibrugarh district.
- Molecular epidemiology of Japanese encephalitis in Assam revealed that JE virus multiplies significantly in goats. Screening of other domestic animals showed the presence of flaviviral infection in pigs, dogs and cattle.
- Association of Chandipura virus with encephalitis outbreaks of encephalitis in children with high mortality, understanding the magnitude of the problem, development of diagnostics and recombinant protein / killed vaccine.

Translational Research

- NIV JE kit was found to be as good as or better than the commercial kits available as certified by the CDC, USA. 504 JE kits supplied for the national program.
- A new index for infected vector abundance (IVA) has been developed to help in the gradation of JE virus circulation in the vector mosquitoes.

H1N1

ICMR INSTITUTES WORKING ON H1N1

1. National Institute of Virology (NIV), Pune*
2. Regional Medical Research Centre, Jabalpur
3. Desert Medicine Research Centre (DMRC), Jodhpur
4. National AIDS Research Institute (NARI), Pune
5. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Whole genome based characterization of the 2009 pandemic H1N1 Influenza viruses.
- Recombinant HA-protein ELISA, comparable to conventional Haemagglutination Inhibition developed for the pandemic H1N1(09) influenza virus.
- A mouse model developed for pandemic and seasonal H1N1 influenza viruses.

* Lead Institute

Epidemiological/ Operational Research

- Pandemic H1N1 2009 outbreak investigations in Panchgani and seroepidemiological surveys in Pune revealed wide transmission in community, especially in school-aged children, most infections being mild or asymptomatic.
- Investigated outbreaks in Port Blair, Car Nicobar and Chowra. Timely diagnosis provided to the health authorities helped in containment of the outbreak.

Translational Research

- Highly efficacious recombinant proteins-based vaccines developed for pandemic H1N1 and H5N1 influenza.

HEPATITIS**ICMR INSTITUTES WORKING ON HEPATITIS**

1. National Institute of Virology (NIV), Pune*
2. Regional Infectious Disease Laboratory (ICMR Virus Unit), Kolkata*
3. Regional Medical Research Centre (RMRC), Dibrugarh
4. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Generation of infectious cDNA clone for hepatitis E virus and characterization of helicase and protease enzymes.
- Identification of a new "I" genotype of HBV among tribal population of Arunachal Pradesh. This recombinant virus found to be prevalent in these tribes since 1963.
- Pig livers sold in Indian markets shown to be positive for HEV RNA.
- Association of various host factors with the pathogenesis of hepatitis E established.
- A candidate vaccine employing NS3 protein and peptide pool of hypervariable region 1 containing neutralization epitope of hepatitis C virus gave excellent results in mice.
- Development of a recombinant hepatitis E vaccine and combination vaccine with hepatitis B as evidenced by challenge experiments in rhesus monkeys.
- Established that Indian HBV isolates have very low prevalence of HBx mutations; absence of C-terminal deletions in HBx; and absence of p53 codon 249 mutations, found in the regions that are highly endemic for hepatocellular carcinoma.
- Identified genotype C (Southeast Asian sub genotype Cs) in one fifth of the Eastern Indian patients in addition to genotype D and A.
- Molecular studies indicated introduction of HBV/Cs through overland drug Trafficking routes via Manipur.
- Studies showed that male with age above 25 years, high HBV DNA levels, presence of T1762/A1764, C1753 and A1899 mutations are critical factors for clinical advancement

* Lead Institute

while age above 25 years and C1753 are significant predictor for cirrhosis in comparison with chronic liver disease.

- Selection and compartmentalization of viral variants with immune escape G145R mutation in peripheral blood leukocytes of Hepatitis B Virus carriers was shown for the first time.
- Detected that few HBsAg-ve/ anti-HBc+ve blood donors have occult HBV infection, with possibility of transmission of hepatitis B in recipients of blood components derived from them.
- Identified very high prevalence focus of Hepatitis B in Arunachal Pradesh.
- A new genotype (HBV genotype I) of Hepatitis B was identified in Arunachal Pradesh.
- Hepatitis C and its association with HIV was worked out in Manipur and Nagaland.

Clinical Research

- Showed that significant differences in risk factors and disease manifestation do exist among patients infected with different HBV genotypes in eastern India.
- Showed that Genotype A and C are frequent among chronic liver disease patients, while genotype D among inactive HBeAg-negative carriers.
- Differential pattern of mutations, liver injury and occult HBV infection was prevalent among sub-genotypes of Hepatitis B Virus Genotype D (D1,D2,D3 and D5).

Epidemiological/ Operational Research

- Associated Pre-core and Basal-Core Promoter mutants with high mortality during an unusual epidemic of hepatitis B virus in Modasa, Gujarat.
- Prevalence of HAV among high socio-economic group was reduced further matching to developed nations. Exposure of Middle socio-economic group also showed downward trend. Highlighted the need for the formulation of a national policy for this vaccine preventable disease.
- Showed a very high rate of exposure to HBV infection and occult HBV infection among the blood donors of Behrampur, Ganjam of Orissa. Ganjam district with very high rate of migration in search of livelihood had the highest HIV prevalence.
- Detected hepatitis B infection among those who were vaccinated and had protective antibodies indicating the possibility of vaccine escape mutants.

Translational Research

- Recombinant Hepatitis E vaccine developed with successful preclinical trial in monkeys.

* Lead Institute

POLIO**ICMR INSTITUTES WORKING ON POLIO**

1. Enterovirus Research Centre (ERC), Mumbai*

Basic Research

- Wild poliovirus type 1 and type 3 transmission pathways were explained by phylogenetic analysis of genomic sequences.
- Characterized polioviruses of Sabin OPV origin isolated from acute flaccid paralysis cases to understand reversion of attenuation sites and recombination with other enteroviruses.
- Genomic characterization of type 2 polioviruses of Sabin OPV origin and VDPVs led to a change in the definition of type 2 VDPV.
- A multiplexed SNP detection assay was developed to detect mutations at attenuation sites in the Sabin OPV viruses. The assay has been validated by genomic sequencing.
- A SNP assay has been developed for detection of polymorphism in the human poliovirus receptor (CD155).
- Studies showed differential innate immune response of human neuronal cells to wild and Sabin attenuated vaccine polioviruses.

Epidemiological/ Operational Research

- All polioviruses, isolated in India and Bangladesh were characterized to report wild poliovirus detection. Molecular epidemiological studies provided evidence of wild poliovirus importation and consequent outbreak of polio due to WPV3 in Bihar in 2007 and WPV1 in western UP in 2008.
- Immunization strategies for migrant, transit and underserved populations based on the detection of wild virus importation in several States in India were developed by the polio programme.
- Confirmation of WPV importations from India into Nepal resulted in cross-border immunization campaigns to stop transmission of WPV across the two countries.
- Type 2 vaccine derived polioviruses (VDPV) outbreaks detected for the first time in India. A small number of VDPV were also isolated in paralytic cases in immunodeficient children.
- Evaluation of population immunity to polioviruses in 25 districts of western Uttar Pradesh revealed immunity gaps for type 2 and type 3 poliovirus in infants.
- Environmental surveillance for wild poliovirus detection revealed importation from high risk endemic areas in Bihar and UP.

Translational Research

- Developed and evaluated an algorithm for testing of clinical samples for rapid detection of poliovirus infection and assisted WHO in implementing the new algorithm in the

* Lead Institute

global polio laboratory network. This improved wild poliovirus reporting from 42 days to 21 days.

- Evaluation of immunogenicity of newer formulations of OPV (mOPV1, 2 and 3 and, bivalent 1 and 3) in collaboration with WHO led to licensing of the vaccines in India.
- Evidence base to show that type 2 VDPV transmissions can be stopped quickly by mass immunization using trivalent OPV.

DIARRHOEA

ICMR INSTITUTES WORKING ON DIARRHOEA

1. National Institute of Cholera and Enteric Diseases (NICED), Kolkata*
2. National Institute of Virology (NIV), Pune*
3. Enterovirus Research Centre (ERC), Mumbai
4. Regional Medical Research Centre (RMRC), Port Blair

Basic Research

- Identification of human- animal reassortant and unusual rotavirus strains.
- Use of IgY antibodies against rotavirus infection established.
- Molecular modelling of the VP6 capsid protein of an avian Rota virus strain done.

Clinical Research

- Rotavirus vaccine trial showed the candidate vaccine (rotarix) was safe and immunogenic in children.

Epidemiological/ Operational Research

- Increasing incidence of rotavirus genotype G12 in Mumbai indicated it as an emergent pathogen in the country.
- Among children below five years, the major causal agent of diarrhoea in hospital was found to be Rotavirus; the other virus of interest was Norovirus.

PARASITIC DISEASE

MALARIA

ICMR INSTITUTES WORKING ON MALARIA

1. National Institute of Malaria Research (NIMR), New Delhi*
2. Desert Medicine Research Centre (DMRC), Jodhpur
3. Regional Medical Research Centre (RMRC), Bhubaneswar
4. Regional Medical Research Centre (RMRC), Dibrugarh

* Lead Institute

5. Regional Medical Research Centre for Tribals (RMRCT), Jabalpur
6. Vector Control Research Centre (VCRC), Puducherry

Basic Research

- Various new species of mosquitoes found while studying ecological succession of anopheline and other mosquitoes in North-Eastern States.
- Comparative genomic studies on the evolutionary understanding on several human genes; Duffy gene responsible for *P. vivax* infection, TNF- α gene responsible for severe malaria, CD36 gene responsible for malaria susceptibility and HBB gene responsible for sickle cell anaemia initiated.
- Indigenous production of monoclonal antibodies PfHRP2 and pLDH achieved.
- Micro-PCR based RT-PCR method of malaria diagnosis showed better detection level than RDT and microscopy.
- Molecular studies showed *An. annularis* and *An. culicifacies* to be resistant to DDT but susceptible to synthetic pyrethroids, while *An. fluviatilis* was found susceptible to DDT.
- Studies on prevalence of 76Tcrt / 86Ymdr1 *Plasmodium falciparum* isolates showed chloroquine resistance evolved de novo in 70% of *P.falciparum* infections, indicating chloroquine treatment failure.
- Mapping of the sibling species of *Anopheles dirus* complex, the major malaria vector in north-east India.
- Discovered, described and named three new mosquito species viz. *Uranotaenia dibrugarhensis*, *Verrallina assamensis* & *Armigeres mahantai* from North-East.
- Susceptibility regulating humoral factors of *Culex quinquefasciatus* against W. bancrofti infection like defensin, serpin, transferrin, actin and lipophorin identified, which may lead to the development of xenomonitoring tools.
- Developed a new rDNA-ITS2 PCR assay for separating the 5 members of the malaria vector *An. culicifacies* complex into two groups.
- Characterized *Culex tritaeniorhynchus*, the vector of JE by DNA barcoding.
- Isolated and identified two mosquitocidal proteins with MW 55 & 35 kDa from *Psuedomonas fluorescens* (VCRC B426).
- Simple PCR-based molecular diagnostic assays developed for *kdr* genotyping in *An. culicifacies* and *An. stephensi*. These assays can be used for monitoring of knockdown resistance in field populations.
- Developed a multiplex PCR for detection of *An. annularis* species complex and their vectorial attributes.
- Comparison of 1,817 functional genes of *P. falciparum* with *P. vivax* had revealed 82% similarity between these two species. While the conserved functional genes between the two species could be utilized in targeting for common drugs, the species-specific

un-conserved genes might be the store house of information, unique to each species, which could well be utilized for effective malaria control program.

- Survey of drug resistance genes in *P. falciparum* from high malaria endemic regions of the Odisha state indicated high prevalence of Pfcr1 (82.7%) and Pfmdr1(56.9%) and about 1.05% of DHFR + DHPS mutations. Microsatellite analysis has revealed that the parasites have evolved de novo in this geographic region.
- The prevalence of quintuple mutation (DHFR triple mutation and DHPS double mutation) found in North-eastern region can be used as a tool to screen clinical isolates by PCR based assay for monitoring SP resistance.
- As no genome sequence information of any Anopheles species other than *An. gambiae* is reported so far, therefore to generate new sequences in Indian malaria vectors, published, X-chromosome was scanned for detail characterization and obtained evolutionary patterns of different genes. The telocentric X-chromosome contains 106 genes of known functions and 982 novel genes.
- The whole genome sequence information of *An. gambiae* was utilized to amplify and sequence three orthologous nuclear genetic regions in six Indian malaria vector species (*An. culicifacies*, *An. minimus*, *An. sundaicus*, *An. fluviatilis*, *An. annularis* and *An. stephensi*). The reconstructed phylogenetic status of Indian malaria vectors followed the pattern based on morphological and cytological classifications.
- Natural infection of *Plasmodium vivax* and *P. falciparum* has been detected in *An. annularis* and *An. splendidus* in Jharkhand.
- Unequivocally established that *An. fluviatilis* S is a distinct species and is unrelated to *An. harrisoni*.
- *An. fluviatilis* species S is an established vector in forested areas of MP, however species T has been reported for first time as a vector from forest fringe areas.
- Molecular characterization of so-called *An. fluviatilis* from Assam, prevalent in post-monsoon season, revealed that they are in fact misidentified *An. minimus*.
- Mapping of the sibling species of *Anopheles dirus* complex, the major malaria vector in north-east India accomplished.

Clinical Research

- Study on treatment practices revealed irrational use of artemisinin including monotherapy and this led to ban on use of oral artemisinin monotherapy in the country by regulatory authorities.
- Pharmaco-vigilance programme for antimalarials launched.
- Mixed infection of *P. vivax* and *P. falciparum* up to the tune of 46% detected from various parts of the country.
- Characterization of the *P. falciparum* strains prevalent in North eastern region revealed that among artemisinin-based combination therapies (ACTs), the AS+SP combination

is safe and effective in achieving rapid parasite clearance well within 48 hours with less possibility of development of gametocytemia.

- Artemisinin Combination Therapy (ACT) found to be most effective against *P.falciparum*.
- Study on pregnant mothers from Nayagarh district of Orissa followed prospectively shown poor compliance (34%) to chloroquine chemoprophylaxis. The study also revealed that 33% of *P. falciparum* infected mothers were resistant to chloroquine.
- *Cx. quinquefasciatus*, *An. stephensi* and *Ae. aegypti* colony maintained in the insectariums and used for mosquitocidal property and measurement of potency of insecticides and larvicidal oils.
- Therapeutic efficacy studies of ACT, artesunate-sulphadoxine-pyremethamine (AS and SP), artemether-lumefantrine, artesunate-amodiaquine, artesunate-mefloquine, combination of dihydroartemisinin and piperazine, pyronaridine-artesunate were found with high efficacy. In a Phase II study (multi-country trial) of artemolane maleate plus piperazine phosphate was also found to have good efficacy.
- A randomized clinical trial conducted in Odisha using chloroquine and three alternate regimens indicated Artemisinin Combination Therapy (ACT) to be the most effective against *P.falciparum* infection, second being Co-Artem.

Epidemiological/Operational Research

- Evaluation and quality assurance of rapid diagnostic tests (RDTs) for malaria was accomplished and information given to programme.
- Study on estimation of malaria morbidity burden in India revealed that if we increase the Annual Blood Exam rate (ABER) matching with fever rate, the estimated malaria burden will be close to actual burden.
- Role of *An. stephensi* in transmission of malaria in rural area of North Gujarat established.
- Evaluation of Biodart (an aqueous Indigenous strain of Bti) and pyriproxifen, an IGR compound was undertaken in multicentric mode which proved very effective for larval control.
- Temephos and fenthion (both, larvicides) for vector control in different areas re-evaluated and consequently fenthion withdrawn from the vector control programme due to development of resistance.
- A study of association between socio-economic factors and transmission of Malaria in desert indicated statistically significant effect of malaria on low socio-economic group (LSEG) of the community as compared to HSEG. LSEG used fewer preventive measures.
- A software with special reference to malaria was developed and implemented in 8 CHCs/ PHCs in Jaisalmer district to collect real-time malaria data using existing infrastructure and through health workers at DMRC, Jodhpur.
- Mapping of anti-malarial drug sensitivity in 14 endemic districts of Orissa, revealed 54% to 100% of CQ resistance in *P. falciparum* infection.

- Studies on malaria in pregnancy revealed that there was a substantial burden of anaemia among pregnant women with malaria. Further, low birth weight was commonly encountered in babies borne by malarious pregnant women.
- Evaluated long lasting mosquito nets (LLINs), viz., Netprotect, PermaNet, DuraNet, Olyset Net and Interceptor in experimental huts for their efficacy against *An. fluviatilis*.
- Malariogenic stratification of Angul district of Orissa, a highly endemic district of malaria, on basis of distribution of sibling species was carried out. Based on insect bionomics and insecticide sensitivity pattern recommendations were made to state malaria programme for adopting rational vector control approach, that has reduced spread of disease in the vulnerable eco zones.

Translational Research

- Technologies transferred to National Programme: (1) Introduction of ACTs in National Drug Policy for malaria; (2) Introduction of Rapid Diagnostic Tests (RDTs) in National Programme and (3) Regulation of ban of marketing of artemisinin monotherapy in India.
- Olyset and permanet introduced in the vector control programme at national level for personal protection.
- Developed climate based model for impact of climate change on malaria by the year 2030.
- Developed village level risk map of malaria in problematic districts of southern and northern Karnataka using satellite remote sensing.
- Identified rainfall and satellite derived vegetation index as important indicators for early warning of malaria in desert.
- Using Remote Sensing (RS) and Geographical Information system (GIS), the vector *An. culicifacies* reported to be invading the deforested areas while the vector *An. minimus* found receding from these areas.
- Operational feasibility, social acceptance and sustainability of an indigenous larvivorous fish, *Aphanius dispar* for malaria control under the vector-borne disease control programme demonstrated in semi-arid area of Kutchh, Gujarat. Scaling-up use of this fish and capacity strengthening initiated in 2008 in collaboration with state Health Department, Gujarat.
- Completed studies on development of a field site for malaria vaccine trials at Rourkela (Orissa).
- Patents filed: 1) antimalarial activity of fractions isolated from *Artemisia roxburghiana*; 2) insecticidal activity of essential oil of *Psoralea corylifolia* against mosquitoes and 3) an immunodiagnostic reagent for the detection of *P.vivax* antigen: Ref. IP01699.
- A software predictive of desert malaria epidemic in desert has been developed and submitted to the programme for possible public health use.
- Indian patents applied for antimalarial property in an indigenous plant extract, and for mosquito larvicidal property in an indigenous plant extract.

- Bivalent malaria kits tested and approved by the Centre successfully inducted into the national program for rapid diagnosis.
- The technology developed for the production of mosquito larvicide, *Bacillus thuringiensis* var. israelensis transferred to a total of 4 firms during the plan period.
- Developed 3 types of fly ash based biopesticidal formulations, water dispersible powder (WDP), briquette (BR) and granular (GR), for controlling mosquito vector breeding in polluted (*Culex quinquefasciatus*) and clean water (*Culicines/Anophelines/Aedes aegypti*) habitats.
- A multiplex PCR was developed for simultaneous identification of anopheline vector species and their sibling species, parasite species and blood meal source in field collected mosquitoes. This technique will facilitate mosquito surveillance studies.

FILARIASIS

ICMR INSTITUTES WORKING ON FILARIASIS

1. Regional Medical Research Centre (RMRC), Bhubaneswar*
2. Vector Control Research Centre (VCRC), Puducherry*
3. Regional Medical Research Centre (RMRC), Port Blair
4. Centre for Research in Medical Entomology (CRME), Madurai

Basic Research

- Studies on immune markers of morbidity in Hydrocele and elephantiasis indicated association of endothelin1 gene polymorphism with lymphoedema and TNF receptor-II with hydrocele.
- High population of T-regulatory cells in cord blood of new born delivered from Circulating Filarial Antigen (CFA) +ve mothers have been found. Significantly increased levels of inflammatory cytokines IFN and decreased levels of IL-10 in cord blood of new born delivered from CFA +ve mother indicates that increased T-regulatory cells could down regulate inflammatory responses and facilitate parasite survival.
- Characterized calreticulin gene of *Wuchereria bancrofti* and Wsp, Gro El and FtsZ genes of its endosymbiont, *Wolbachia* as good targets for development of antifilarial drugs/vaccines.
- Macrophage Migration Inhibitory Factor (MMIF) of the filarial parasite found to be a good target for immunomodulator development.
- Identified 3 Single Nucleotide Polymorphisms (SNPs) in the genes of arachidonic acid metabolic pathway as biomarkers for the detection of non-responsiveness to DEC.
- Identified an epitope (P2) from L3 cDNA library of *Wuchereria bancrofti*, having potential in the xenomonitoring of LF.

* Lead Institute

- Baseline data on endemicity of filariasis from a few villages of Ghatampur, Kanpur Dehat have been generated, breast involvement in female observed as a dominant phenomenon.
- After exploring a variety of whole and purified filarial antigens, candidate *B. malayi* filarial antigens such as Bm mf S2 and Bm mf ES4 of diagnostic use have been identified.

Clinical Research

- Validated that annual single dose mass drug administration (MDA) of diethylcarbamazine (DEC) and albendazole combination therapy has an edge over DEC alone in lymphatic filariasis (LF) elimination.
- Established that the combination therapy of DEC and albendazole for filariasis resulted in enhanced efficacy against geohelminths.
- For the first time, Lymphoscintigraphy and ultrasonography for adult parasite conducted in young children with *W. bancrofti* infection established presence of lymphatic pathology that reverses with annual dosage of MDA.
- Developed vector transmission indicators for impact assessment of MDA against filariasis. Rate of reduction of microfilaraemia with MDA -100mg, 200 mg & 300 mg dosages found to be comparable with reduction in transmission, therefore low dose can be used in program.
- Newer anti filarial drug like moxadectum and its adulticidal effect showed more side reactions and hence not found suitable.
- Clinical trial with anti filarial drug indicated higher efficacy of double dose of albendazole (800mg) with DEC (300mg) administered biannually than existing regimen of (400 mg Albendazole + 300 mg DEC annual) in adult worm clearance.
- Treatment with tetracycline (0.2 mg/lit) right from egg to pupae cleared Wolbachia infection in *Aedes aegypti* and found suitable to control human and animal filariasis.

Epidemiological/ Operational Research

- Followed cohort of children below 5 years for Bancroftian filariasis up to 18 years revealed that most of the children (48%) in endemic areas are infected. while Mf prevalence rises with advancement of age, the CFA level does not, emphasizing the need for mass drug administration (MDA) in children to curtail transmission.
- For the Lymphatic Filariasis (LF) elimination programme, co-administration of albendazole with DEC found to be operationally feasible, safe for community use and has an edge over DEC alone and accepted and implemented by the National Programme; DEC fortified salt has been demonstrated to be a potential supplementary strategy to MDA of annual single dose DEC.
- Experiments suggested that the vector control, when used as an adjunct to MDA curtailed transmission and prevented the resurgence of LF transmission.
- The estimated quality of life of patients with grade IV oedema was only one third of the normal individuals and one year of morbidity management could improve their quality of life by 7%.

- A recombinant antigen rWb14 was found to be more sensitive than Wb paramyosin to detect filarial antibodies in microfilaraemic cases. (MGIMS, Sewagram & Anna University, Chennai).

Translational Research

- Delineated vector dynamics of diurnally subperiodic *W. bancrofti* filariasis in Nancowry group of islands and formulated strategy for elimination through the use of DEC fortified salt.
- Using a GIS based geo-environmental risk model, a filariasis transmission risk map for India created.
- Developed an AS-PCR assay based on a non-synonymous nucleotide variation (G->T) in the VEGFR-3 gene (Vascular Endothelial Growth Factor Receptor-3) coding for a tyrosine kinase to differentiate primary lymphoedema from secondary lymphoedema cases.
- A prototype electrochemical sensor developed for detecting *W. bancrofti* infection (DNA) in vector mosquitoes.
- A Real-Time PCR assay developed to detect albendazole resistance in *W. bancrofti* from microfilaria carriers.
- Identified 14 analogues of 5-Hydroxy-2-methyl-1,4-naphthoquinone (lead molecule isolated from the root extract of *Plumbago indica / rosea*) as potential candidates for further development as macrofilaricidal drug out of 75 synthesized and screened for macrofilaricidal activity.

LEISHMANIASIS

ICMR INSTITUTES WORKING ON LEISHMANIASIS

1. National Institute of Pathology (NIOP), New Delhi*
2. Rajendra Memorial Research Institute of Medical Sciences (RMRIMS), Patna*
3. Regional Medical Research Centre (RMRC), Dibrugarh

Basic Research

- Identified several virulence related parasite genes by microarray analysis followed by functional characterization of selected genes.
- Centrin gene knockout parasite mutants were examined as attenuated live vaccine. The mutants conferred protective immunity *in vivo* in mice and hamster.
- Identified genetic determinants in SAG resistance using genomic microarray approach which included PSA-2 and H2A genes; their over-expression in the parasite altered the sensitive phenotype to resistant.
- Captured the comprehensive picture of immune parameters in the lesion tissue of PKDL patients using cDNA array technology, implicating the presence of effector (IFN- γ ,

* Lead Institute

TNF- α) and regulatory (IL-10, TGF- β) molecules together with apoptosis (FasL/TRAIL) and chemokines related genes (MIP-1 α , MIP-1 β and MCP-1).

- *Leishmania donovani* isolates from SAG responder and non-responder patients showed differential ex vivo immune response and the isolates obtained from SAG responder subject elevated protective immune response in T-cells from SAG non responder patients.
- PCR-based diagnostic tool for leishmaniasis using peripheral blood samples established. PCR-based diagnosis found to have highest sensitivity (about 92%).
- Showed that TGF- β has a role in apoptosis of T- cell population in VL.
- Observed reduction in absolute circulating CD4+ and CD8+, with up regulation of IL-10 and down regulation of IFN- γ during active PKDL.
- Expression level of Natural T-reg cells found to be significantly high and co related with persistence of *L. donovani*.
- In acute VL both LDL and HDL down regulated, whereas VLDL, TG and Apo A1 were up regulated.
- Observed that CD2 boost up of protective Th1 response is also beneficial in enabling SAG to induce leishmanicidal molecules in macrophages to control the VL infection.
- Developed a freeze dried plant extract, with a potentiality to replace FBS/blood in culture media even at very low inoculum size.
- Developed a novel non-invasive method for diagnosis of VL with rK-39 strip test using sputum sample.
- Nested PCR of skin biopsies of hypopigmented macular cases of PKDL revealed significantly increased positivity (92.5%) as compared to the conventional method of microscopy (44.4%).
- In clinical isolates of *L. donovani* resistant to Amphotericin B (AmB) altered membrane sterol composition & content, better drug efflux/sequestration mechanism, over expression of enzymes of thiol metabolism and an upregulated peroxide elimination cascade were observed.
- Two sets of primers, BHUL18S and BHUSSU, developed by Banaras Hindu University, Varanasi showed about high sensitivity and specificity in diagnosing VL cases from patient's peripheral blood collected from simple needle prick.
- *In vitro* SAG susceptibility to miltefosine and amphotericin B significantly correlated of field isolates KA with SAG while paromomycin did not. Investigated the mechanism of miltefosine resistance using lab generated miltefosine resistant *L. donovani*.

Clinical Research

- Evaluated the association between localized and circulating levels of immune-determinants in Cutaneous Leishmaniasis (CL) patients by RT-PCR.
- Established the association between parasite burden and IL-4 response in lesion tissues in patients of Indian CL.
- Evaluated the dose-defining study of Miltefosine as first line drug in the LD elimination program.

- Phase II clinical trial of oral Sitamaquine in VL patients in hospitalization set up revealed that Sitamaquine is a safe and efficacious anti Kala-azar drug.
- Clinical trial to assess the safety and efficacy of injectable Paromomycin, showed 95% efficacy rate with no major side effects. This drug may be the drug of choice to treat SAG unresponsive cases and VL cases co-infected with other diseases like T.B. and HIV.
- Clinical trial of oral Miltefosine in PKDL patients with longer duration of doses (8 and 12 weeks) revealed 12 weeks treatment is better than 8 weeks.
- Combination therapy using Miltefosine and Ambisome, Paromomycin and Ambisome found to be a better alternative in reduced duration of treatment.
- *Leishmania donovani* reported as an important cause of cutaneous leishmaniasis in Himachal Pradesh.

Epidemiological/ Operational Research

- Established *Leishmania tropica* as the causative agent of CL in the disease endemic region of Rajasthan.
- Under the study “Efficacy, acceptability and cost effectiveness of long lasting insecticidal nets in the prevention of kala-azar” sponsored by the European Commission”, RMRIMS, Patna has evaluated and compared the various existing technologies for sand fly collection to be used in this study through a pilot study. CDC-Light trap was found more effective than CDC-UV and in terms of per hour collection, mouth aspirator was found more efficient than CDC followed by sticky traps.
- For surveillance of kala-azar, Camp approach was found with higher case yield than house-to house survey.
- Observed that asymptomatic cases in VL endemic population are a major threat for VL control strategies.
- Detected focus of visceral leishmaniasis in Assam.

Translational Research

- Developed and applied species-specific PCR for detecting *Leishmania donovani* which was tested in the endemic area and widely utilized in referral labs as a confirmatory test.
- Developed and applied real-time PCR assay to diagnose and simultaneously estimate parasite load in clinical samples of Visceral Leishmaniasis (VL) and Post Kala-azar Dermal Leishmaniasis (PKDL).
- Developed and applied immunological methods such as DAT, ELISA and rk39 based strip test for diagnosis of VL.
- Application of remote sensing and GIS as an “Epidemic predictor” established.
- Long-lasting impregnated bed net (LLIN), evaluated on experimental basis found effective for vector control.

- “Monitoring and evaluation toolkit” developed for spray activity. Usefulness of compression pump was compared with stirrup pump based on the logistics and operational observations compression pump was found better than stirrup pump.
- Software package (85% accuracy) developed to forecast the disease: Wet fallow land and water body are endemic for sandfly, the non-endemic districts were covered by forest and agricultural fallow land.

PARAGONIMIASIS

ICMR INSTITUTE WORKING ON PARAGONIMIASIS

1. Regional Medical Research Centre (RMRC), Dibrugarh

Basic Research

- Etiology of endemic haemoptysis confused with pulmonary tuberculosis established, crabs identified as intermediate host and detailed life cycle of *Paragonimus* lung fluke established.
- Prevalence and disease burden of paragonimiasis determined in different north-eastern states.
- Molecular characterization and infrapopulation differentiation of *Paragonimus* lung fluke in north-east India accomplished.
- A rodent model of Paragonimiasis for drug testing and other research work developed.

Technique Development

- A ELISA kit developed for detection of Paragonimiasis in humans.

NON-COMMUNICABLE DISEASES

CANCER

ICMR INSTITUTES WORKING ON CANCER

1. Institute of Cytology and Preventive Oncology, NOIDA*
2. National Centre for Disease Information and Research, Bangalore
3. National Institute of Pathology, Delhi
4. Regional Medical Research Centre, Dibrugarh
5. National Institute of Nutrition, Hyderabad

Major contributions

- The National Cancer Registry Programme (NCRP): 24 population based cancer registries and 6 hospital based cancer registries, under the NCRP network. 16 institutions (including the 6 HBCRs) are participating in the Patterns of Care and Survival Studies

* Lead Institute

(on cancer breast, cervix and Head & Neck cancers). The data has provided information on magnitude of cancer problem, trends from the registry areas and helped in hypothesis generation.

- Cancer Atlas: Provided information for doing evidence based cancer control activities through specific indicators.
- Guidelines for Management of Cancers in buccal mucosa and cervix were developed.
- Developed sensitive test for detection of cervical cancer lesion using samples collected in non invasive manner.
- Developed a magnifying device (Magnivisualizer) with an inbuilt source of light for use in the field conditions.
- Investigation of genetic risk factors for young breast cancer patients have shown no significant contribution of BRCA 1 & 2 genes, however, the CYP17 A2 allele, VDR Poly AL allele and >20 CAG repeats identified as putative high risk alleles and women carrying genotype with three putative high risk alleles with increased risk of developing breast cancer (OR=4.68) than those carrying one or two putative high risk alleles.
- A Th2 dominant host immune profile shown to have association with recurrence of tumor in bladder cancer patients. Combination panel of immuno-histochemical markers (p21waf1/VEGF/CD105) was more effective in predicting recurrence of bladder cancer than a single marker.
- Germ-line sequence alterations in BRCA2 gene in familial ESCC patients from this high-risk area of India suggested that BRCA2 may play a role in genetic susceptibility to familial ESCC.
- Studies on usage of smokeless tobacco and its long term consequences.
- Identification of deficiencies in cancer patient care in the Indian setting in terms of standardised recording of clinical information, compliance to treatment and follow-up.
- An indigenous PCR based test developed for the detection of HPV and its types.
- p53 codon72 polymorphism- Interaction with smoking was a significant risk factor for oral cancer and interaction with betel quid was significant risk factor for lung cancer.
- Setup and run a functional cytogenetic laboratory with the ability to undertake standard and advanced (molecular) chromosomal analysis for prenatal, postnatal and cancer samples. Developed newer technologies for diagnosis of chromosomal disorders.
- Studies showed that Nicobarese are high risk group for chronic NCDs, prevention being initiated.
- Detected higher frequencies of KIR2DL2 ligands among Jarawa: Higher susceptibility to infectious diseases and cancer.
- Identification of proportion of patients presenting at late stage.
- Laid a framework towards clinical evaluation and multi-centric trials.

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- Research related to diet and cancer studies, n6 diets had deleterious effects on tumorigenesis. Studied the role of dietary aldose reductase inhibitors in human cancer.
- Community based intervention for chronic non-communicable diseases risk reduction among Nicobarese.
- Fertility Preservation in Individuals with Gonadal Insufficiency including Cancer Survivors: cryopreserve the gonadal tissue prior to cancer therapy for future use to ensure biological parenthood. Methodology to cryopreserve gonadal tissue for future clinical use was established.
- Studies directed to understand the significance of PSP94 in the pathogenesis of prostate cancer revealed that PSP94 and its interacting partner, CRISP-3 independently cause growth inhibition in cell line specific manner. This suggests CRISP-3 may have PSP94-independent role during prostate tumorigenesis.
- Studies in patients with urinary bladder cancer demonstrated the feasibility of reactivating the expression of hypermethylated and silenced tumor suppressor genes.
- Androgen receptor identified as independent predictive marker for response to neo-adjuvant chemotherapy in locally advanced breast cancer cases.
- EMA, WT1, ezrin, claudin 1 & SPARC identified as potentially useful markers for differentiation of fibroblastic meningioma from schwannoma.
- EPHX1 exon4, 139His/Arg and 139Arg/Arg genotypes found to be patients with higher risk for oesophageal and lung cancer.
- Betel quid chewing was identified by MDR analysis as the single main risk factor for breast cancer in NE region.
- Up-regulation of gene involved in β -cell receptor signaling pathway and down regulation of genes in Natural Killer cell mediated cytotoxicity in familial ESCC suggested that immune response may influence the natural history of ESCC in high-risk area of India.

Diabetes

ICMR INSTITUTES WORKING IN THE AREA

1. National Centre for Disease Informatics and Research (NCDIR), Bangalore
2. National Institute of Nutrition, (NIN), Hyderabad*
3. Regional Medical Research Centre, (RMRC), Dibrugarh
4. National Institute for Research in Tuberculosis (NIRT), Chennai
5. Regional Medical Research Centre (RMRC), Bhubaneswar
6. Head quarters Task Forces & NCD Division, New Delhi
7. Advance Center on Genomics of Type II Diabetes, Chennai
 - Diabetes Atlas: the collated data was mapped and the maps were prepared using the MapInfo software.

* Lead Institute

- Novel mutations Arg263His, co-segregated in a diabetic family has been discovered.
- Lower incidence of diabetes mellitus and impaired glucose tolerance in the Raika and other communities were found to be due to consumption of camel milk.
- Curcumin holds promise as an agent for preventing or treating diabetic complications.
- Molecular link between Diabetes and Obesity: Resistin, secreted by fat cells (adipocytes) is down regulated by anti-diabetic drugs like thiazolidinediones (TZD) and has been implicated as a link between type 2 diabetes and obesity in the mouse model.
- Functional foods with respect to aldose reductase inhibitors and antiglycating agents against diabetic complications has led to identification of some compounds from dietary sources for combating diabetic complications *i.e.* diabetic retinopathy and cataract.
- For the first time, a novel mutation (F71L) in α -crystallin associated with age-related cataract due to defective chaperone-like function identified.
- Demonstrated the prophylactic effects of Pyridoxal 5 Phosphate (PLP) towards the beta cell protection in diabetogenic mice due to its antioxidant function.

Environmental and Occupational Health

ICMR INSTITUTES WORKING IN THIS AREA

1. National Institute of Occupational Health, Ahmedabad*.
 2. National Institute of Malaria Research, New Delhi.
- A Centre for Advanced Research on Environmental Health on Air Pollution established.
 - New Initiative on Climate change and its effects on vector transmission, eye health and respiratory health started so as to understand the patterns in disease vis-a-vis disease variability.

Hemoglobinopathies

ICMR Institutes working in this area

1. National Institute of Immunohematology (NIIH), Mumbai*.
 2. Regional Medical Research Centre (RMRC), Jabalpur.
 3. Regional Medical Research Centre (RMRC), Bhubaneswar.
 4. Regional Medical Research Centre (RMRC), Dibrugarh.
- Detected novel mutations causing red cell enzymopathies with pathologic population genetics importance, some of these mutations eventually have been integrated into our prenatal diagnosis programme.

* Lead Institute

- Established a very cheap, fast and accurate flow cytometric technique for evaluation of osmotic fragility in hemolytic anemias.
- Developed a Microtitre plate based cheap and affordable technique for detection of pyrimidine 5' nucleotidase deficiency in red cells.
- CGH technique established for studying hematological malignancies with small chromosomal imbalance.
- A simple, cheap, semiquantitative technique developed for factor XIII deficiency.
- Non - invasive prenatal diagnostic technique developed for hemoglobinopathy *i.e.* detection in the 10 to 15 week foetus.

XI PLAN ACHIEVEMENTS: EXTRAMURAL RESEARCH

Extramural research is promoted by ICMR through task force studies with emphasises on time, goal-oriented approach, clearly defined targets, standardized and uniform methodologies, and often a multicentric structure, open-ended research on the basis of applications for grants-in-aid received from scientists from medical colleges, universities, R&D organizations, NGOs *etc* and setting up of Centres for Advanced Research in different research areas around existing expertise and infrastructure in selected departments of medical colleges, universities and other research institutes and non governmental organisations. The achievements in the XI plan and the proposed activities are as follows:

DIVISION OF EPIDEMIOLOGY AND COMMUNICABLE DISEASES

The Division's extramural and intramural activities contributed significantly to understanding of epidemiology of various infectious diseases such as viral diseases (emerging-re-emerging viral infections, HIV, influenza, viral hepatitis, dengue, Chikungunya, JE/AES *etc.*), bacterial/mycobacterial diseases, parasitic diseases like malaria, filariasis, kala-azar *etc.* In addition, research on health issues of tribal health of the country as well as the North-eastern population were the other major thrust areas of the Division.

Salient Achievements

- During the first four years of XI plan the Division has funded 498 extramural research projects on communicable diseases.
- **Tribal Health Research Forum** has been established to synergize the efforts of seven ICMR Institutes in the area of tribal health. During the two meetings of the Forum, an Expert group has reviewed the research on hemoglobinopathies, nutritional disorders, tuberculosis, viral hepatitis, Fluorosis, diarrheal diseases, leptospirosis, vector borne diseases, maternal and child health and life style diseases conducted in tribal populations of the country and has identified the potential leads that can be translated for public health benefit.
- **Vector Science Forum** has been created to promote research on vectors and develop a common platform for all vector biologists, entomologists, programme people and experts embarking upon common issues and also promote goal directed research for control of Vector Borne Diseases in the country.

Viral Diseases:

- **Viral Diagnostic Laboratories** are being set up in the country to build capacity for handling outbreaks of all emerging-re-emerging and common viral diseases all across the country and to carryout research. Three different levels of laboratories are being set

up. Eight labs are already functional and another 10 will be coming up by end of 2011-12. Eventually this programme will merge and synergize with activities of DHR .

- A network of laboratories for diagnosis and characterization of H1N1 influenza virus was established during the crisis of the 2009-2010 pandemic. ICMR's National Institute of Virology, Pune has earlier been identified as a WHO Referral Centre and reference center with eight other regional centers.
- Cases and deaths due to Acute Encephalitis Syndrome (AES) have been consistently reported from many states of India. The etiology of AES could be determined in only 25% of the cases (18-20% JE and 5-7% bacterial and other causes). In order to address this complex problem, a Task Force on Acute Encephalitis Syndrome has been formed and five multicentric research studies were initiated in areas of development of new diagnostic techniques, clinical studies and vaccine efficacy studies.
- Control of JE in Vridhachalam, South Arcot District, Tamil Nadu: New vector indices like Dusk index for JE vector which relates proportion of parous female mosquitoes with vector abundance were developed; surveillance was strengthened, MAC-ELISA for diagnosis of JE in humans using finger prick blood samples was standardized and utilized and implementation of water management and application of neem-coated urea as fertilizer and pesticide were tested in the rice land agro-ecosystems to reduce densities of mosquitoes and found to be a useful approach (*CRME, Madurai*).
- A multicentric cross-sectional epidemiological study was carried out to understand the epidemiology of viral hepatitis in primitive tribes of Orissa, Madhya Pradesh/ Chhattisgarh (MP/CG) and Jharkhand. The analysis of risk factors revealed that body piercing and history of injection were significantly associated with HBV/HCV infection. All the HBV positive samples were of genotype D, similar to other parts of the country (*RMRC, Jabalpur, Bhubneshwar and IPGIMER, Kolkata*).
- The results of a project suggest that co infection of genotype A and D of Hepatitis B virus are more frequently present in HBV related hepatocellular carcinoma. Samples from human, monkey and swine revealed that all samples belonged to genotype 1 HEV virus suggesting HEV may be a zoonotic disease (*AIIMS, New Delhi*).
- A study conducted in North-east part of the country revealed the presence of JE virus genotype I (very rare in India) in addition to genotype III (common in India) In addition, presence of West Nile virus was also identified (*RMRC, Dibrugarh*).
- A study of genotyping of HIV in North India revealed that subtype C HIV-1 was predominant in the North Indian infected population. An in-house protocol for the detection of drug resistant mutation in HIV-1 has been developed which needs to be validated and compared with commercially available kits (*PGIMER, Chandigarh*).

Parasitic Diseases:

- Malaria Parasite bank has served as a national resource for *Plasmodium* isolates in the country. Till now a total of 1075 isolates of human malaria parasites (*P. falciparum*, *P. vivax* and *P. malariae*) have been collected and cryopreserved in parasite bank. The facility is also utilized by various universities, Institutions and research organizations (*National Institute of Malaria Research, New Delhi*).
- The Integrated Disease Vector Control (IDVC) project initiated in 1985 has 10 field stations located in different malaria endemic regions of India and which continued to

provide support to the local public health authorities, technical support to Directorate of National Vector Borne Disease Control Program (NVBDCP) for training, monitoring of Malaria in high risk malaria districts, rapid diagnostic kits and testing of new antimalarials (*National Institute of Malaria Research, Delhi*).

- A completed study in Madhya Pradesh revealed that prevalence of *P. vivax* was highest among children of 4-6 years of age and declined in older age groups while *P. falciparum* was highest in children of 6-8 years and then gradually declines. The malaria associated anemia was 35, 34 and 53 % in pregnant women, infants and children respectively (*Regional Medical Research Center for Tribal Health, Jabalpur*).
- Development of rWb14 antigen based IgG4 antibody assay as a useful tool to detect infected cases of Filaria for the prompt initiation of anti-filarial therapy and for the surveillance of elimination programme (*Jamnial Bajaj Tropical Disease Research Centre, Sevagram, Wardha*).
- A geo-environmental risk model (GERM) on GIS platform for determining potential areas of transmission of lymphatic filariasis based on a map for filariasis transmission has been developed and will be useful for the National LF Elimination programme for prioritizing the areas for intervention (*Vector Control Research Centre, Puducherry*).
- A diagnostic method for Visceral Leishmaniasis (VL) using PCR technique was developed and showed 87.2% sensitivity and 86.7% specificity on whole blood. (*BHU, Varanasi*).

Bacterial Diseases:

- In view of the serious concern of increasing antimicrobial resistance being reported from various parts of the country, ICMR has established an Antimicrobial Resistance Surveillance network. Multicentric projects have been shortlisted for further processing for funding.
- A study conducted to find out the prevalence of hospital isolates resistant to third generation cephalosporins revealed the presence of NDM-1 in 3% of the hospital isolates (*Christian Medical College, Vellore*).
- Fimbrial proteins of *E. coli* have been purified and characterized. These subunits appear to have potential to be used for raising antibodies and can be evaluated as potential candidate vaccine (*Centre for DNA Fingerprinting and Diagnostics, Hyderabad*).
- A study revealed the use of ESBL DNA micro-arrays for rapid genotypic detection of β -lactamases as an important tool for monitoring the spread of ESBL resistance genes within the hospital settings (*PGIMER, Chandigarh*).
- A study conducted to develop diagnostic methods to identify food borne Infections caused by Non-Typhoidal-Salmonella (NTS) serovars. RAPD and ERIC-PCR together showed a high sensitivity and specificity of detection of NTS serovars (*College of Fisheries, Mangalore*).

Mycobacterial Diseases:

- Significantly elevated mean levels of LH, FSH and prolactin in leprosy affected females was observed. (*AIIMS, New Delhi*).

- Epidemiological studies at Ghatampur (UP) have shown that 75% cases in endemic pockets are due to backlog. This study has generated important base line data on leprosy genotypes. Trends show a steep decline in prevalence of disease. Using gene amplification methods both DNA & RNA of *M. leprae* have been isolated from soil & water sources collected from around the patient's residences indicating that *M. leprae* persists in environment. (NJILOMD, Agra).
- Discovered a novel restriction enzyme NruI using bioinformatics tool to develop a PCR restriction analysis assay for differentiating between *M. tuberculosis* and non-tubercular mycobacterium (NTM) from sputum samples (VPCI, Delhi).
- Identified two putative peptide transporter operons, OppA and PPK2 in the genome of *M. tuberculosis* which regulate the ability of *M. tuberculosis* to lower glutathione levels in infected compared to uninfected macrophages. These can be explored as novel drug candidates of *Mycobacterium tuberculosis* (Bose Institute, Kolkata).
- A study on mutations in *embB*, *embC* & *embR* genes involved in resistance to Ethambutol in *M. tuberculosis* clinical isolates from Lucknow has provided useful information about these mutations (SGPGI, Lucknow).

Fungi:

- The Center for Advanced Research in Medical Mycology, Chandigarh achieved the following: (i) established serodiagnosis of Zygomycosis using a purified 66 KD immunodominant antigen, (ii) developed a novel molecular identification method for medically important Zygomycetes from unique sequences in the ITS (Internal Transcribed Spacer) region and Fluorescent Immune Sequence Hybridization (FISH) technique (iii) established molecular strain typing of *Rhizopus oryzae* by Multilocus Micosatellite (MLMT) typing protocol, (iv) established molecular strain typing of *Apophysomyces elegans* by amplified fragment length polymorphism (AFLP), developed molecular strain typing of *Aspergillus flavus* by Multilocus Sequence Typing (MLST), (v) developed a nine marker microsatellite panel using MLMT and AFLP typing of *Aspergillus flavus* strains isolated from different clinical sites from patients with Aspergillosis, (vi) established molecular typing method for *Penicillium marneffeii* by combining RFLP of ITS and NTS regions, (vii) developed a molecular typing method for *Kodamaea ohmeri* by AFLP (viii) novel protein/antigens were identified as biomarkers for 'Paranasal Sinus Mycoses' (ix) training workshops on medical mycology were also convened.

REPRODUCTIVE HEALTH & NUTRITION

The Division of RHN funded 463 projects, of which 28 were fellowships, 81 Ad-hoc studies and 55 Task Force studies. Three Centers for Advance Research were also established.

Reproductive Biology & Fertility Regulation

- The interim data analysis after two year follow-up on Phase-III Clinical Trial with an intravasal injectable male contraceptive RISUG® did not indicate any side effects. All subjects are maintaining the clinical efficacy of the drug.
- Comparative long-term retrospective follow up study (after 9-10 years) of RISUG injected and vasectomized (NSV) subjects showed no serious adverse clinical symptoms

in RISUG injected subjects. This suggests that RISUG is a safe and effective long term male contraceptive.

- Phase – 3 clinical trial with subdermal contraceptive single rod implant Implanon[®] indicated that Implanon is acceptable to women as a three year method and is highly efficacious in preventing pregnancy with minimal side effects.
- Emergency Contraceptive Pill (ECP) services provided by paramedics was of comparable quality as of physicians. Compliance in using teaching aid during counseling on ECP was higher than physicians. The study showed that by allowing paramedics to provide ECP services, its accessibility and use will increase manifold.
- Pre-programme introduction of injectable contraceptives through district hospitals has been initiated with the standard operating guidelines, manuals; job aids for physicians, paramedical worker prepared for the study.
- At the behest of the MOHFW, Govt. of India the Council drafted the *Assisted Reproductive Technology (Regulation) Bill & Rules – 2010*.

Maternal Health

- Presence of anticardiolipin antibodies (ACL) significantly increased the risk of fetal loss, low birth weight and preterm labour. Women with Antiphospholipid Syndrome (APS) benefit from therapy and levels of ACL and Lupus anticoagulant (LA) can be most useful in making decision to treat.
- In women with poor reproductive performance such as unexplained infertility or intrauterine growth retardation, serological screening for celiac disease should be studied.
- Prevalence of hepatitis C during pregnancy was found to be 1.03%, however 61.9% cases did not have any identifiable risk factors and didn't have adverse effect on pregnancy outcome.
- Marginally higher expression of HLA-G transcript with dexamethasone as compared to hydrocortisone was observed suggesting potential of these molecules as candidate drugs for assisting the maintenance of a successful pregnancy in Recurrent Spontaneous Abortion (RSA).
- Data on the case load and management practices of eclampsia indicated a need to promote and scale-up the implementation of evidence-based practices in eclampsia to reduce maternal and perinatal morbidity and mortality
- Effectiveness of low dose magnesium sulphate was compared with standard dose for management of eclampsia. Results showed that the rate of recurrent convulsions were higher with low dose regimen but were not associated with an increase in maternal mortality.
- The levels of antioxidant factors and effect of vitamin E supplementation in pregnancy induced hypertension did not find a significant change in baseline level of Vit E as compared to normal pregnant women though supplementation led to increase in the levels within the normal range.
- Oxidative stress parameters studied in anaemic pregnant women with daily vs weekly iron therapy indicate less oxidative stress in the weekly arm.

- Study of maternal hemoglobin and its association with rate of preterm birth, birth weight of newborns and other neonatal outcomes indicated that Maternal hemoglobin <10 g/dl is significantly associated with preterm labor and low birth weight, but there is no association with perinatal mortality.
- Clinical, ultrasonographic and biochemical parameters evaluated to formulate a scoring system to predict risk of preterm delivery in pregnant women indicated infective etiology (poor orodental hygiene) but no biochemical marker for prediction of PTL could be identified.
- Engagement of AYUSH practitioners (Ayurveda and Homeopathy) in the public health system is being studied to assess the training needs of AYUSH practitioners in providing SBA services.
- Intrapartum and early postpartum provider practices and barriers to implementation of guidelines for skilled birth attendance obtained from all levels of health care studied in 5 districts of the country indicated that in-service training is key to promoting good provider practices and emphasis should be given to maintaining adequate delivery records, ensuring “5 cleans” during delivery and plotting of partogram.
- Need based intervention to reduce episiotomy rates in health facilities as study indicated a higher incidence of perineal injury, infection and vulval hematoma in women when episiotomy is universal.
- WHO Global Survey on maternal and perinatal health Asia (GSA)- India indicated that caesarean section should be done only when medically indicated.
- Designed and validated a breast-nodularity measuring scale to reduce un-necessary biopsies and improve clinical judgment through physical breast examination.
- Genetic and molecular factors in the aetiology of endometriosis identified genetic sequences homologous to shigella bacteria in the ectopic endometriotic tissue.
- Study of effect of different management strategies on the ovulatory response and pregnancy rates indicated a combination of metformin and life style modification with a resultant improvement in ovulation, pregnancy outcome, self-esteem and endocrine parameters should be the first therapeutic option for obese, infertile PCOS women.
- Effect of different doses of mifepristone (10 & 25 mg) on size and symptoms of uterine leiomyoma size indicated symptomatic relief, reduction in myoma volume, development of reversible amenorrhoea and endometrial hyperplasia without premalignant potential.
- Diagnosis of female genital-tuberculosis (GTB) by various diagnostic modalities and fertility-outcome after treatment were evaluated. No single test could pick-up all cases of GTB, hence, whole battery of tests is needed to increase pick-up.
- Sexual Behavior and Contraceptive Use among HIV Positive People carried out at three centers to explore the changes and factors that influence the sexual behavior and contraceptive use among people aware of their HIV positive status and also to explore the perspectives of the health care providers and program managers.

- Results of Phase-I trials indicated that polyherbal BASANT cream was safe and well tolerated when applied once daily for 14 consecutive days among 30 healthy women.
- A cross-sectional study is being carried out to determine the prevalence and incidence of HIV among high risk group of commercial sex workers. Based on this, sites are being prepared for conducting effectiveness trials of microbicides in 6 districts of the country.
- Under the Brown/Tufts Program for Enhanced HIV Prevention Training of ICMR Researchers, two scientists were trained in microbicide research for a duration of 3-6 months.
- Good Clinical Laboratory Practices (GCLP) Guidelines were drafted and put up on ICMR website for use by researchers as well as laboratories.

Child Health

- A multi-centric open labeled trial to study the Effectiveness of 3-day amoxycillin vs. 5-day co-trimoxazole was done for the treatment of non-severe pneumonia in children aged 2–59 months. Treatment in terms of World Health Organization (WHO) defined non-severe pneumonia in primary health centers in rural India was compared. No difference in effectiveness of oral co-trimoxazole or amoxycillin in treating non-severe pneumonia was observed.
- Feasibility of introducing genetic services in the National Family Welfare Programme in India showed that genetic factors could play an important role in the outcome of pregnancy. This study carried out to identify risk factors that result in adverse pregnancy outcome and to develop a system of screening and referral to a tertiary hospital equipped with facilities for diagnosis and management of high risk pregnancies showed that a simple questionnaire may be used for screening of pregnant women at risk of having an adverse outcome.
- The study on impact of daily zinc supplementation to infants born with low birth weight on mortality and severe disease requiring hospitalization concluded that daily zinc supplementation with 1RDA(5mg) dose had no beneficial effect in preventing severe disease (diarrhea, ARI).
- The impact of neonatal referral card on neonatal mortality and on qualified medical care seeking medical behaviour of the parent/guardians of neonates was studied in a before and after intervention. This study conducted at 2 urban public hospitals at Lucknow showed that qualified medical care-seeking for neonatal illnesses improved significantly after intervention.
- The Pune low birth weight study - birth to adulthood showed that all LBW children showed poor speed on differential aptitude test, pre term SGA children had low scores in mechanical reasoning, full term SGA children were poor in Space relation. LBW (<2000g) especially the VLBW (<1500g) and preterm children have lower IQs compared to normal controls. SE status, mothers education had a great impact on IQ failure.
- A study conducted on single stage treatment of spina bifida with hydrocephalus based on a prediction rule derived from cranial ultrasound concluded that performing surgery for spinal bifida with hydrocephalus in one stage is of therapeutic and monetary benefit to the patient.

- Key results on the Home based management of young infants are: In the *Shishu Rakshak* arm there was 21% decline in early neonatal mortality rate compared to control arm. Decline in IMR(29%), young infant mortality rate(25%) and post-neonatal mortality rate (42%) was observed in *Shishu Rakshak* arm compared to control arm. In the AWW arm also 13% decline in IMR was observed compared to control population but it was statistically not significant. The impact on NMR, post-neonatal mortality rate and young infant mortality rate in the AWW arm was less remarkable and / or statistically insignificant.
- A study with nevirapine levels in HIV-infected children receiving antiretroviral therapy with fixed dose combinations enrolled 79 children (58 male and 21 female) receiving fixed dose combination ART. The plasma concentrations of nevirapine, stavudine and lamivudine were simultaneously measured by liquid chromatography- mass spectrometry/mass spectrometry (LC-MS/MS). It was observed that the current dosing schedule leads to adequate plasma levels of nevirapine. Most of the children had viral suppression.
- Demographic and genetic studies related to the incidence of Neural tube Defects from 199 cases (NTDs) and 335 controls suggest the cumulative effect of various factors that might have resulted in the conception of NTDs, and the peri-conceptional folic acid supplementation might have reduces the effect of some factors.

Reproductive Biology

- A study on the effect of levonorgestrel of G protein mediated signal transduction of platelet function in female rabbits indicated that prolonged use of LNG oral contraceptive may promote venous thromboembolism in women.
- Evaluation of role of environmental hazards in the etiology of female reproductive failure indicated that increase concentration of dioxin-TCDD in women leads to the severity of the endometriosis.
- A study on modulation of stress associated biochemical changes in infertile male seminal plasma by Indian herbal preparations study demonstrated the positive impact of *M. pruriens* not only on dopamine levels but also on other biochemical constituents, such as adrenaline and noradrenaline, in the reproductive tract. *M. pruriens* seem to influence fertility by its action on the central nervous system through dopamine.
- A study to evaluate the correlation between levels of cytokines (IL-6, IL-10) in seminal plasma in different groups of infertile men and correlation with sperm morphology, functions and bacterial infection in semen indicated a correlation between the levels of cytokines (IL6 & IL10), PMN elastase and sperm function tests in STD's patients.
- Proteomic studies of spermatogenically inactive (postnatal) and active (adult) sertoli cell secretory products to determine factors responsible for the regulation of spermatogenesis showed the effects of hormones on the protein secretion profile of sertoli cells cultured from infant and also from adult rat testes and has also characterized the proteins which are unique in infant or in adult sertoli cells.
- Data on the purification and characterization of motility inhibiting protein factor from goat epididymal plasma and fertility management is likely to be useful in understanding the biochemical regulation of sperm quiescence, motility and fertility, which are essential for fertility management in human as well as in animal breeding. As motility

is essential for fertilization therefore, the forward motility inhibitory factor (MIF) and its antibody identified in the present investigation may play an important role in control of fertility.

- Study on recombinant human zona pellucida glycoproteins binding characteristics to spermatozoa and subsequent biochemical changes would help in better understanding of the molecular basis of fertilization in human and thus help in further improving the protocols for *in vitro* fertilization & also in designing novel drugable contraceptive.

Nutrition

- Maximum residue limits for pesticide residues in carbonated water was fixed. The National Level Expert Group constituted by the Health Ministry to guide the sub-committee of Central Committee for Food Standards (CCFS) recommended a maximum residue level of one part per billion (ppb) for an individual pesticide for carbonated water. In June, 2009, the Ministry of Health and Family Welfare issued the final Gazette notification, No. 357 "Prevention of Food Adulteration (First Amendment Rules, 2009)", which implements the tolerance limits of insecticides and pesticides for carbonated water.
- Determination of levels of aflatoxins in stored paddy/rice PAU-201 variety: Upon the direction of the Union Government, ICMR co-ordinated a study on determination of levels of aflatoxins in stored paddy/rice PAU-201 variety samples collected from six districts of Punjab. Based on the findings of the scientific studies involving analysis of aflatoxin levels, assessment of fungal contamination, and presence of iron in the black/brown damaged portion of rice, it was concluded that the presence of black spot didn't have any fungus and didn't correlate with toxin. PAU-201 rice variety samples collected from Punjab are safe for human consumption.
- Study on Developing Capacity Building Among Primitive Tribes demonstrated effective health care delivery by community participation and their empowerment.
- The following guidelines have been developed: Probiotics; Iron and Folic Acid supplementation; Vitamin A supplementation; Iodine deficiency disorders.
- The issue of safety of consumption of *lauki juice* was addressed through an Expert Committee constituted by DHR/ICMR as part of the Parliament Assurance to look into the issue of safety of consumption of *lauki juice*. Information on suspected *lauki* toxicity cases was collected from all over the country, summarized and interpreted with help of experts, clinicians and researchers. The report has been submitted to Government of India. Committee recommended that *lauki* should be tasted before extracting juice that it is not bitter, since there is no known antidote for *lauki* toxicity, guidelines for clinicians also to be given.
- Nutrition status of population based on biochemical parameters like retinol, tocopherol, zinc, ferritin *etc.* was assessed, especially in North-East (Assam, Manipur & Meghalaya) and tribal belt (Dhar, Madhya Pradesh).
- A Task force on fluorosis has been constituted and progress on disease and its management/ prevention formulated.

- Issue of antibiotics in honey has been addressed through an expert group on assessed the extent of problem of antibiotic residues in Honey, to review the existing standards for honey. The Committee made some recommendations to Food Safety and Standards Authority of India.
- A study on micronutrient status of low birth weight Infants during early infancy revealed that the postnatal growth of LBW group lagged significantly behind the NBW group in terms of weight, length and head circumference with birth weight being the significant predictor of the same. Micronutrients levels did not have any correlation with postnatal growth.
- A study on abdominal obesity and its relation to plasma homocysteine & other coronary heart disease risk factors in middle aged men (mean age 46.27 ± 4.63 yr) showed the prevalence of obesity >25 BMI to be 44% and abdominal obesity (>90 cm WC) to be 35% among the middle age men with HDL concentrations were found to be significantly ($p < 0.05$) lower in men with hyperhomocysteinemia compared to normal homocysteine levels ($<15 \mu\text{moles/l}$).
- A study on genetic determination of non-alcoholic fatty liver disease and muscle mass in North Indians showed that the family history of diabetes is significantly higher in those diagnosed to have fatty liver (30.8%) as compared to normal controls (21.9%).
- The Centre for Advanced Research on Nutrition at Nutrition foundation of India focused on the areas of operational research, preparing papers on nutrition policy research and capacity building.
- Nutrition Policy Research: Under this, the Centre prepared the papers on various policy issues like changing face of under nutrition in children and its policy implications, Adoption of WHO Growth Standards– issues & implications, poverty nutrition linkages, changing food consumption patterns in India *etc*
- Operational Research: Some studies include i) Detection & management of anaemia in pregnancy in urban primary health care institutions; ii) Effect of administration of 1500 mg elemental iron on maternal hemoglobin and birth weight; iii) Study on iron, folic acid & vitamin B-12 status in pregnant anemic women and women receiving iron therapy; iv) Combating undernutrition in preschool children in *Anganwadis*.
- Constitution of ICMR-ICAR Joint Committee for Research on Food Safety to look into the issue of effects of ripening and coloring agents like calcium carbide and oxytocin used for fruits/vegetables. The data will have application on the formulation of national policy.
- Centre for Promotion of Nutrition Research & Training with special focus on North-East, Tribal & Inaccessible population was established. The laboratory at the Centre has been awarded NABL accreditation under medical testing laboratory.
- Human Resources Development - The centre was actively involved in activities like RCH and NRHM training programmes, Internship for Home Science (49 students) and other students, Ph.D thesis of scientific staff, development of booklet on Nutrition of women and Children for use in ASHA training under NRHM *etc*. Young Scientists Symposia were organized in Ujjain and Agra to train young and middle age scientists in research methodologies.

- Ongoing activities in the field of fluorosis, ICMR-ICAR panel, hypertension, Centre for Promotion of Nutrition Research and Training with special focus on north-east, tribal and inaccessible population and ad-hoc projects as well as Advance Center for Research.

DIVISION OF NON-COMMUNICABLE DISEASES

During the XI plan 66 Task force projects, 204 ad-hoc research projects, 91 fellowships, one Centre for Advanced Research and 22 registries were supported.

Non-communicable diseases(NCDs) have emerged as a major cause of morbidity and mortality in India. The Council has started several programmes on different NCDs.

Oncology

• National Cancer Registry Programme

The National Cancer Registry Programme (NCRP) commenced in 1982, with the objectives of generating reliable data on the magnitude and patterns of cancer; undertake epidemiologic studies in the form of case control or cohort studies based on observations of registry data; Provide research base for developing appropriate strategies to aid in National Cancer Control Programme; and develop human resource in cancer registration and epidemiology. There are 24 Population Based Cancer Registries (PBCRs) and 6 Hospital Based Cancer Registries (HBCRs) under the NCRP network. During 2009-10, the PBCR Report for twenty PBCRs in the country for the years - 2006-2008 was presented. In males, the age adjusted incidence rate (AAR) varied from 53.0 per 100,000 in the rural PBCR at Barshi to 239.2 per 100,000 in Aizawl district of Mizoram state. Among females, the AAR varied from 49.9 per 100,000 to 197.4 per 100,000.

• Cancer Atlas for India

The project was aimed at collection of data on cancer occurrence from different parts of the country. The project generated a lot of interest in certain areas, which helped in initiation of population based cancer registries in some areas. The project is being continued in some parts of North-Eastern India and is initiated in some districts of Punjab.

• Genetic Polymorphism in drug metabolizing enzymes and oral cancers & pre-cancers

The study on the gene polymorphism in drug metabolizing enzymes in patients with oral cancer and pre cancers through a population based survey did not observe significant role of the above markers in progression/ regression of the oral pre-cancerous lesions.

• Immunogenicity in oral cancers

Oral cancer patients, persons with oral pre-cancers and tobacco habits were assessed for their T cell repertoire and immune dysfunction. The study indicated an important role of CD3-zeta chain related T cells in cases of cancers and precancerous.

• Molecular cytogenetic studies in oral cancers

Study aimed at identification of chromosomal markers that may be associated with oral cancers in India, through the technique of comparative genomic hybridization. A non random pattern of

chromosomal alterations was observed with frequent gains ($\geq 25\%$) on 8q, 9q, 11q11-13, 7p, 20q, 3q and 20p and frequent losses ($\geq 25\%$) on 3p, 8p and 18q chromosomes.

- **Review of guidelines for management of cancers**

With a view to develop guidelines in Indian conditions, twenty sub-committees were constituted to study the guidelines for 20 cancer sites. Reports on buccal mucosa cancer, stomach and cervix have been finalized and are available on ICMR website.

- **Multi-disciplinary study on breast cancer**

The National Institute of Pathology, Delhi has been able to establish the breast cancer cell lines from primary cultures and tested in nude mice for its tumorigenic properties. The pre-pilot project on a multi-disciplinary study on breast cancer has been completed and operational details have been worked out.

- **Study on association of oral pre-cancers with use of plain pan masala**

A large population based study is examining the oral cavity of persons above 15 years of age and collecting data on various tobacco and areca nut use habits, to assess the role of plain pan masala in causation of oral pre-cancerous lesions.

- **Assessment of cancer occurrence scenario in Punjab**

The ICMR has initiated a population based cancer registry at Patiala and a hospital based cancer registry at Chandigarh. A cancer atlas project is also proposed for rest of Punjab. The ICMR team recommended preparation of a plan for cancer control in the state by the state government, in consultation with Department of Health/ Directorate General of Health Services; initiation of training for undertaking cancer control activities; and to enhance cancer management facilities through establishment of one Regional Cancer Centre/ Tertiary Cancer Care Centre, and at least three oncology wings.

- **Indo-German Collaboration in Cancer**

Collaborative cancer research projects between India and Germany are coordinated by ICMR in India and BMBF & DKFZ, Germany. Projects supported by ICMR included: Cloning of novel and rare chromosomal translocations in acute myeloid and lymphoblastic leukemia (AML and ALL), Development of Chimeric Genetic Vaccine against Human Papillomavirus Type 16, and “Influence of O-acetylated cell surface expressed sialoglycans angiogenesis of bone marrow associated leukemias.”

- **ICMR – PATH Study on Assessing Introduction of HPV Vaccine in India**

ICMR is collaborating with PATH, on a project funded by the Bill & Melinda Gates Foundation to assess the preparedness and feasibility of state health services for possible introduction of HPV vaccination.

- **ICMR-University of Minnesota Collaboration on Cancer Research**

The ICMR has signed a Memorandum of Understanding with the University of Minnesota, USA, to undertake collaborative research in the field of biomedical sciences. The collaboration has been expanded to include cancers. Three projects have been identified for support during

independent evaluation by both sides (after a request for proposals) and subsequent discussions by the joint working group.

- **ICMR-European Union Workshop on Cancer**

A collaborative workshop on cancer and neurodegenerative diseases was organized at ICMR headquarters between ICMR and EU representatives. The group recommended collaborative research on, epidemiology and etiology of infection-related cancers such as cancer associated with HPV, hepatitis B & C viruses, and *Helicobacter pylori*. Some identified cancer sites were, breast, prostate, colo-rectal, lung, oral cavity, and oesophagus.

Cardiovascular Diseases

- **Rheumatic Fever and Rheumatic Heart Diseases**

The ICMR initiated Jai Vigyan Mission Mode Project on Community Control of RF/RHD in India in the year 2000. The project was to study epidemiology including typing of GAS strains, starting of RF/RHD registries and development of a vaccine against streptococci.

- **Epidemiological Component**

The epidemiological component has been completed at PGI Chandigarh, and CMC, Vellore centers. During the cross sectional survey, it was observed that the prevalence of β -hemolytic Streptococci (BHS) was 26.5 % and 8.8 % respectively, whereas that of Group A Streptococcus (GAS) was 11.1 % and 2.5 % in throat samples respectively.

- **Vaccine Component**

The studies on emm typing of GAS strains collected during the course of epidemiological studies mentioned above and by the registries established in different regions of the country in this project, suggested a wide heterogeneity of strains circulating in the community. Therefore a vaccine against Group A streptococcus based on N terminal sequence of M protein of the infectious organism is not plausible in our country.

- **Registry component**

The emm typing of GAS strains indicated the heterogeneity of the strains circulating in the community. A significant development of the project has been the up scaling of this project to Punjab Rheumatic and Congenital Heart Disease Programme by Chandigarh nodal centre. The program has also been initiated in four districts taken up by Himachal Pradesh Government under NRHM.

- **Congenital Heart Diseases**

The overall prevalence of congenital heart disease reported in a the study conducted at Vellore was 7.75% which is much higher than previously reported figures. On multivariate analysis, only six variables were found to be significantly associated with CHD: male sex, family history of CHD, presence of murmur, central cyanosis, abnormal precordial pulsations and post-ductal oxygen saturation <94%.

- **Genetic Basis of Salt Sensitive Hypertension (North- East)**

A multicentric project "Salt Sensitivity and Candidate Gene Polymorphisms in Essential Hypertension in tribal population of Mizoram, tea garden communities of Assam and indigenous

Assamese population” has been completed. The prevalence of hypertension in Tea Garden Workers, Assamese Indigenous population and Mizoram population was found to be 65.8%, 58.9% and 24.4% respectively. The mean arterial blood pressure showed a sharp decline on decreasing salt intake in hypertensive probands as compared to normo-tensive controls. Salt sensitivity phenotype was observed with a higher frequency in probands than controls in both Tea Garden Worker (38.9% versus 6.2%) and Assamese Indigenous population.

Mental Health

• Urban mental health problems and service needs

A multicentric project on urban mental health problems and service needs was undertaken at Delhi, Chennai and Lucknow. The prevalence rate of psychiatric morbidity was found as 59/1000 for all mental health problems (comparable to the estimates made by the meta-analysis) and 48/1000 for Common Mental Disorders (CMDs). The modules for domestic violence and depression have been developed.

• Mental Health service needs and service delivery models in the disaster (earthquakes) affected population in Gujarat

The prevalence of psychiatric morbidity was found higher in disaster affected group as compared to control group) at Ahmedabad and Rajkot centres respectively. The most prevalent psychiatric morbidity were the depressive disorders and recurrent depressive disorders, followed by anxiety disorders and dissociative (conversion) disorder and somatoform disorders in both (affected and control) groups. Mental health morbidity and psychological symptoms were higher in females as compared to males.

• Mental health needs assessment & service delivery models in Tsunami affected population of coastal Tamil Nadu

The study has been completed at Chennai and Nagapattinam centres. The data shows that majority of children (93.6%) showed aggression and dependency (81%) in their drawings. About 60% of them displayed anxiety, assaultiveness and feelings of insecurity. The commonest behavioral problems observed were bedwetting, nail biting, and temper tantrums. Compared to psychiatric morbidity prevalence of 50% immediately after Tsunami, the prevalence rate now (five years after disaster) was observed to be only 4.9%.

Neurology

• Stroke

A study on the contribution of pro-thrombotic state to the etiology of ischemic stroke in the young indicated that a large majority of patients had anterior circulation strokes and around 46% had a prothrombotic state. The study showed that around 33% of the patients had MTHFR gene mutation. The study on the role of hypertension in stroke indicated that approximately one-third stroke survivors' suffered from depression and post stroke depression was observed to be associated with age at first stroke, educational level and gender.

• Parkinson's Disease

In a study on “A longitudinal study to estimate proportion of patients with dementia and cognitive decline in Parkinson's disease (PD), its clinical correlates with special reference to

apolipoprotein-E alleles,” prevalence of dementia was observed to be 17.1/1000 in early PD cases, whereas incidence was 4.96 per thousand per year.

- **Epilepsy in Pregnant Women**

A task force project on epilepsy in pregnancy was completed at two centers – Safdarjung Hospital, New Delhi and SCTIMST, Thiruvananthapuram. It was observed that major malformations were found in about 3% children born to the women with epilepsy as compared to about 1.4% in controlled group in New Delhi and in 11.7% and 3.3% of pregnancies with epilepsy and without epilepsy in Thiruvananthapuram.

Diabetes

- **Development of Web Based Data Capture Module for Diabetes**

The ICMR-WHO project on Development of Web Based Data Capture Module for Diabetes was completed. The screen based proformae were developed for data entry. The Module has been further tested and is being used by the Collaborating Centres for data entry in ICMR's Task Force Project on Registry of People with Diabetes with Young Age at the Onset.

- **Development and Updation of Diabetes Atlas in India**

The ICMR-WHO Project on Development and Updation of Diabetes Atlas in India, was completed. The literature search was conducted on PubMed by following inclusion and exclusion criteria meant for the protocol. The publications were divided into different time periods (decades). The data was published in form of color coded maps and submitted to WHO.

- **Identifying Strategies for Data Collection in Diabetes**

The ICMR WHO Workshop on “Identifying Strategies for Data Collection in Diabetes was conducted in November 2007, Delhi and Group suggested undertaking a large study on Diabetes Atlas (India) under different time periods. The 66 studies directly provided a data related to prevalence of Diabetes. A detailed report is published with color coded maps of diabetes for different time periods.

- **National Task Force on Camel Milk and Diabetes**

The task force on Camel Milk and Diabetes was initiated at the behest of the Ministry of Health and Family Welfare. The two projects entitled, “Hypoglycemic/insulin like activity in camel milk: quantification of the effect in animal models of diabetes/insulin resistance,” and “Effect of camel milk on glucose metabolism in adults with normal glucose tolerance and type 2 diabetes in Raika community: a cross over study,” were undertaken by National Institute of Nutrition, Hyderabad and SP Medical College, Bikaner. Besides, a separate Expert Group on Genetic Basis of Resistance to Diabetes has been created under which two projects were initiated *viz*: HLA profiling in Raika Community, and a multicentric study on Genetic Resistance to Diabetes in Raika Community, with the objectives to study expression of genes in Raika and Non Raika community residing near the same geographic region. The findings suggested that the protection of Raika community against type 2 diabetes might be because of the higher prevalence of protective alleles.

- **Centre for Advance Research for Genomics in Type 2 Diabetes**

The ICMR's Centre for Advance Research for Genomics in Type 2 Diabetes Mellitus aims to undertake both research and training component. For research component, two proposals entitled, "Study of genes related to maturity onset diabetes of the young (MODY) and early onset diabetes," and "Study of genes implicated in ion channel dysfunction in diabetes," were undertaken so as to determine the prevalence of MODY in different regions of India and screen the known gene variants in unrelated diabetic subjects and normal glucose tolerant subjects so as to find the association with the disease. One of the novel mutations Arg263His, co-segregated in a family has been discovered. The training component is being imparted and till now, approximately 150 young researches are trained in modern techniques of genomics and genetics.

- **Task Force on ICMR-Indian National Diabetes Study (ICMR-INDIAB)-Phase I**

A project on India National Diabetes Study aims to determine the prevalence of diabetes and pre-diabetes in India by conducting a nationwide study on a representative sample of India (32000 subjects). The preliminary findings indicate the percentage prevalence range from 2.8-6.6% in rural and 9.1-13% in urban settings.

- **Task Force on Genomics of Type 1 Diabetes**

The study on Genomic Analysis of Type 1 Diabetes, aims to understand the genomic characterization of multiple autoimmune favoring HLA-DR3 haplotypes in type 1 diabetes (T1D) in different ethnic groups of India (North, South and Kashmiri populations of India) and their comparison with similar haplotypes in Western Caucasians and to perform extensive sequencing of HLA-C and MICA genes in disease associated haplotypes. Distribution of HLA-DQB1*02 and DQB1*03 alleles was observed to be increased in patients in South India whereas HLA-DRB1*02 was increased in Type 1 D patients in AIIMS, Delhi.

Environmental and Occupational Health

- **Centre for Advanced Research on Environmental Health-Air Pollution**

The advanced centre has been initiated at Sri Ramachandra University, Chennai wherein a cohort of mother-child will be established to be followed up for five years to document the dose response of indoor air pollution on mothers and child's health.

Climate Change and Health: The Task Force project on Climate change and its effects on vector transmission, eye health and respiratory health has been initiated and pattern of disease variation with respect to temperature variability is being collected.

Indo- US Programme on Environment and Occupational Health: The programme has so far funded around 17 research projects with major component of technology transfer between the two countries.

Asthma

The 12-centre study on prevalence and aetiology of asthma using a standardized questionnaire the pooled prevalence of asthma (using the questionnaire definition) across the twelve centres as 2.05% (2.28% in rural and 1.64% in urban areas). There were wide variations across the different centres.

Non- Communicable Disease Surveillance

• Surveillance of Risk factors for Non-Communicable Diseases

The Division of NCD has been identified as the nodal agency for NCD surveillance by the WHO, and with its collaboration a survey of NCD risk factors was undertaken. The ICMR signed a MoU with Ministry of Health and Family Welfare for standardization and quality assurance of the surveys in 3 phases beginning in 2007.

NCD Database

• Causes of Death by Verbal Autopsy

The multi centric study conducted in Assam, Bihar, Rajasthan, Tamil Nadu and Maharashtra showed that NCDs account for more deaths in states which are in higher socioeconomic strata as compared to the others.

Non-Communicable Disease Burden

The study undertaken to estimate the first set national disease burden estimates for major NCDs like IHD, diabetes, stroke and cancer using disparate sources of information.

Orthopedics Disability & Rehabilitation

• Epidemiology of Musculoskeletal Conditions in India

The Council initiated a multi-centric epidemiological cum prevalence study with specific objectives to assess the magnitude and impact assessment of select musculoskeletal disorders in adults (aged over 18 years) in the community with a focus on osteoarthritis, rheumatoid arthritis and spinal disorders. The prevalence rate of musculoskeletal disorders in the study was found to be 7.08% in Delhi , 11.52% at Dibrugarh and 9.53% in Jodhpur

Geriatrics

A task force project was conducted to assess the influence of social support networks and the economic factors on the functional status and coping strategies of the elderly. Cognitive impairment was found in large number of subjects (69%). Majority (85%) of urban older people were found to be functional with regards to basic activities of daily living, where as 60% of them have some degree of limitation in incremental or intermediate activities of daily living.

Oral Health

• Research Methodology Workshop

A joint ICMR-MMU-DCI workshop on *Research Methodology for Oral Health Researchers* was held at Mullana, Haryana. The interactive sessions provided the methodological background for training the participants.

Trauma, Accidents and Injuries

In 2007-08, a feasibility study for development of a hospital based injury surveillance system in two centres at Bangalore and Pune was undertaken. Under the programme, data on deaths

and injuries were collected in a uniform and scientific manner using a surveillance approach. The programme has been able to develop uniform data for the city on injury deaths and hospitalizations.

Otolaryngology

• Augmenting Research Efforts in ENT

Keeping in view of dearth of population based data on the disease burden of hearing impairment in India, studies have been initiated in identified areas such as epidemiological studies to assess the burden of disease, studies on early prevention and control, intervention and genetic studies.

DIVISION OF BASIC MEDICAL SCIENCES

The Division promoted research in different biomedical subjects *viz.* Allergy, Anatomy, Anthropology, Biochemistry, Cell and Molecular Biology, Genomics, Haematology, Human Genetics, Immunology, Nano-Medicine, Organ Transplantation, Pharmacology, Physiology, Stem Cell Research, Traditional Medicine, Toxicology *etc.*

During the period, the Division established 12 Centers for Advanced Research and 8 Bioinformatics Centers sanctioned about 40 task force projects, over 300 ad hoc research schemes and 385 fellowships. A total of 3533 short term studentships for medical college undergraduate students were also awarded during XI plan.

Centers for Advanced Research:

Centre for Advanced Research in Cancer Genetics & Genomics, ACTREC, Navi Mumbai:

- Established as an Apex Referral Centre in India for comprehensive clinical and laboratory genetic services and genetics research for all major cancer predisposition syndromes; a Model Comprehensive Cancer Genetics Unit with best international practices in pre-test counseling, genetic testing, post test counseling, screening & medical management and a DNA bank of 1176 cases and EBV cell lines from 450 cases, the largest collection of clinical and research resources in diverse hereditary cancers outside USA and Europe.

Advanced Centre for Research and Training in Human Molecular Cytogenetics, IAIB, Bangalore:

- Developed facilities for the routine analysis of human chromosomes by fluorescent *in situ* hybridization (FISH), primed *in situ* labeling (PRINS) and spectral karyotyping (SKY).
- Facility for FISH analysis of microdeletion syndromes, Probe development and cost reduction in the diagnosis of chromosome disorders, BAC clones for microdeletion syndromes and primed *in situ* labeling allows for rapid detection of aneuploidies.
- Cell transformation and cell banking by EBV for rare genetic disorders.
- Conducted seven short-term, intensive training courses and workshops for clinicians and young scientists from basic science background.

Centre for Advanced Research in Pharmacogenomics at JIPMER, Puducherry

The outcomes of the studies conducted so far indicate the following:

- CYP2C9 genetic polymorphism data has been generated that will significantly influence the dose requirement, toxicity as well as steady state level of phenytoin in epileptic patients. The genetic polymorphisms of CYP2C9 and MDR1 was not found to influence the plasma levels of glibenclamide in diabetic patients of South India. However, the genetic polymorphisms have an influence on the control of diabetic status of type 2 diabetes mellitus patients on therapy with glibenclamide. Further, one month of antituberculosis treatment causes a significant decrease in the metabolic ratio of phenytoin implying increased induction of CYP2C9.
- Besides research work the centre was also involved in capacity building activities and had conducted six annual national workshops in pharmacogenomics techniques.

Genetic Disease Registry, DNA Banking and EBV Transformed Cell Lines from Informative Families of Rare Genetic Disorders, SGPGL, Lucknow

The aim of the registry is to collect and store clinical information as well as biological material (DNA and EBV transformed cell lines) from families with rare and unique genetic disorders for Identification of genes causing genetic disorders; characterization of mutations causing genetic disorders; study of genotype- phenotype correlation and evaluate the role of allelic variation and gene –gene and gene –environmental interactions in determining phenotypic heterogeneity and understanding of biochemical pathways from mutation to phenotype expression to establish pathophysiology of genetic disorders. Till date, blood samples from over 1000 individuals with different genetic disorders have been collected and are under investigations.

Centre for Advanced Research in Evidence Based Health Care, CMC Vellore

Centre is trying to help in the identification of gaps in evidence requiring systematic reviews or new interventional trials like improving the quality of design, conduct and reporting of randomized clinical trials. To increase the capacity among health professionals (and health policy makers) and to understand systemic reviews and their role in evidence based healthcare. 57 introductory workshops were conducted which included Beginners guide to EBM series for students, a workshop for medical journal editors, ethics committees and workshop on the WHO Evidence Informed Policy Network (EVIPNet) for health policy makers.

National Tumor Tissue Repository (NTTR), Tata Memorial Center, Mumbai

The objective is rapid harvesting and freezing tumour tissues as well as normal tissues obtained from cancer patients being treated in operating theatres of TMH/ACTREC, coding, banking and computerizing the necessary demographic and clinical data. Till date they have collected over 14,946 normal and tumor tissues from various anatomic sites viz. breast and axillary Nodes, head neck & regional nodes, gastrointestinal tract, urinary system and gynae regional nodes, thoracic system, bone and soft tissues.

Centre for Advanced Research in Yoga and Neurophysiology, Swamy Vivekananda Research Foundation, Bangalore

Results indicate the overall neurophysiological correlates of meditation offer objective support for meditation as therapy and as an effective strategy to perform better in cognitive tasks and to organize higher brain functions specific to education in children and adults.

Advanced Centre of Reverse Pharmacology in Traditional Medicine, Medical Research Centre, Kasturba Health Society, Mumbai

This Centre has been established mainly to develop safe and scientifically investigated Ayurveda-inspired effective phyto-pharmaceutical products/ preventive- and/or therapeutic-modalities for identified disease conditions *i.e.* for malaria, sarcopenia and cognition ; to initiate pharmacoepidemiology and vigilance studies in traditional medicine; to create innovative methods and instruments of investigation to further evolve Reverse Pharmacology as a discipline. This Centre has initiated various activities such antimalarial activity and clinical safety of the traditionally used paste formulation of leaves *Nyctanthes arbor-tristis*, *Sudarshan Ghanavati* and *Ashwagandha*.

Center for Advanced Research in DNA fingerprinting and diagnostics of Medicine Potential in Plant from Eastern and North-Eastern India, Bose Institute, Kolkata in collaboration with Manipur University and Botanical Survey of India (BSI)

Main objective of this centre is molecular documentation for establishing species specific DNA markers of selected medicinal plants from Eastern and North Eastern India. Genotypic analysis of several plants from Sikkim and Meghalaya has been studied so far to understand correlation of color of flower with genotypes and anti-oxidant potential of some of them.

Advanced Centre for Research in Reproductive and Genetic Toxicology at NIRRH, Mumbai

This center has been mainly established with the objectives to conduct reproductive and genetic toxicity evaluation of drugs, chemicals, and other agents including vaccines and biotechnological products, undertake research at cellular and molecular level to elucidate the mechanism of action of these agents to provide a basis of toxic manifestations and sound extrapolations.

Advanced Clinical Pharmacodynamic Centre for the Evaluation of The Pharmacodynamic Effects of drugs at Nizams Institute of Medical Sciences Hyderabad

The centre was established to develop specialised facility for carrying out simple non invasive pharmacodynamics screening methods to investigate the effect of drugs on cardiovascular and central nervous system functions and capacity building. Centre has so far worked on development of non-invasive methods and various experimental pain models in healthy human subjects for the evaluation of analgesic drugs, development of psychomotor function tests for evaluation of psychoactive compounds.

Center for Advanced Research in Hepatocyte Progenitor Cells Isolation, Characterization and Transplantation at Govt. Stanley Medical College, Chennai

The Centre has initiated its studies after establishing labs, equipments and standardization of various techniques of isolation and characterization of liver cells.

Biomedical Informatics Centres

The Council established eight Biomedical Informatics Centres at SGPGI Lucknow, PGI Chandigarh, AIIMS New Delhi, NIRRH Mumbai, TRC Chennai, NICED Kolkata, NIN

Hyderabad, RMRIMS Patna and a coordinating unit at ICMR Headquarters, New Delhi under the Task Force of Genomics & Molecular Medicine. The Centres are working on databases of biomedical information research projects and training programs.

Task Force Studies

Inborn Metabolic Disorders -Newborn Screening (NBS) for Congenital Hypothyroidism (CH) & Adrenal Hyperplasia (CAH) - a multi-centric Study : A common protocol for a pilot study on newborn screening for congenital hypothyroidism and congenital adrenal hyperplasia in 1 lakh newborns has been developed and screening completed in 85000 newborns. A website has been devoted to Inborn Metabolic Disorders with valuable information regarding ICMR Newborn Screening program for physicians as well as patients (<http://icmrmetbionetindia.org>). The NTF-IMD group has prepared 'Work Manual for the Task Force on IMD' 'Clinical Manual on Inborn Errors of Metabolism' 'Clinical and Lab Manual for Newborn Screening of CH and CAH'.

Research in Ageing:

The highlights of some of the studies undertaken are as follow:

- A study on **Influence of DNA repair gene polymorphisms on cancer and ageing** at Manipal Life Sciences Centre has shown that the differences may be due to interaction of existing and new mutations or polymorphisms in DNA repair genes which may modify DNA repair capacity.
- Results of study on neuro-immune interactions during aging and immunodeficiency carried out at University of Hyderabad, Hyderabad using multipoint age comparison approach showed an association of immunological and neurological changes with ageing.
- **Selenoproteins and antioxidants in the pathogenesis of Alzheimer's disease** study carried out at PSG College of Technology, Coimbatore have shown that the alteration in the levels of selenium in the Alzheimer's patients leads to the decrease in the levels of selenoprotein P and alterations in the levels of selenoenzymes like thioredoxin reductase and glutathione peroxidase indicating the increased oxidative stress in the demented patients.
- **Study of Ageing of microglia and associated disabilities of microglia in neuroprotection** carried out at Jiwaji University, Gwalior demonstrated that shift in microglial morphology, immunophenotype and inflammatory profile with age have a bearing on spatial learning and memory as age advances.
- **Reversing age related brain functions impairments by late onset dietary restriction** : Studies carried out at Guru Nanak Dev University, Amritsar have provided a scientific evidence for cognition and motor coordination enhancing properties of late onset short term intermittent fasting dietary restriction (IF-DR) regimen in aging rat brain.
- Results of a study on **Health problems and care and support available to elderly during sickness in rural Tamil Nadu at Gandhigram Rural University** showed that most of the elderly were living with their children and were maintaining cordial relationship with the family members. The life style index showed poor status for more than three fourth of elderly.

Genomics and Molecular Medicine

Realizing the immense potential of genome research, the ICMR initiated multidisciplinary programme on “Genomics and Molecular Medicine” of 110 projects sanctioned during 10th plan, highlights of some of the projects completed during 11th plan are :

- **A study of Genomic analysis of hepatitis a virus isolates from different geographic locations of India** carried out at NIV, Pune showed the variations between Southern, Western, Northern and Eastern HAV strains was higher in VP1/2A junction as compared to other HAV parts of HAV genome.
- **Genomic Diversity of Viscerotropic Leishmania in relation to kala-azar in India**, a study carried out at RMRI, Patna suggest that the regulation is present at the level of protein expression mediated by translational control, protein stability and posttranslational modification and the small protein Amastin.
- **Functional genomics based approach to novel anti-malarial targets and agents was studied at Department of Structural Biophysics, IISc Bangalore and NII, New Delhi** established that Enoyl acyl carrier protein reductase of *Plasmodium falciparum* (PfENR) is a good target for the development of antimalarials as well as vaccines. The study also identified rhodanine class of compounds as inhibitors of PfENR and reported a number of new inhibitors belonging to this class.
- **Genetic polymorphism and gallstone disease** : A study carried out at Department of Genetics, SGPGI, Lucknow established the association of APOA1-75 G/A, APOC3 SstI, APOB VNTR, APOC1 HpaI and LRPAPI ins/del polymorphisms with gallstone disease.
- **Therapeutic Intervention of Anthrax: A molecular medicine approach study** accomplished at School of Biotechnology, JNU, New Delhi has shown that the Protective Antigen (PA) component of Anthrax toxin is primarily responsible for most of the symptoms of anthrax is known as a major immunogen of *Bacillus anthracis*.
- **Core Facility for Integrated projects on Molecular Genetics of Neurological disorders** at NIMHANS, Bangalore. Under this project a laboratory for DNA isolation and storage of DNA samples in a retrievable organized manner has been established. Following independent projects were carried out :
 - **Duchenne Muscular Dystrophy (DMD)**: As part of the ICMR sponsored research, molecular characterization of DMD mutations has been done, of the 134 samples tested, 84 (62.6%) samples showed at least one deletion in the exons tested.
 - **Huntington’s disease**: More than 150 families with HD have been under follow-up at NIMHANS over the past 4 years. A significant correlation exists between age at onset and CAG repeat length ($r=0.54$, $p<0.01$) suggesting that with an increase in length of trinucleotide repeats the onset of disease occurs earlier.
 - **Spino Cerebellar Ataxia (SCA)**: Molecular analysis has been carried out for detection of trinucleotide repeat amplification at SCA1, SCA2, SCA3, SCA6, SCA7, SCA8, SCA12, Friedrich’s Ataxia (FA) and dentatorubral-pallidoluysian atrophy (DRPLA) in a large number of affected individuals, and relatives. More than a hundred probands have tested positive for these mutations, and SCA1, 2

and 3 are detected in descending order of frequency. Infrequent mutations include SCA8, DRPLA and SCA12.

- **Spinal muscular atrophy (SMA):** Analysis of samples for deletion of exons 7 and exon8 in SMN1 (survival of motor neuron) gene has been standardized. Among the SMA type I patients, 42% showed deletions of SMN1 & NAIP. In patients clinically diagnosed with type II SMA, 80% showed deletions of the SMN1 exons.
- **A functional genomics approach to study the slow growth phenotype in mycobacteria** carried out at Indian Institute of Science, Bangalore observed growth properties of strains containing varying levels of initiator tRNA, which showed the increase in an initiator tRNA levels leads to better fitness.
- **Analysis of Polymorphism and Expression Profile of Genes of Mammalian Cell Entry (mce) Operons in clinical isolates of mycobacterium tuberculosis** carried out at Dr. B. R. Ambedker Center for Biomedical Research, Delhi University, Delhi has led to the identification of a gain of function mutation in mce operons.
- **Leprosy Genomics: the Genomic diversity of Leprosy bacillus and expression of its genes in human host: a study carried out at National JALMA Institute for Leprosy and other Mycobacterial Diseases (ICMR), Agra** has led to identification of genetic markers with potential to elicit diversity among *M. leprae* strains. A DNA chip to investigate other markers was developed and lead to identification of gene associated with survival in host.
- **Genetic Analysis of Pancreatitis in Indian Population** at CCMB, Hyderabad has demonstrated that the cohort in this study represents the conglomeration of chronic pancreatitis patients usually seen in routine clinical practice in developing countries like India. Only, N34S SPINK1 mutation is the only factor imparting a genetic basis to chronic pancreatitis in Indian patients.
- A study carried out at IISc, Bangalore to understand immunogenomics and pathogenomics of *Mycobacterium tuberculosis* and *Mycobacterium bovis* revealed that of all PE and PPE proteins, a significant number of these peptides are predicted to be high-affinity HLA binders, irrespective of the length of the protein. The predicted epitopes can be tested experimentally for their inclusion in a potential vaccine against tuberculosis that is HLA haplotype-specific.
- **Functional genomics based approach to novel anti-malarial targets and agents,** a study was carried out at JNCASR Bangalore. Potential targets on FIKK kinase for designing protein kinase inhibitors that can effectively prevent the survival of the parasites were identified.
- **Genetic manipulation of biosynthesis of neurotoxin in transgenic *Lathyrus* by expressing oxalate decarboxylase from *Collybia velutipes* at National Centre for Plant Genome Research, JNU , New Delhi.** The transgenic plants showed normal phenotype with the transferred trait being stably inherited to the next generation.
- **Genetic Markers : Vulnerability to common neuropsychiatric disease,** a study carried out at IHBAS, Delhi/ BITS, Pillani. The study concluded, the presence of ALDH2-1 * allele could increase the vulnerability of an individual to concomitant

use of both alcohol and nicotine ultimately resulting in dependence on both these substances.

- A study on **Genetics of Reproductive Dysfunction in Women** at Centre for Cellular and Molecular Biology, Hyderabad concludes that the occurrence of chromosomal anomalies in women with ovarian dysfunction *i.e.*, primary and secondary amenorrhoea, premature ovarian failure is considerably high accounting to 20% abnormality.
- **Study on Gene Expression profiling of normal and malignant human retina and eyelids** at IISc, Bangalore through microarray analysis of Rb and MCC tumors have shown for the first time up- and down-regulation of several genes which have potential as molecular markers and therapeutic targets in future.

Stem Cell Research & Therapy (SCRT)

- Pilot studies completed to evaluate safety and efficacy of the autologous stem cells in different conditions.
- Formulation of Guidelines for Stem Cell Research and Therapy in collaboration with DBT.
- ICMR has constituted and notified **National Apex Committee for Stem Cell Research and Therapy** (NAC-SCRT) to oversee and monitor Stem cell Research activities in the country.
- **Public Consultations on Guidelines for Stem Cell Research & Therapy** for sensitization of different stakeholders and to have consensus on the draft guidelines.
- **Investigation into the utility of a synthetic thermo-reversible hydrogel polymer as supportive matrix towards the development of 3-D composite skin for application in wound healing and other dermatological disorders** at NIOP (ICMR), New Delhi showed the potential of Mebiol gel to demonstrate for the first time the cell proliferation of a selectively small sized keratinocyte population which is known to comprise of the stem cell fraction of epidermal keratinocytes.
- **Isolation and expression of Mesenchymal Stem Cells (MSC) from Human Bone Marrow (BM)/ Umbilical Cord Blood (UCB) and valuation of its Cardio- Myogenic and Neurogenic differentiation potential** at AIIMS, New Delhi. The study provided strong evidence to demonstrate the potential of MSCs to differentiate into cardiomyocyte like cells and neuronal lineage specifically towards dopaminergic neurons.
- **Study on expansion of adult human bone marrow and cord blood stem cell for reconstituting marrow, and for reprogramming into hepatocytes** at National Institute of Immunology, New Delhi The comprehensive results of *ex vivo* expansion of cord blood mesenchymal stem cells showed expansion of CD34+ and primitive hematopoietic stem cells.
- **Autologous Bone Marrow Stem Cell Transplantation for treatment of Cirrhosis of Liver (Child Pugh A and B)** at Centre for Liver Diseases and Diagnosis, Deccan College of Medical Sciences and Allied Hospitals, Hyderabad demonstrated safety and efficacy of BMSC transplantation through hepatic artery for the treatment of Chronic Liver Failure.

Community control of Thalassemia: Establishment of molecular characterization of haemoglobinopathies and prenatal diagnosis of Thalassemia and Sickle cell disease.

This has started as demonstration/ operational research project in five regions in Maharashtra, Gujarat, Karnataka, West Bengal and Punjab.

Task force on Indigenous production of Shikimic Acid : a raw material for manufacture of Osetamiver : Feeling the need for indigenous production of shikimic acid a raw material for the manufacture of Osetamiver an antiviral drug used in the treatment of H1N1 swine flu that is currently a global pandemic, the division initiated steps to produce this compound in India by exploring all options involving appropriate competent groups which can do the required R & D and develop production technology for manufacture of compound. Four projects were funded at IIT, Delhi; UOD; NIPER, Mohali and NCL, Pune. The progress looks positive and preliminary outcome looks very encouraging. It is expected that by the end of two years, one or more new indigenous processes of shikimic acid production would be developed for large scale validation.

GOLDEN TRIANGLE PARTNERSHIP SCHEME

- Golden Triangle Partnership (GTP) Scheme, a collaborative project between Deptt. of AYUSH, CSIR and ICMR aims at scientifically validating the Traditional Systems of Medicine to make these systems globally acceptable.
- The ICMR has been given the responsibility of conducting clinical trials for these areas once standardization, quality control and pre-clinical studies are completed by CSIR on the formulations identified by the Deptt. of AYUSH. Under this partnership programme area of HIV/ AIDS has been entirely entrusted to ICMR.
- Protocols have been drafted for multicentric clinical trials using integrated approach of Modern Medicine and Traditional Medicine like Ayurveda for Benign Prostatic Hypertrophy, Osteoporosis, Hypertension, Dyslipidemia and also Siddha for treatment of HIV/AIDS.
- For the area of HIV/AIDS, NIPER, Mohali and SASTRA, Thanjavur have been identified for the standardisation of the identified formulations. For *in vivo*, *in vitro* screening and pre-clinical toxicity studies the responsibilities have been given to NARI, Pune and NIN, Hyderabad respectively.

ICMR-NIF JOINT INITIATIVE

- ICMR is partnering with National Innovation Foundation (NIF) established by Department of Science and Technology for validating the practices, which are claimed to have therapeutic value by grassroots knowledge healers both contemporary and of traditional origin. Projects sanctioned under this initiative include, Antihepatotoxic activity of *Abelmoschus esculentus* and *Datura metel* used by the herbal healers ; Anti diabetic activity of *Convolvulus arvensis* and *Nicotiana tabacum* used by herbal healers; Evolution of Anti-typhoid activity of *Shorea robusta L.*: An ethnomedicine of Kaatabhai Tribes of Maharashtra, India

Ad-hoc Research Schemes

Anatomy

- A study was completed at PGI, Chandigarh to identify the sexual and ethnic differences in facial anthropometry of Northwest Indians population and to elucidate the pattern of

relation between these measurements. The observations of the present study may aid to enhance the knowledge of the morphometry of the upper middle and lower faces in the two sexes. Regression equations have been generated which will help in facial reconstruction.

Anthropology

- **A study on body composition and prevalence of overweight among adolescents in Manipur** along with factors associated with overweight was completed at Regional Institute of Medical Sciences, Imphal. It was observed that children of fat parents, private schooling, playing indoor or outdoor games, mode of transport to school, sleeping hours, television hours and snacking while watching TV were found to be significantly associated with overweight and obesity.

Biochemistry

- **Study on role of apoptosis in disappearance of melanocytes in Vitiligo** conducted at PGIMER, Chandigarh has demonstrated that okadaic acid treatment increase the apoptotic markers significantly in perilesional unstable vitiligo melanocytes.
- **Studies on Digoxin and Neurodegeneration** conducted at University of Kerala, Thiruvananthapuram have partially purified fraction isolated from Brahmi which has potentiality in the treatment of various neurodegenerative and neuropsychiatric disorders.
- **Cellular and molecular mechanism of emphysema and its prevention using the guinea pig as a model animal** at University College of Science, Kolkata have demonstrated that p-Benzosemiquinone appears to be a major causative factor of cigarette smoke-induced oxidative protein damage that leads to apoptosis and lung injury. The pathological events are prevented by a moderately large dose of vitamin C.

Cellular & Molecular Biology

- **A study on role of Mitochondria in apoptosis and human cancer** at AIIMS, New Delhi have demonstrated a detailed understanding of apoptotic mechanisms and the factors that can compromise them is critical to the design of more potent, specific, and effective cancer therapies. As part of a central mechanism of amplification of the apoptotic signal, mitochondria may be an appropriate target for therapeutic agents designed to modulate apoptosis.
- **Genetic polymorphism of cholesterol ester transfer protein in hyperlipidemic patients: a case control study** at AIIMS, New Delhi. It was observed that the ApoE4 allele might be associated with hyperlipidemia.
- **Study on role of p53 homolog p73 in transcriptional regulation of human caspase genes induced by anti-cancer drugs** at Centre for Cellular and Molecular Biology, Hyderabad has shown that optimal induction of caspase-1 by cisplatin and interferon- γ was dependent on p73. p73 cooperates with IRF-1 in activation of caspase-1 promoter
- **Study on hormonal regulation of apolipoprotein E gene expression in mice brain during aging, Age-depended expression of apolipoprotein E in mouse cerebral cortex** conducted at BHU, Varanasi showed that during normal aging ApoE level

is maintained in old as adult, suggesting the involvement of other factors in ApoE mediated brain functions in old age.

- **DNA methylation regulated genes in oral cancer Manipal Life Sciences Centre, Manipal University, Manipal.** The study supports that confirming global hypomethylation is a potential epigenetic biomarker in oral carcinogenesis.
- **Study on Genetic basis of alcohol induced pancreatic disorders** at AIIMS, New Delhi/BITS Pillani demonstrated ADH3, ALDH2, CYP2E1, SPINK1 PRSS1 and CFTR gene polymorphism does not influence the development of Alcoholic chronic pancreatitis in Indian CP patients.

Haematology

- A study was carried out to study the Sickle Cell Anemia in Scheduled Tribe (Garasia) of Sirohi District of Rajasthan for the Detection, Control & Management of Sickle Cell Anemia. In this prospective cross-sectional study, the prevalence of sickle cell anemia was found to be 9.5% (548/5741) of which 0.8% (47/5741) were homozygous (disease, Hb SS) whereas 8.7% (501/5741) were heterozygous (carrier, Hb AS). The study may be useful to health authorities for planning necessary health interventions in this area.

Human Genetics

- A study on Prevalence, Phenotype, Genotype and Mode of Inheritance of Chromosome 22q11 microdeletion in patients with selected congenital heart disease (Conotruncal malformations) was completed at Amrita Institute of Medical Sciences, Kochi where 207 consecutive patients were studied. FISH was positive for microdeletion 22q11 in 40 patients (19%).
- Another study on the **prevalence of 22q 11 deletion syndrome in children** with structural cardiac malformation at AIIMS, New Delhi suggests screening for 22q11.2 microdeletion should be considered in those cardiac malformation cases with extra-cardiac manifestations in particular facial dysmorphism and hypocalcaemia and it should be offered to all family where recurrence can be prevented.
- A study of **lysosomal storage disorders in children** with regression of milestone was completed at FRIGE, Ahmedabad suggests that early diagnosis by screening test followed by confirmative lysosomal enzyme study will help the early therapeutic intervention.
- A study was carried out to see **the role of neurotransmitter, vascular and hormonal genes in migraine susceptibility** at Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow. A total of 217 migraine patients (MA), 179 normotensive patients with Tension Type Headache (TTH) and 217 age-sex matched normotensive healthy controls (HC) were enrolled. On performing the gene-gene interaction analysis in case of MA group, it was found that the ACE (DD) and MTHFR C677T (CT) acted synergistically to enhance the disease risk to 4.7 folds (OR=4.732; CI=1.695-13.210; *P* value=0.003).
- **Molecular genetic study carried out in Indian children with Rett Syndrome** at AIIMS, New Delhi. Results strongly support that MECP2 mutations are major cause of classical form of disease.
- The Council has supported regular Short Term Courses in Genetic Counseling at Department of Medical Genetics, SGPGI, Lucknow. involving participation of 25-40

participants from all parts of India. The course has been developed with the aim of training clinicians in clinical genetics so that they provide diagnosis, draw pedigree, advise appropriate tests, interpret results & provide genetic counseling. A Handbook of Clinical Genetics has also been prepared.

Pharmacology

- **Novel systems for improved delivery of antidiabetic drugs at Bombay College of Pharmacy, Mumbai:** Investigations were carried out to design novel biocompatible nanocarriers for improving anti-diabetic activity of 2 hydrophobic drugs *viz.* repaglinide and quercetin, novel lipid based nanocarriers *viz.* GeluPearl and LeciPlex were designed which could improve the therapeutic efficacy of these drugs.
- **Design and Synthesis of Novel Non-nucleoside Reverse Transcriptase Inhibitors for the Treatment of AIDS and Opportunistic infections Associated with AIDS including Tuberculosis” at Birla Institute of Technology & Science, Pilani,** various isatin derivatives & anti-HIV pro-drugs have been synthesized. The synthesized compounds were evaluated for their anti HIV activity and cytotoxicity against replication of HIV strain IIB some of the derivatives were found to show anti-HIV and anti-TB activity and these molecules may be useful for treating HIV-TB co-infection.
- **A study on Ophthalmic drug formulations using polymeric nanoparticles as carriers** was done at AIIMS New Delhi: The study concluded that there is a difference in the permeability coefficient among the fluoroquinolones studied *viz.* ofloxacin, lomefloxacin and sparfloxacin. Amniotic membrane can also be used as a drug penetration enhancer in certain cases of corneal diseases.
- **Effect of fatty acid synthase inhibitors in Y79 retinoblastoma cell line at BITS, Pilani:** This study suggested that FAS is a promising biomolecule that is amenable to pharmacological and clinical applications in retinoblastoma treatment and management.
- **A study was carried out to evaluate the in vitro efficacy of PLGA nanoparticles encapsulated with chemotherapeutic drugs to induce apoptosis in Y79 retinoblastoma cell line** at Institute of Life sciences, Bhubaneswar : Etoposide-loaded nanoparticles with higher entrapment efficiency, ~86% with an optimum size range have been prepared. The results suggest that etoposide-loaded nanoparticles could be potentially useful as a novel drug delivery system for retinoblastoma in the future.

Physiology

- A study on **Impact of Specific Nutritional Interventions on The Performance of Young Sports Persons : A Community Based Control Study** was completed at Sports Medicine Center, Kolkata. The beneficial effects of fat-rich diet were evident only after a period of adaptation with increased training load. Also the increased dietary fat along with training load imparted no adverse effect on physical fitness and lipid status of adolescent soccer trainee.

Traditional Medicine/Medicinal Plants

- **Development of anti-ulcer drug from Indian Medicinal plant *Tectona grandis*** at Central Drug Research Institute, Lucknow showed that ethanolic extract of *Tectona*

grandis (TG) has highly significant anti-ulcer activity against various acute gastric and duodenal ulcer models in rats and guinea pigs respectively, comparable to standard anti-ulcer drugs.

- **Phytochemical and Pharmacological Investigations of Some Plants for Antidiabetic Activity at C.U.Shah College of Pharmacy, SNDT Women's University, Mumbai:** Three bioactive extracts/fraction of garlic extract with good antioxidant potential were studied for antidiabetic potential on STZ-Nicotinamide induced model of type 2 diabetes and two bioactive garlic methanol extracts showed promising activity.
- **Knowledge Network on Medicinal Plants at Indian Institute of Integrative Medicine, Jammu-**The project was aimed to prepare a database on selected medicinal plants (50) in electronic form which include information with respect to: botanical aspects, traditional knowledge, chemistry, pharmacology, formulations, commercial aspects and patents. A monographs on 40 plants have been completed.
- **Development of an herbal package with antidiarrhoeal activity and its popularization in a rural community at Foundation for Medical Research, Mumbai:** Medicinal plants can serve as an adjunct to oral rehydration therapy in case of diarrhoeal disease with a view to develop cost effective approach. Studies with four plants to assess their effect on the intestinal immune response showed *P. guajava* to be the most effective.

Other Activities: Bioethics

Realising the needs to put in place adequate safeguards to protect the rights and welfare of human participants subjected to biomedical research the Council has created a Bioethics Cell at ICMR headquarters office. Efforts have been initiated to build capacity for ethical review among the members of the Institutional Ethics Committees (IEC) as well as among researchers by conducting regular trainings among various stakeholders besides developing ethical guidelines.

Achievements

The Council has taken an initiative to assist the Institutional ethics committees in raising their standards to the International level by organizing training courses and workshops for ethics committee members following the International requirements as outlined by Strategic Initiatives for Developing capacity in Ethical Review (SIDCER) and Forum for Ethical Review Committees in Asia and Western Pacific (FERCAP). The Council conducted 3 courses which include Human Subject Protection Course (HSPC), Standard Operating Procedures (SOP), Training and Survey of Institutional Ethics Committee at Mumbai. Following the training the two ethics committees at Tata Memorial Hospital, Mumbai and Seth GS Medical Medical College and KEM Hospital, Mumbai were awarded International recognition at the FERCAP Conference held in Nov, 2009 at Chiang Mai, Thailand.

In addition in the year 2011 the Council has conducted two training workshops HSPC and SOP Training at Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow which were attended by >70 members of 12 institutional ethics committees from Lucknow and neighboring areas. These efforts are a prelude to developing an appropriate system for accreditation of ethics committees in the country and will help in improving and maintaining ethical standards.

SOCIAL & BEHAVIOURAL RESEARCH

The Council recognizes and supports that SBR should form an integral component of health research to assess, monitor and continuously make sustained efforts for the outreach of these innovations to augment health care delivery at the periphery. This is necessary in India to the overwhelming presence of vulnerable and disadvantaged populations who often may not be benefiting from the developmental efforts.

Briefly the following are some significant achievements:

- A study of psychosocial and service dynamics of illegal abortion in rural areas of India showed that the prevalence of induced abortion ranged from 7-24 percent, mostly these abortions done by private providers. The main reason for seeking abortion were completion of family, unwanted pregnancy, ill health of women and unwillingness for a female child.
- Imparting reproductive and sexual health education of school-going adolescents in six states (urban and rural) showed increasing awareness among adolescents on these issues and intention towards adapting safe practices; the IEC programme was found beneficial.
- Analysis of roles and capacities of *Panchayati Raj* institutions to manage the grass root health care system carried out in five states showed that i) there was no health committee working in many *panchayats*; and ii) there was no provision of health care in the budget of the *Panchayat*. The major reasons for the status were lack of funds, technical knowledge and lack of co-operation with the health staff.

MEDICINAL PLANTS

- The Medicinal Plants Unit (MPU) consolidated Indian research efforts in the area of medicinal plants through a series of review monographs with particular focus on their medicinal potential besides other activities.
- Five volumes containing multidisciplinary information on about 1310 medicinal plant species was brought out.
- The development of Quality Standards of Selected Indian Medicinal Plants and Monographs in four volumes incorporating standards of 138 medicinal plants.
- Repository of Reference Phyto-constituents of important Indian medicinal plants for the generation of phytochemical reference standards (PRS) and development now contains 30 important PRS.
- Monographs on diseases of public health importance like liver disorders published.
- Set up a web site that contains information related to medicinal plants and plants based drugs/products to provide bibliographic and other scientific information to various institutions/scientists.
- Established the identity of selected controversial Ayurvedic plant drugs based on the description given in the classical texts with inputs from modern scientific data.

HEALTH SYSTEMS RESEARCH

It is known that the interface between health research and policymaking is a complex process, more so in developing countries where there is skewed development and large pockets of the

vulnerable and marginalized who often do not get to avail of the benefits of the health care system. It is therefore necessary to conduct health systems research to understand the contextual factors as well as key influences on the interface. Research and analysis through HSR also would provide the relationship between research (evidence) and policy making, especially impact of these on the poor and marginalized populations.

The following are some of the areas in which studies were initiated during the XI Plan period:

- Public, public-private and NGO partnership for improving RCH services in both urban and rural areas.
- The role of health insurance in improving health care in rural populations and urban slums, especially their willingness to pay was studied as also utilization in health care in rural part of central India.
- Studies initiated towards reduction of gap in the health system manpower and service delivery in eight States to evaluate and identify key points for the functioning of *Janani Suraksha Yojana*, expectations and performance of ASHA workers.
- Multi-centric Task Force Projects initiated to study the access and delivery of healthcare services among rural-urban migrants.

CRITICAL ONGOING PROGRAMMES: INTRAMURAL

Budgetary Requirement: ₹ 1000 crore

Various important activities/ studies are progressing which will spill over to XII plan, their continuation is essential for conclusive outcomes & explore larger perspectives.

Centre for Research in Medical Entomology, Madurai

Basic research

- Identification and characterization of midgut proteins of *Aedes albopictus* and their role in dengue virus transmission.
- Monitoring of dengue virus infection in monkeys (zoonosis) in Kerala, Southern India.
- Taxonomic validation of sibling species under the *Anopheles culicifacies* complex, in accordance with the international code of zoological nomenclature; Studies on malaria transmission dynamics in Rameswaram Island with the role of *An. culicifacies* sl.

Clinical research

- Morbidity management of lymphatic filariasis in endemic villages of Tirukoilur, South India.

Epidemiological /Operational Research

- Prospective survey of dengue virus infections in rural areas of Tamil Nadu.
- Surveillance of dengue fever/dengue haemorrhagic fever and dengue shock syndrome, using improved surveillance methods, using real time PCR technology and by serological methods in Tamil Nadu.
- Development of DHF by serological methods in Tamil Nadu.

Translation Research

- Field evaluation of Neem (*Azadirachta indica*) leaves and neem cake for the control of Japanese encephalitis vectors in rice agro-ecosystem.

Desert Medicine Research Centre, Jodhpur

Basic research

- Culture & sensitivity studies on *Mycobacterium tuberculosis* using Blood agar slants for reduction of time in diagnosis of TB.

Epidemiological/Operational Research

- Nutrition Monitoring Survey on National Nutrition Monitoring Bureau's (NNMB) pattern in Jodhpur district of Rajasthan.

Translational Research

- Evaluation of diagnostic & reference services for Dengue and H1N1 viruses will be continued along with ongoing research for novel markers, prevention & cure.
- Translational Research on dengue & tuberculosis by investigation of outbreaks and by mapping disease burden.

Enterovirus Research Centre, Mumbai**Basic Research**

- Studies in transgenic animals that could not be done due to lack of facilities.
- Expansion of EV71 pathogenesis studies & analysis of microarray data.

Epidemiological/Operational Research

- AFP surveillance and polio eradication support.
- Environmental surveillance for wild poliovirus, vaccine derived polioviruses (VDPV) and Sabin OPV strains.

Translational Research

- Molecular epidemiology and molecular characterization of polioviruses.
- Investigations on determinants of poliovirus neurovirulence.

Food and Drug Toxicology Centre (FDTRC), Hyderabad**Basic research**

- Assessment of allergenicity potential of novel proteins expressed in genetically modified (GM) plants.

Clinical Research

- Effect of high fluoride and low calcium on bone metabolism in rats and genotoxicity.
- Kidney and bone disease – role of silica, strontium and fluorides.

Epidemiological/Operational Research

- Assessment of consumption of processed and non-processed foods in India.
- Creation of demand for millet foods through PCS value chain and value chain commercialization of maize products.
- Micronutrient profile of population residing in endemic fluoride deficient areas.
- Organophosphorus pesticide exposure of urban children with conventional diets through bio-monitoring of children of different age group and different socio-economic status.

- Assessment of pesticide exposure and various cancers in agricultural farming community of Guntur District.
- Dietary intake of selected nutrients and exposure estimates of contaminants in various socio-economic group in Hyderabad.

Genetic Research Centre, Mumbai

Basic Research

- Mutation analysis of genes responsible for sex development in cases of sex development disorders will be continued with a view to screen additional genes using advanced methods like microarray.
- Study on Fragile X males.
- Identification of genetic syndromes & Genetic counseling.
- Prenatal diagnosis in order to enable at-risk couples to make appropriate decisions.

Institute of Cytology and Preventive Oncology, Noida

Basic Research

- Development of prophylactic DNA based vaccine with high antigenic potential against Human Papilloma Virus-HPV 16 and HPV18.
- Role of genetic polymorphism of genes involved in Phase-I and Phase-II detoxification system. GSTM1 and GSTT1 genes in different cancers and Cytokine genes (Oral cancer), Cyclin D1 gene (Bladder cancer), FHIT & RASSF1A (Colorectal cancer).

Epidemiological/Operational Research

- Colposcopic networking for early detection of cervical cancer and its precursors.
- Magnivisualizer for early detection of precancerous lesions of oral cavity.

ICMR Virus unit, Kolkata (Regional Infectious Disease Laboratory)

Basic Research

- Studies on Liver Disease in HIV infection.
- Cytokine gene polymorphism in Hepatitis.
- Propagation of Hepatitis C Virus in tissue culture model for better therapeutic treatment against HCV.
- Seroprevalence of HSV infection among Dermatology & STD Clinic attendees of Medical College Hospital, Kolkata and the molecular characterization of herpes virus strains isolated from clinically diagnosed genital herpes patients.
- Studies on HCMV infection among the infected population of Eastern India.
- Evaluation of anti-herpes virus activity of a bioactive alkaloid, its characterization, synthesis and mechanism of action.

- Studies on molecular epidemiology of HCV for continuously monitoring of HCV genotypes circulating in Eastern and North-Eastern India.

Microbial Containment Complex, Pune

- Development of National virus repository.
- Molecular characterization of viruses (Bunyaviruses) isolated from India.
- Establishment of BSL-4 laboratory facility.
- Survey of highly pathogenic zoonotic pathogens from Bats and domestic animals.

National AIDS Research Institute, Pune

Basic Research

- Vaccine and Microbicide trials on female controlled methods.
- HIV virus pathogenesis study & repository.

Clinical Research

- Counseling and voluntary testing of HIV seropositive individuals under CARE protocol.
- Screening of new molecules and biologicals for anti-HIV Activity.
- Studies on Adherence, Stigma, Mental Health and QOL. LTNP and seroconverter cohorts.

Epidemiological/Operational Research

- Studies in “at Risk” Populations with AIDS, Treatment and Care Centre (NACO).
- Expansion of Database-Registry Matching Studies, Neuro AIDS, Vaccine Trial Centre, Virus Bank & Disease Burden/ Impact studies.

Translational Research

- Support for Program (surveillance, EQAS-HIV serology and CD4, ART Centre,) community engagement for research & training for HRD.

National Institute of Cholera and Enteric Diseases, Kolkata

Basic Research

- Genomic analysis of multidrug resistant *Campylobacter* species isolated from diarrhoeal patients.
- Molecular characterization (MC) of *Salmonella enterica* serovar *Typhi* isolated from blood of clinically suspected typhoid fever cases in children, MC of Group A, B or C Rotaviruses detected as sole pathogen from acute watery diarrhoea cases in Kolkata, Detection and MC of complete nucleotide sequence of human picobirnavirus causing acute watery diarrhoea among children in Kolkata, MC of a *Vibrio cholerae* secreted chitinase. MC of Human Caliciviruses and Astroviruses.
- Studies on colonization ability of tcp-ve *Vibrio cholerae* strains in animal model.

- Exploring the role of the rotavirus encoded non-structural protein(s) in evasion of cellular immune responses.
- Interplay between colonization factor CS6 of enterotoxigenic *Escherichia coli* and host intestinal cells.
- Studies on a novel approach of using outer membrane vesicles (OMVs) of *Shigella* as a candidate vaccine in animal models.
- A study on the identification of novel virulence factors of *Salmonella enterica* serovar Typhi, proteases of *Vibrio cholerae* and their role in pathogenesis and immune responses.
- Studies on RNA maturation and processing in *Giardia lamblia*.
- Role of gut microflora in neonatal sepsis with special reference to Gram-negative bacteria.

Clinical Research

- Hospital based Diarrhoeal Diseases Surveillance at ID Hospital (in patients) and Dr. B.C. Roy Hospital for Children (out patients), Kolkata. Out patient based surveillance on diarrhoeal diseases at Dr. B. C. Roy Memorial Hospital for Children.
- Pathogenetic implications of *H. pylori* strains in gastroduodenal diseases and gastric cancer.
- Identifying factors influencing HIV transmission in married couples- a step towards intervention development.
- Relation between diarrhoea and climatic factors in Kolkata: Twenty years retrospective study.

Epidemiological/Operational Research

- A comprehensive population-based diarrheal disease surveillance program among under-five children in rural West Bengal, India.
- Molecular epidemiology of cholera in India.
- Nationwide screening of phage types of *Vibrio cholerae* O1 biotype ElTor.
- Role of seasonality on the distribution, abundance and diversity of *Vibrio* organisms in estuaries of West Bengal: relation with cholera incidence.
- Rationality of prescription habits by the health care providers for treatment of diarrhoea/ cholera in urban slums of Kolkata: an observational study.
- Generation of database on diarrhoeal diseases outbreaks in India.
- Health care utilization and attitude survey regarding diarrhoea in children less than 5 years.

National Institute of Epidemiology, Chennai

Epidemiological/Operational Research

- Cardiovascular diseases, diabetes, hypertension and risk factors in urban and rural populations in Tamil Nadu have completed 10500 enrollments in 11 villages.

- Association of various lifestyle, biological and genetic risk factors with cardiovascular diseases.

Translational Research

- MPH (Epidemiology and Health systems): Modified with specialization in Epidemiology and Health Systems.
- Post Graduate Diploma in HIV Epidemiology (PGDHE): with Tamil Nadu AIDS Control Society 5-10 graduates every year.
- Strengthening field epidemiology in North Eastern states of India: Short term training programs.
- Long term Bio-ethics training program for India.

National Institute of Immunohaematology, Mumbai

Basic Research

- Molecular Pathology of severe Von Willebrand disease.
- SNPs in target genes in warfarin metabolism pathway in thrombosis patients.
- Molecular basis of Hemophagocytic lymphohistiocytosis in India, induction of fetal haemoglobin by naturally occurring compound and erythroid cultures.
- Delayed Vitamin K deficiency: genetic profile of factors in vitamin K cycle and gamma carboxylation system.
- Molecular characterization of Haemophilia A patients from Western India.
- Establishment of Molecular Characterization and Prenatal diagnosis of Thalassaemia and Sickle Cell Disease at Regional Centers.
- Modulation of the clinical phenotype of sickle cell disease by genetic polymorphisms in modifier genes.
- Study of biology of Leukemic Stem Cells & Evaluation of Alpha Hemoglobin Stabilizing Protein (AHSP) as a genetic modifier and effect of linked and unlinked determinants on clinical manifestations of Hemoglobinopathies.

Clinical Research

- Study of pattern of Primary Immunodeficiency in Western India with a view to establish a diagnostic algorithm suitable for this population.
- The Mannose Binding Lectin (MBL) Gene Polymorphism in Systemic Lupus Erythematosus (SLE) and its association with clinical manifestations of the Disease.
- Phenotyping of subjects with borderline hemoglobin A₂ levels and effect of linked and unlinked determinants on β thalassemia carrier screening.
- Understanding the unexplained Hyperbilirubinemia in Hemoglobinopathies.

Epidemiological/Operational Research

- Assessment of neonatal screening for sickle cell disease and effect of early intervention.

Translational Research

- Translational Research Workshops on Training in Diagnosis and molecular characterization of hemoglobinopathies in medical colleges.
- Development of a rapid granule release assay for evaluation of genetic Hemophagocytic Lymphohistiocytosis (HLH).
- Diagnosis of haemophilia and other bleeding disorders with a view to establish full fledged diagnosis laboratories in selected centers in six states in Central and North East India.

National JALMA Institute for Leprosy & Other Mycobacterial Diseases, Agra

Basic Research

- Intracellular expression of proteins in mycobacteria –a proteomic analysis.
- Protective efficacy of different vaccines in animal models of tuberculosis.
- Mechanisms of endothelial cell infection by ultrastructural, molecular and immunological methods.
- Seroassays for leprosy using newer antigens/ techniques.
- Cytokine gene polymorphism in leprosy & TB, Toll-2 receptor gene polymorphism.
- Search for new antigens of *M.tb* capable of inducing strong T helper type 1 (Th 1).
- Molecular methods for detection of drug resistance in leprosy and TB.
- Molecular characterization of *M.tb* strains and their growth kinetics in experimental animals.
- Understanding the differential gene expression of *M.leprae* using genomic approaches.
- Pharmacogenetic and pharmacogenomic studies in tuberculosis.

Clinical Research

- Study of the profile of leprosy in female patients / Hormonal changes.
- Mw immunotherapy plus DOTS in TB.
- Nerve decompression studies in leprosy patients.
- Evaluation of the effect of addition of immunotherapy with Mw vaccine to standard chemotherapy in Borderline Leprosy.

Epidemiological/Operational Research

- Drug resistance surveillance in TB.
- Molecular epidemiological studies using different genotyping methods.
- Understanding the genomic diversity in leprosy bacillus.
- Epidemiological studies of leprosy in Agra district (U.P.).
- Epidemiological studies in Ghatampur field area.

Translational Research

- Application of direct *in situ* hybridization and PCR procedure on tissue specimens for early diagnosis of leprosy and TB.
- Quantitative assessment of mutations by real time PCR of genes encoding for resistance.

National Institute of Malaria Research, New Delhi**Basic Research**

- Collection of *Plasmodium* field isolates, adaptation, cryopreservation and characterization of *P. falciparum* isolates for malarial parasite bank.
- Screening of medicinal plant extracts for their antiplasmodial activity.
- Incidence of mixed-species malaria infection in the country & new genome base diagnostic tool will also be developed from blood/saliva samples.
- *Anopheles culicifacies* evolutionary genomics.
- Evolution of insecticide resistance in *Anopheles culicifacies*.

Clinical Research

- Studies on drug trials.
- Testing and development of vector control tools using herbal, microbial and chemical products
- Monitoring of current antimalarial therapy for its efficacy and side effects.
- Quality assurance of malaria Rapid Diagnostic Tests and target antigens of the RDTs.

Epidemiological/Operational Research

- Studies of anopheline species complex on the distribution, biology and vectorial potential of the members of *An. culicifacies*/*An. fluviatilis*/*An. minimus* complexes in malarious areas for situation specific and effective vector control strategies.
- 10 field stations (located at Bangalore, Chennai, Goa, Guwahati Haridwar, Jabalpur, Nadiad, Ranchi, Raipur and Rourkela) under Integrated Disease Vector Control project with coordination from NIMR HQ. Their activities will also be extended to other vector borne disease like dengue, chikungunya, filariasis and leishmaniasis as recommended by Scientific Advisory Committee (SAC) from time to time.
- Climate change and its impact on malaria and malaria vectors.
- Phase II of Health impact assessment of entire Narmada basin in Madhya Pradesh and Sardar Sarovar Command areas of Rajasthan in districts Jalore and Barmer.

Translational Research

- Technical and epidemiological/ operational support to National Vector Borne Disease Control Programme (NVBDCP).
- Development of molecular assay(s) on resistance and this incorporation into diagnostic system in NVBDCP.

- Studies on bio diversity of anophelines with emphasis on malaria vectors in India.
- Early detection of malaria epidemics using satellite and environmental data.

National Institute of Nutrition, Hyderabad

Basic Research

- Diversification of Indian diet to improve iron bioavailability- study is using Caco-2 Cell line model.
- Simultaneous determination of biochemical indicators of micronutrient status from dried blood spots.
- Lipid Chemistry studies to explore potential Role of Dietary Nutrients *i.e.* Vitamin A on regulation of development and / or control of obesity using a genetic obese mutant rat model with impaired glucose tolerance trait (WNIN/GR-Ob)–Nutrient-Gene Interactions.
- Evaluating impact of dietary fats rich in n-6 & n-3 polyunsaturated fatty acids on adiposity and insulin resistance in diet induced obese rat model to find the missing molecular link with vitamin A metabolism.
- Impact assessment of nutritionally superior varieties of mustard oil on lipid metabolism.
- Bioactive Phytochemicals in Indian foods.
- Studies on the gastroprotective effects of Naga king pepper.
- Carbohydrate contents of Indian foods- revision.
- Stem cell research by assessment of adult human pancreatic islets following autologous transplantation (NCCS-NIN-AIG).
- Amino Acid – Metal complexes as model for the Glucose Tolerance Factor of Yeast: Hypoglycemic activity and therapeutic potential in Diabetes.
- Synthesis, structure and mechanism of action in yeast and animals.
- IGF1 and BDNF signaling in the brain of NIN obese mutant rats during ageing: Effect of calorie and micro-nutrient restrictions.
- Study evaluating role of Ubiquitin- proteasome pathway in vitamin D deficiency induced muscle atrophy.
- Efficacy of polyphenol rich plant food sources as proteasome inhibitors and their role in cancer.

Clinical Research

- Study for Dietary diversification of Indian vegetarian diet to improve iron bioavailability.
- Stress, allostatic load and micronutrient status among school students: impact of dietary advice.
- Regulatory role of zinc in hepcidin mediated iron metabolism.

- Endocrinology and Metabolism study on Foetal programming for neuro musculoskeletal development in the rat offspring. Role of antenatal and perinatal magnesium deficiency.

Operational Research

- Continued Nutrition Extension, Education & Communication through various programs like Nutrition communication through space technology enabled village resource centres (VRCs) currently in Andhra Pradesh.
- Evaluation of nutrition reports. Workshop for Journalists on reporting scientific findings in newspapers. Effect of communication intervention on reading of food labels.
- Evaluation of Oorja (Nutrition) Club initiative in about 300 schools in the state of Andhra Pradesh.
- Integrated Indian food composition database project.
- Nutrient profiling of rice varieties from different ecological zones.

National Nutrition Monitoring Bureau (NNMB)

Clinical Research

- Assessment of consumption pattern of carbonated beverages and its ill effects on adolescents and young adults (18-35years).
- Nutritional and health status of street children in Hyderabad.
- Creating a DNA Bio-repository and setting up of a Sports Nutrition Cell.

Epidemiological/Operational Research

- 3rd survey to assess diet and nutritional status of rural population and prevalence of Hypertension & Type-2 diabetes among adults.

National Centre for Laboratory Animal Sciences (NCLAS), Hyderabad

Basic Research

- Localization and cloning of genes responsible for obesity & other diseases in WNIN.
- Impact of microbes and environment on obesity.
- Development of new animal models for disease specific research.

National Institute of Medical Statistics, New Delhi

Epidemiological/Operational Research

- **Training on Research Methodology**, Sampling Methods in Health Research Clinical Trials and Statistical Computing, Statistical Methods for the Evaluation of Diagnostic Kits using packages, viz. EpiInfo, SPSS, STATA, 'R', SAS *etc.*
- National Clinical Trials Registry: Data mining.

- An Estimation of maternal mortality ratio in Orissa and Rajasthan.
- District level infant and child mortality in India.
- NACO's HIV Sentinel Surveillance and estimation of HIV burden in the country.
- Estimation and Prediction of HIV/AIDS in India using Deterministic Asian Epidemic Model (AEM): A case of Mumbai and Chennai.

National Institute of Occupational Health, Ahmedabad

Epidemiological/Operational Research

- Preventive, promotive research in occupational hazards in unorganized sectors including vulnerable population women children and elderly.
- Environmental health issues due to ambient air pollution, climate change, dust related diseases, solid waste disposal, disaster epidemiology.

Translational Research

- Effective translational research in developing research methodologies and techniques such as ergonomic measures, dust control devices, *etc.*

National Institute of Pathology, New Delhi

Basic Research

- Studies on gene expression and hypermethylation profiles in early onset breast cancer.
- Haematological malignancies-expression of fusion oncoproteins and cell cycle regulators in acute and chronic leukemias.
- Cancers in North-East India.
- Immunogenetic profile of nasopharyngeal cancer in a high prevalence region of North-East India.
- Genome-wide analysis of genetic alterations in patients with oesophageal cancer from north-east India using single nucleotide polymorphism arrays.
- Epigenetic studies in oesophageal cancer in high risk region of North-East India.
- Urinary bladder cancer, Characterization of host immune profile associated with progression of superficial TCC of bladder by microarray analysis.
- Role of cyclo-oxygenases in cytokines dysfunction of invasive and non-invasive TCC of human bladder.
- Identification of epigenetic biomarkers for recurrent and invasive behaviour of urinary bladder cancer.
- Studies on Infectious diseases like on Chlamydiasis to evaluate role of oxidative stress in *Chlamydia trachomatis* infected first trimester spontaneous aborters.
- Immunomolecular expression of cyclo-oxygenases and prostaglandin receptors in endometrial curettage tissue of *Chlamydia trachomatis* infected women during spontaneous abortion.

- Role of *Chlamydia trachomatis* in reactive arthritis.
- Protective immunogenicity of centrin knock-out. Live attenuated *leishmania* parasite in the animal models and in human cells.
- Parasite surface antigen-2 (psa-2) of *Leishmania donovani*: studies on its role in parasite virulence, drug resistance and modulation of host macrophage function.
- Pre-clinical studies of a PSA based human vaccine candidate for visceral leishmaniasis.
- Transcriptome profiling for identification and characterization of miltefosine resistance associated genes of *Leishmania donovani*.
- Analysis of host immuno- determinants involved in the pathogenesis of post kala-azar dermal leishmaniasis, Analysis of host immuno-determinants involved in the pathogenesis of Indian cutaneous leishmaniasis (CL), Leprosy-clinicopathological determinants in leprosy type 1 reactions.
- Adult stem cell biology- a novel arithmetic approach for fool-proof production of growth arrest in 3t3 cells suitable for human epidermal culture.
- Environmental biology- assessment (HEBM) of pesticide exposure in tea garden workers of north eastern states of India will be requiring continued efforts for more knowledge and updation.
- Leishmaniasis- Development of non-invasive diagnostic assays for PKDL.
- New tools for monitoring drug resistance and treatment response in visceral leishmaniasis in the Indian subcontinent.

National Institute for Research in Reproductive Health, Mumbai

Basic Research

- Research on Female Fertility (Embryogenesis, Endometrial proteins, Implantation and Pregnancy).
- Identification of Endometrial proteins in uterine receptivity, implantation and endometrial hyperplasia with targets to modify endometrial epithelial /stromal cells in response to embryo secreted factors.
- Study to modify proteins in endowing the endometrium with receptivity.
- Cellular events regulating cell surface protein repertoire on endometrial epithelial cells.
- Impact assessment of uterine fibroids on endometrial receptivity.
- Developing an animal model for endometrial hyperplasia.
- Male Fertility studies on Spermatogenesis, sperm proteins, FSH receptor & prostate secretory protein-94.
- Role of estradiol in spermatogenesis in rat model to identify molecules important for spermiation.

- Role of c-kit/Oct4 genes in the early events of spermatogenesis.
- Identification and characterization of sperm flagellar proteins relevant to motility.
- Validation of differentially regulated sperm proteins & Role of tubulin acetylation/deacetylation in sperm, Studies on sperm progesterone in male fertility.
- The role of DAZ gene copies in infertile to determine additional genetic factors responsible for azoospermia focussing towards determining the copy number variations of DAZ gene on the Y chromosome and their association with sperm production and embryo quality.
- Genomic imprinting as a paternal epigenetic factor in early embryo loss to investigate placental development in embryos sired by tamoxifen treated male rats.
- Studies on new targets for the development of anti-fertility vaccine using sperm protein-KLH conjugated peptide 1 of 80 kDa protein.
- MDP conjugated R-17 peptide of human seminal plasma in bonnet monkey for pre-clinical safety and efficacy studies.
- FSH receptor genotype in women is expected to yield Developing Species Specific FSH Assay.
- Reproductive Cancers cell line & growth inhibition by CRISP-3 and transcriptional regulation of CRISP-3.
- Studies on mechanism of sexual transmission of HIV.
- HIV variants, Recombinant HIV1 C Vaccines.
- Studies on cytokines gene polymorphisms in relation to HPV/HIV infection/treatment.
- Develop biomarkers of Premature Ovarian Failure.
- Development of molecular tools for the diagnosis of Congenital Adrenal Hyperplasia, Endometriosis to validate biomarkers and their role in endometriosis related infertility to develop PCR based diagnostic test for endometrial tuberculosis using menstrual blood.
- Indigenous ELISAs for bone turnover markers.
- Identification and Characterization of Sperm Antigens Liprin- α , Fbox6, SFP6 and MMSDH proteins to develop test to assess sperm quality and fertilizing ability, Resazurin reduction test to assess the sperm quality in men.

Epidemiological/Operational Research

- Operational research to improve ART adherence among PLHA, to test Intervention model for better contraceptives, Raising HIV/AIDS awareness among Non-Infected Wives, Enhancing participation of men in reproductive health.

Translational Research

- National Center for Pre-clinical Reproductive and Genetic Toxicology & Clinical Research to develop detection PCR tests & commercialization.

National Institute for Research in Tuberculosis, Chennai**Basic Research**

- Drug interactions with both bacterial and human proteasomes.
- Study of cell wall components of tubercle bacilli in different metabolic states/ Initiated.
- Taxonomical studies on mycobacteria using HPLC techniques to get their geographical distribution.
- Molecular studies on new drug targets (pyrazinamide resistance in *M. tuberculosis* is due to mutations in the *pncA* gene coding for pyrazinamidase).
- **HIV-TB studies** on molecular characterization of the envelope gene of Indian HIV-1 subtype C isolates.
- Immunological status and characterization of dormancy associated antigens of *M. tuberculosis*, immunodiagnostic antigens from the secretory proteome of *M. tuberculosis*, evaluation of role of Neutrophils and dendritic cells, Chemokine, DC-SIGN and Toll-like receptor gene in innate immunity of TB.

Clinical Research

- Critical ongoing studies include- Development and refinement of chemotherapy tools for the TB control programme with the focus to develop regimens that shorten the duration of chemotherapy, to identify user-friendly and cost-effective regimens.
- Clinical pharmacology studies such as development and validation to estimate certain anti-TB and antiretroviral drugs.
- Pharmacokinetics of anti-TB drugs in HIV-infected children: impact of age, nutritional status, and HIV infection to examine the impact of age.
- Nutritional status and HIV infection and the pharmacokinetics of rifampicin, isoniazid, pyrazinamide and ethambutol in children infected with TB and HIV.
- Studies on Pharmacokinetics of moxifloxacin in healthy subjects.
- Monitoring of plasma NNRTI levels in HIV-infected TB patients to examine the association between plasma nevirapine and efavirenz with virological outcomes.

Epidemiological/Operational Research

- Operational Research in TB is to continue on performance of the RNTCP.

National Institute of Virology, Pune**Basic Research**

- Studies on respiratory viruses other than influenza.
- Studies on the influence of C3d on immune response against HA and NA of avian influenza (H5N1) and pandemic influenza (pH1N1) using DNA vaccination approach.

- Molecular and immunological characterization Studies on the following: Norovirus structural proteins, Non Polio Enteroviruses from patients with Acute Flaccid Paralysis.
- Enteroviruses from patients with acute gastroenteritis.
- Adeno, Astro and Aichi virus strains in Acute Gastroenteritis patients, Sapoviruses (SaVs) in Acute gastroenteritis, Entero viruses associated with Hand Foot and Mouth Disease (HFMD) in India.
- Enteroviruses associated with outbreaks of conjunctivitis, insecticide resistance in *Culex spp.* from endemic area of Japanese encephalitis.
- Viruses (Bunyaviruses) isolats, etiological agent(s) of AES in eastern UP, human group A and group B rotaviruses.
- Enteric viruses in different species of animals.
- Pathogenesis of hepatitis viruses.
- Differential role of Th1 and Th2 CD4 T cells in protection from lethal encephalitis in mice.

Clinical Research

- Cytokine responses in children hospitalized with acute diarrhoea.
- Immune response against viruses in AES patients at peptide and cytokine level.
- Role of complement during Influenza infection. Studies on the pathogenesis of Avian Influenza viruses.
- Host gene expression profiling during Highly Pathogenic Avian Influenza Virus (H5N1) infection.
- Virus–host interaction during infection with highly pathogenic Influenza A viruses.
- Development of infectious cDNA clone of pathogenic West Nile virus strain 68856 to determine the role of glycosylation as virulence determinant.
- Determinants of peripheral pathogenicity of West Nile virus.
- Role of innate immune response in Japanese encephalitis virus infection in humans.

Epidemiological/Operational Research

- Study for Zoonotic viral pathogens in Bats, Studies on *Aedes* fauna of Kerala.
- Avian Influenza surveillance in poultry, domestic ducks and in wild migratory birds in districts of West Bengal.
- Outbreak Investigations, Reagent preparation/Diagnostic services, Characterization of Immune Response in Dengue-Cell mediated & Humoral, Immune Response (non-MHC).
- Pathogenesis, Virological surveillance of Influenza viruses in Pune.
- Community-based surveillance of viral diseases/syndromes in Janata Vasahat in Pune, Maharashtra.

- Multi-centric hospital-based surveillance of acute encephalitis syndrome among children
- Surveillance of Rotavirus disease and strains in adolescent and adult cases of acute gastroenteritis.
- Aetiological and epidemiological investigations on arbovirus infections and laboratory diagnosis in Karnataka, Evaluation of host gene expression profile in case of infection with swine- origin influenza A H1N1 (S-OIV) viruses.
- Role of PBMC population in active replication of Chandipura virus.

National Centre for Disease Informatics and Research, Bangalore

The Institution is in making: Research activities which are spill over from XI plan are:

Epidemiological/Operational Research

- Task Force Project on Hospital Based Cancer Registry at Dr. B B Cancer Institute, PGIMER, Chandigarh, Guwahati (Assam), Population Based Registry at General Hospital, Naharalagun (Arunchal Pradesh), General Hospital, Pasighat (Arunchal Pradesh), Government Medical College, Patiala.
- Ad-hoc Research Project on Rural Cancer Registry at Sevagram – Wardha, Cancer Atlas in North East Region including Coordinating Unit of NCRP, Bangalore, Inclusion of Non-NCRP Registries into NCRP network PBCR at Ahmedabad, Thiruvananthapuram, Karungapally, Nagpur, Pune and Aurangabad, Additional Three PBCRs under North East Region at Agartala, Shillong and Kohima including Coordinating Unit of NCRP, Patterns of Care and Survival Studies on Cancer Breast, Cancer Cervix and Head and Neck Cancers.
- Project on Atlas of Cancer in Punjab State (Collaborating centres in Delhi, Chandigarh, Rajasthan and Punjab) including Coordinating Unit of NCRP, Bangalore.
- Long Term Project on Older Six PBCRs under North East Region at Aizawl, Gangtok, Imphal, Silchar, Dibrugarh and Guwahati including Coordinating Unit of NCRP and Monitoring Unit of NERCR at Dibrugarh.
- One Coordinating Unit of NCRP will continue at 13 Cancer Registries.

National Institute for Research in Environmental Health, Bhopal

- Studies initiated on affected population in relation to environmental pollution to continue.

Regional Medical Research Centre, Belgaum

Basic Research

- Quality standards for crude drugs.
- Phytochemistry or testing/Quality Control/Standardisation of herbal medicine in the ISM. Identify marker molecules of important medicinal plants.

- Chemoprofiling of plants to understand geoclimatic variations.
- Development of safety and efficacy profiles for selected leads/formulations/fractions.

Epidemiological/Operational Research

- Study on availability/usage of traditional/herbal medicine in the community.
- Directory of traditional healers in Belgaum region was prepared. It is proposed to extend these studies to other regions to obtain more information for identification of herbs for clinical usefulness. Consolidation of herbal garden and museum of medicinal plants.

Regional Medical Research Centre, Bhubaneswar

Basic Research

- Biological function and role in pathogenicity of RIF/RIFIN genes of *P. falciparum* to elucidate the importance of RIF gene and to identify newer drug/ vaccine target.
- Molecular typing of rotavirus infection in human.
- Molecular and Epidemiological characterization of opportunistic enteric pathogens with special reference to *Cryptosporidium* and *Giardia lamblia* in HIV +ve cases.

Clinical Research

- Identification of the causative organism (bacterial/fungal) and their drug sensitivity in management of filarial lymphoedema with complications.
- Effect evaluation of yogic exercise and Electrotherapy induced muscular contraction in reduction of filarial Lymphoedema.
- Nutrition research on development of home-based management strategy for improving moderate/severely malnourished children.

Translational Research

- Strategy for optimizing the accessibility and utilization under National Malaria Control Programme.

Regional Medical Research Centre, Dibrugarh

Epidemiological/Operational Research

- Validation of early warning system for occurrence of Japanese encephalitis in Assam.
- Genetic biodiversity and population genetic analysis of malaria vectors in NE India.

Translational Research

- Commercialization for the diagnostic kit developed for pulmonary paragonimiasis.
- Plant based antimalarials.
- Some of the new tests for Plant based mosquito larvicide.

Regional Medical Research Centre for Tribals, Jabalpur**Basic Research**

- *In-vitro* molecular markers for monitoring the *P. falciparum* resistance in Central India.

Clinical Research

- Analysis of *in vitro* transcriptome of *P. falciparum* from Indian patients suffering from cerebral malaria and its comparison with patients infected with other severe malaria.
- Clinical profile of Sick cell disease in central India.
- Studies on seroprevalence of dengue in Madhya Pradesh, India.
- Basic research by *in vitro* evaluation of molecular markers for monitoring the *P. falciparum* resistance to antimalarial drugs in central India.

Epidemiological/Operational Research

- CSF and serum predictors of fatal cerebral malaria.
- Incidence of malaria in endemic regions of central India.
- Occurrence of *P. falciparum* malaria in the heterozygotes of haemoglobinopathic individuals.
- Reaching primitive tribal Group with IEC to improve awareness to malaria: Appraisal of Baigas of Baigachak area of Dindori District of Madhya Pradesh.
- Disease burden due to fluorosis in tribal areas of Madhya Pradesh.
- Sociobehavioural research to Reach Primitive tribal Group for IEC to improve awareness about Malaria, Evaluation of Disease burden due to fluorosis in tribal areas of Madhya Pradesh, Studies on seroprevalence of dengue & Clinical profile of Sick cell disease in central India. These all work need continuation.

Regional Medical Research Centre, Port Blair**Basic Research**

- Non-communicable diseases-HLA gene diversity, SNPs and infectious disease susceptibility among the primitive tribes showed higher prevalence of KIR2DL2 ligands in Jarawas making them more susceptible to infectious diseases and cancer.
- DNA vaccine development for Chikungunya.
- Leptospirosis- DNA vaccine for leptospirosis. Whole genome sequencing project of leptospiral isolates: Sequencing of four strains completed, further analysis is to be continued.
- A latex agglutination test and an IgM ELISA for leptospirosis. Improvement of these tests and development of antigen detecting test are on-going.

- Activities as part of the mandate of the National Leptospirosis Reference Centre and WHO CC. Studies to identify hotspots, ecology of leptospirosis, its transmission, environmental parameters, determinants to identify target intervention, are to be continued.

Clinical Research

- Studies on pathogenesis of Chikungunya infection to improve patient management.
- Studies on Hepatitis B in relation to existence of vaccine escape mutant for hepatitis, studies to identify viral load & treatment effect in long term.
- Studies on Leptospirosis associated pulmonary haemorrhage (LAPH) syndrome.

Epidemiological/Operational Research

- Estimation of real time prevalence of antibodies against common viruses.
- Surveillance of viral diseases: Dengue, DHF and DSS and H1N1.
- Molecular, epidemiology and geographic genomics of viral infections studies in Andaman and Nicobar, because of the proximity of the islands to Southeast Asian archipelago and the mixture of population.
- Diarrhoeal diseases- Surveillance of bacterial diarrhoeas and emergence of drug resistance among enteric pathogens for treatment policy of diarrhoea.
- Tuberculosis- Prevalence of pulmonary tuberculosis and annual risk among the Nicobarese of Car Nicobar and control of tuberculosis in the tribal.
- Ecology of Anopheline mosquitoes transmitting malaria in Andaman and Nicobar Islands, Chikungunya & *Aedes albopictus* currently under control but need surveillance continuation.
- Non-communicable diseases- Hypertension among Nicobarese community based intervention, and epigenetic studies.
- Indigenous medicinal plants and aquatic fauna- Digital database of new drugs from plants, compilation of knowledge from indigenous tribes and other communities on the use of medicinal plants and other natural products for their medicinal properties.

Translational Research

- Vector borne diseases-Elimination of sub-periodic filariasis from Nancowry group of islands is found possible with DEC fortified salt, need to continue monitoring.

Rajendra Memorial Research Institute of Medical Sciences, Patna

Basic Research

- Purification and biochemical characterization of trypanothione and trypanothione peroxidase in *L. donovani*: a possible marker for diagnosis of visceral leishmaniasis.
- Identification and characterization of cyclooxygenase-like enzyme from *L. donovani*, in-silico.

- Identification of polymorphic microsatellite loci and finding an evolutionary relationship between different *Leishmania* strains.
- Whole Transcriptome Analysis of *Leishmania donovani* by Next Generation Sequencing.
- Efficacy of indoor synthetic pyrethroids spraying on sandfly population in Bihar, Analysis of Isd11 and frataxin interaction and their roles in Fe-S cluster machinery in *Leishmania donovani*.
- Study of trypanothione metabolism and associated pathways in *Leishmania donovani*: cloning, biochemical characterization and physiological significance of trypanothione synthetase and trypanothione reductase, Biochemical and functional characterization of Iron-Sulfur Cluster (ISC) assembly and cellular localization of LdIsceS, LdIsceU proteins in *L. donovani*.
- GPI-anchored membrane proteins of *Leishmania donovani* mediated regulation of Toll-like Receptors and costimulatory molecules on antigen presenting cells and induction of cytokines.
- *Leishmania donovani* antigen and their influence on natural T-regulatory cells in immuno-suppressed VL patients.
- Analysis of the *Leishmania donovani* parasite and part played by its antigen on immunological imbalances during VL.
- Search for anti-leishmanial activity in crude plant's extract, Anti-leishmanial activity of nano amphotericin B deoxycholate in experimental VL infection, Identification of anemia as pathogenic factor in visceral leishmaniasis.
- Studies on differential proteomic responses of *Leishmania donovani* on exposure to nitrosative and oxidative stress.
- Comparative molecular modelling of various important proteins of different *Leishmania* strains and ligand-protein interaction, Evaluation of insecticidal effect of plant extract to sandfly in laboratory.
- Association of HLA class I and II alleles in susceptibility to visceral leishmaniasis in endemic and non-endemic regions of Bihar.
- Screening cocktail *Leishmania* antigen (PDIS-70) along with immunomodulator for their role in Immunity and protection in Visceral leishmaniasis, Cloning, expression & functional characterization of oleate desaturase of *Leishmania donovani*.
- Novel Noninvasive Method for Diagnosis of Visceral Leishmaniasis (VL) and Post Kala-azar Dermal Leishmaniasis (PKDL) by rK39 Test in Sputum Samples.
- Development of PCR based diagnosis of Visceral Leishmaniasis (VL) from Urine samples.

Clinical Research

- Clinical manifestation and treatment outcome of patients with visceral leishmaniasis and HIV co-infection.
- Efficacy and safety of Micafungin sodium in patients of Kala -azar(VL) (Clinical study-phase II).

- Early detection and evaluation of Microalbuminuria and other Laboratory measurements for assessment of renal function in kala azar and PKDL cases in relation to parasite load.
- Analysis of leucocyte population in correlation with chemokines and cytokine expression in Post kala-azar dermal leishmaniasis (PKDL).
- Pathogenesis of *Leishmania donovani* vs vector salivary gland homogenate (SGH), SGH from *Phlebotomus argentipes* for their role on host immune response with special emphasis to test their efficacy as vaccine for kala-azar.
- Safety and efficacy of a combination of Amphotericin B and Miltefosine compared to Amphotericin B alone in patients with Post Kala-azar Dermal Leishmaniasis (PKDL).
- Haemoglobinopathies with anemia of kala-azar cases from Bihar, Innate Immunity function in visceral leishmaniasis and under malnutrition.
- Study to assess the safety and efficacy of zinc supplementation in treatment of visceral leishmaniasis (VL) in Bihar.

Epidemiological/Operational Research

- Evaluation of Parameters associated with progression of asymptomatic to symptomatic VL cases, Quality of life of visceral leishmaniasis (VL) patients in Bihar, India.
- Hospital based surveillance of kala-azar, Establishment of repository *Leishmania* parasites and sera bank at RMRIMS, Patna.

Vector Control Research Centre, Puducherry

Basic Research

- Isolation and characterization of apyrase gene of the saliva of dengue vectors, *Aedes albopictus*. Monitoring of dengue virus infection in monkeys (zoonosis).
- Development of a mosquito repellent from *Cymbopogon* spp.
- Detection of Chikungunya virus in wild caught *Aedes albopictus* by using molecular methods.
- Rapid detection of Japanese encephalitis virus in desiccated vector.

Clinical Research

- Inter-specific competition study between Dengue vectors *Aedes albopictus* and *Ae. aegypti* for breeding and feeding pattern in different physiographic regions of Kerala State. Bar coding of Mosquito fauna in the Western Ghats region.
- Mosquito taxonomy and systematic revision of FBI monographs on Indian mosquito fauna, biodiversity in Nilgiri Hill, Multi-centric evaluation of L3 stage specific RT-PCR assay for the detection of infective stage (L3) *Wuchereria bancrofti* in vector.
- Tracking the effect of secondary infection causing bacteria of ADL patients on certain immune genes of the filariasis vector *Cx. quinquefasciatus*.

- Studies on the role of rat fleas in the transmission of Leptospirosis.
- Biodiversity of arthropods & biomedical importance of them in Western Ghats.

Epidemiological/Operational Research

Critical ongoing studies on vector borne- viral diseases are

- JE surveillance Network in Tamil Nadu.
- Molecular identification of dengue and Japanese encephalitis virus vectors using genomic DNA.
- Entomo-serological surveillance of Chikungunya/Dengue vectors in the Lakshadweep Islands.
- The monitoring of JE virus activity in Tanjore & Tirunelveli zone, southern India, Development of a pictorial taxonomic key for dengue/chikungunya vectors (*Aedes* mosquitoes) for field application.
- Diversity in Denosonucleosis viruses in the natural population of *Aedes aegypti* and *Aedes albopictus* in southern India and its evaluation as bio-control agents in the control of dengue.
- Prevalence of drug resistance and molecular diversity of *Plasmodium falciparum* and *P. vivax* populations in Rameshwaram.
- Virological and entomological surveillance of West Nile virus using improved molecular methods.
- Role of vector control and mass drug administration (MDA) in the filariasis elimination campaign.
- Mosquito pupal exuvium – an alternative source of genomic DNA, development of ovipositional trap for mosquito control and evaluation.
- Community-based Master Plan to control mosquito menace in urban agglomeration of Madurai City, Monitoring susceptibility status of vectors of various arthropod-borne viral diseases against insecticides.
- Public health use of Thrombinase, a blood clot dissolving enzyme, from *Bacillus sphaericus*. Cyclosporin-A from the fungus *Tolypocladium* sp. Lipopeptides produced by *Bacillus subtilis* (VCRC B471) for the control of mosquito vectors.
- WHO-WHOPES research programmes (Pesticide Evaluation Scheme) & HRD activities of training consultancies.

Translational Research

- Studies on Japanese encephalitis vaccine (SA-14-14-2).
- Development of formulations of *Pseudomonas fluorescens* (VCRC B426) and evaluation against mosquito vectors, Large scale evaluation of biomarkers developed for lymphatic filariasis.

ICMR HEADQUARTERS

International Health Division

The International collaborations are sought under bilateral, multilateral or regional framework modes for facilitating and strengthening interactions among governments, academia, institutions and industries in the areas of mutual interest.

The following activities will be continued and strengthened:

- Bilateral S&T cooperative agreements with other countries.
- Specific agreements with other International organizations/ Institutions.
- The Memoranda of Understanding/Joint statements with collaborating global bodies.
- Workshops and other training programmes already committed.
- Clearing of proposals through the Health Ministry's Screening Committee.
- Managing Indo-German Science Center for Infectious Diseases.

Human Resource Planning and Development

The following activities would be continued and strengthened:

- Award of ICMR Junior Research Fellowships.
- MD-Ph.D. Programme.
- Financial assistance for MD/MS/MCH thesis.
- Short-Term Training Scholarship Programme.
- International travel grant to Non-ICMR scientists.
- ICMR Centenary Post Doctoral Fellowship Programme.
- ICMR Awards and Prizes for excellence in biomedical research.

Publication, Information and Communication

- The publication of periodicals of the Council such as the *Indian Journal of Medical Research*, *ICMR Bulletin*, *ICMR Patrika* etc. will be continued and improved in terms of quality and outreach.
- The library and information services of the Council will be strengthened through networking, addition of more e-journals, reference resources and updation of catalogues/ indices.
- Ongoing activities of the Bioinformatics Centres, the maintenance of the ICMR website, Management Information System on Extramural Research activities, providing of internet and intranet services, video conferencing activities etc. would be continued.
- Data Repository and Business Intelligence Project will be continued with data collection, analysis, data mining, generation of reports, framing policies for data access, data security, providing data from databases for further research.
- The ICMR-NIC Centre continued to provide biomedical information services from PubMed and other databases and would enhance the number of the Indian Medical

Journals in the IndMED database as also enhance the full text access in MedIND with more features. The centre will be strengthened further.

Intellectual Property Rights Management

- The IPR Unit will continue to provide single-window support system to inventions generated with ICMR support and took steps to commercialize such leads that have industrial application.
- Products/processes under development such as the RDB kit, magnivisualizer, thrombinase *etc.* will be vigorously pursued for the introduction of the products in the public health system.
- The translation of leads generated through the support of the Council under process will be intensified with the identification of industry partner and initiate development process with the help of the inventors.

STATUS OF ONE TIME UP-GRADATION ACTIVITIES OF XI PLAN

A total of 134 activities were proposed by the ICMR Institutes under one time up-gradation during XI Plan and a Budget of ₹300 Crore was allotted for the same. Out of these 134 activities a total of 116 activities were either completed or initiated and ongoing. However, 18 activities could not be completed due to various unforeseen events. A spill over Budget of ₹ 132.24 Crore after calculating the inflation has been added in XII Plan Budget to meet these remaining activities.

EMERGENCY OUTBREAK / DISASTER FUND

Budgetary Requirement: ₹50 crore

A rapid outbreak/disaster fund is required to respond to any man made or natural disasters in the country. The fund will help in rapid mobilization of resources that are crucial for such situations. Dedicated fund will remove the barriers to urgent response in these situations in which the delays would result in avoidable spread and loss of life. Recent examples have been the outbreak of emerging and re emerging infectious diseases like SARS, H5N1, H1N1 Chandipura virus, Crimean Congo Haemorrhagic infections *etc.* Besides, health issues arising in the unforeseen events like tsunami, cyclones, earth quake *etc.* also need to be addressed.

CRITICAL ONGOING PROGRAMMES: EXTRAMURAL

Budgetary Requirement: ₹600 crore

The need to promote basic, applied research for the improvement in the health care services in India cannot be overemphasized and would be possible only if all the major potential colleges/institutions participate in the national endeavour, especially Medical Colleges/Institutions that provide education and training in important areas of medical/health research. The Council has recognized this critical need and has been striving hard to encourage medical colleges in the country to seek support for research. This is done through focused support through Task Force Mode where the priorities are identified centrally and identified qualified researchers are brought together to take up time-bound, target-oriented research to address a specific problem of national importance. In addition, doctors/scientists can also seek support under the investigator-oriented research where they could choose a problem of national importance and apply for a grant. Younger researchers can avail of Senior and Junior research fellowships for training that could lead to a higher degree. Finally, undergraduate medical students can also seek small support to take up a small project during summer vacation under the Short Term Studentship programme. These schemes have been proved very successful in the Council as many established medical scientists have sometime or other availing of the ICMR support under the extramural mode.

To sum up, there are two major streams of support for biomedical research by the ICMR. Intramural research conducted by the various permanent institutes/centres and extramural research that is carried out outside the ICMR institutional network by medical colleges/Universities/institutes and voluntary agencies. The basic concept behind extramural support systems is that not all the expertise needed by the Council to create new knowledge for the various health problems. The extramural support system also helps the Council to tap the extensive expertise available outside its network of institutes. Therefore, this partnership have been very productive with the optimal utilization of complementary skills. The major means of extramural support include:

- Centres for Advanced Research (CAR)
- Task Force Projects
- Adhoc research schemes

During XI plan period extramural funding was provided to investigators in 69 medical colleges with 256 projects in the year 2007-08 that expanded to 87 medical colleges with 451 projects in 2010-11. Similarly funding to non-ICMR Institutes/organizations including Universities increased from 274 with 1119 projects in 2007-08 to 329 with 1445 projects in 2010-11. It is evident that more medical colleges were added every successive year as also the number of investigators.

About one third of the projects initiated during the XI plan will be continued in the XII Plan. Included under this head are projects which are long-term studies and are undertaking relevant and essential activities.

EPIDEMIOLOGY & COMMUNICABLE DISEASES

- **Approximately 400 projects will continue into the XII plan**
- Long term projects: Studies of Entomology and Sero-Epidemiology of Japanese encephalitis at Vridhachalam, South Arcot District of Tamil Nadu, Malaria Parasite Bank Project and Integrated Diseases Vector Control of Malaria, Filariasis and other Vector Borne Diseases.
- A total of 98 Task Force projects on virology, Acute Encephalitis Syndrome, Leprosy, Tribal Health, STD's, and Parasitic Diseases.
- About 300 projects on different areas of communicable diseases will continue.

REPRODUCTIVE HEALTH AND NUTRITION

About 250 studies (Task force, ad-hoc, fellowship projects) will continue into the XII plan period.

REPRODUCTIVE BIOLOGY & FERTILITY REGULATION

Contraception

- Phase-III Clinical Trial with the intravasal injectable male contraceptive – RISUG - Post marketing surveillance as well as psychological consequences of the RISUG injection.
- Pre-programme introduction of injectable contraceptives through district hospitals.
- Evaluation of progesterone vaginal ring (PVR) as a new contraceptive option in India
- Impact evaluation and training needs for ECP in India.

Environment and Reproductive Health

- National Task Force on Hazards of Environment Pollutant and Changing Life styles on Human Reproduction.
- Effects of Non-ionizing Electro Magnetic Field (EMF) on Human Health.

Infertility

- Study the average sperm count and other semen characteristics.
- Acceptability and Utilization of female condom among Couples attending Family Planning Clinics.
- Evaluation of acceptability & expulsion rates of immediate post partum IUCD inserted by two different techniques.
- A study of "Near Miss" obstetric events and maternal deaths in Maharashtra.
- Assessment of effectiveness of *Nischay* scheme (provision of pregnancy detection kit) in increasing early detection of pregnancy in State of Haryana.

- Evaluate the performance of ethics committees in evaluating reproductive health research on human subjects.
- Work towards legislation of The Assisted Reproductive Technology (Regulation) Bill & Rules – 2010.
- Setting up of the National Registry of ART Clinics in India.

MATERNAL HEALTH

- Tranexamic acid (TXA) for the treatment of postpartum haemorrhage.
- Basic and translational studies addressing pregnancy complications, gynaecological morbidity, infertility and menopausal problems.
- Multicountry study on Maternal and Perinatal Health /deaths (with WHO collaboration).

WOMEN'S HEALTH

- Multi centric study on female genital fistula for prevention and treatment of genital fistulas.
- Validation of Hemoglobin Color Scale (HCS) vis-a-vis cyanmethemoglobin colorimetric and cell counter method for Haemoglobin estimation.
- Epidemiology, diagnosis and management of preterm to better define the etiologic mechanisms and other factors responsible for PTB.

HIV/AIDS AND MICROBICIDES

- Strengthening linkages between SRH and HIV/AIDS for preventing unintended pregnancies in women with HIV, mother-to-child transmission.
- ICMR-DBT collaboration on HIV/AIDS and Microbicides to design novel vaccines and adjuvant formulations.

CHILD HEALTH

- Community based implementation of kangaroo mother care for reducing neonatal mortality due to hypothermia.
- Correlation of nitrogen balance with outcome in pediatric surgical patients and calculation of modified dietary allowance for children.
- Evaluation of transcutaneous bilirubinometry in preterm very low birth weight neonates.
- Ad-hoc projects on childhood related illness such as Zinc supplementation in cystic fibrosis, malnutrition and HIV infection, Ocular kinetics of anti cancer agents in retinoblastoma, Kawasaki disease, LBW babies and economic burden of intensive care, Pediatric HIV in a High Prevalence Belgaum, Age-Related Blood Lymphocyte Subsets, zinc supplementation in HIV +ve children, Pharmacokinetics of anti-tubercular drugs in children.

NUTRITION

- Ongoing activities in the field of fluorosis, ICMR-ICAR panel, hypertension, Centre for promotion of nutrition research & training with special focus on north-east, tribal & inaccessible population and ad-hoc projects as well as advance centre.

DIABETES MELLITUS

- Prevalence of Gestational Diabetes & risk factors assessment.
- Health Account Scheme (DHR): empowering people for health care through intersectoral coordination.
- Adhoc proposals in Diabetes majorly in the area of new & cost-effective diagnostic and screening tools, behavioral, therapeutic interventions and preventive strategies to curb the epidemic of disease.

NON-COMMUNICABLE DISEASES

Approximately 200 projects and one Centre for Advanced Research would continue into XII plan.

ONCOLOGY

- **National Cancer Registry Programme**

The existing network of 24 population based cancer registries and 6 hospital cancer registries would be expanded as per specific identified needs of some regions.

- **Cancer Atlas**

The project would continue in the North-Eastern states area, which are currently not covered by population, based cancer registries and also in Punjab state would also continue.

- **Cancer Screening**

The model project for implementation of evidence based modalities for screening and early detection of cancers in India, a project on screening for cancers of cervix, breast and oral cavity in Himachal Pradesh.

- **Review of guidelines for management of cancers**

The programme would be carried out and expanded to cover all cancer sites.

- **Studies on breast cancer**

A multi-disciplinary study on understanding the mechanism of disease process and understanding the risk factors for breast cancer in urban as well as rural areas of India.

- **Immunophenotyping of Hematolymphoid Neoplasms**

Assessment of the role of various antibody panels for diagnosis and follow up of patients with haematolymphoid neoplasma.

- **Assessment of cancer occurrence scenario in Punjab**

The ICMR has initiated a Population Based Cancer Registry at Patiala and a Hospital Based Cancer Registry in Chandigarh. A cancer atlas project for rest of the Punjab has been initiated and would be expanded.

- **Indo-German Collaboration in Cancer**

Three studies are ongoing and others invited proposals are being evaluated.

- **ICMR-US Collaboration on Cancer Research**

The research proposals along with the University of Minnesota are being evaluated. Research proposals with other Universities/organizations would also be initiated.

- **ICMR-European Union Collaboration on Cancer**

Research would be initiated in 12th plan after signing of the MoU, which is being processed. Besides the other identified areas, comparative epidemiological studies on cancer in populations of Indian migrants to Europe would also be undertaken.

CARDIOVASCULAR DISEASES

- **Management for Acute Coronary Events (MACE) Registry: A Web Based National Network of Registry for Patients Hospitalized with Acute Cardiovascular Events**

The Phase II of the study would be conducted with the objectives to ascertain the characteristics of hospitalized ACS patients and would be expanded in as many centres as possible in the country.

- **Foetal Origin of Coronary Heart Disease**

Based on findings of phase I, a proposal on “Relationship of birth size, infant and childhood growth on telomere length and telomerase activity in adulthood” would be undertaken.

- **ICMR-INSERM Collaboration in Cardiovascular Diseases**

A project “Designing a biobank for biological samples collected from a mega study on acute coronary events in Indians” has been initiated under ICMR INSERM collaboration. The Management of Acute Coronary Event (MACE) registry Biobank will be used in molecular epidemiology and translation studies in Acute Coronary Syndrome/Coronary Artery Disease.

- **Indo-Canadian Collaboration in Cardiovascular Diseases**

International Conference: Canada-India Networking Initiative (CINI) on Cardiovascular Health: The Collaboration would focus on **Development of Global Health Research networks in Cardiovascular Health; and Research Enabling Tools.**

MENTAL HEALTH

- **Biological Psychiatry & Pharmacogenomics -Treatment outcome of severe mental Illness**

The pharmacokinetics in non-responders schizophrenia patients would continue.

NEUROLOGY

- **Establishment of Population Based Stroke Registry in India**

The phase II of the study to assess the stroke related disability.

- **Neurological disorders in aging**

In Phase II (Pilot study), prevalence of vascular cognitive impairment in a consecutive series of stroke patients will be determined and the Phase III (Follow up study) in the

cohort of patients established with a full risk factor, clinical, neuropsychological and imaging profile in Phase II.

- **Registry of Epilepsy in Pregnant Women**

Monitor pregnancy among women with epilepsy for control of seizures and epilepsy during pregnancy, the outcome and complications of pregnancy, the fetal outcome with special reference to major malformations and developmental problems.

- **Muscular dystrophies in children and adults**

Centres of Excellence at Mumbai and at Coimbatore in order to undertake focused research on Muscular Dystrophy (DMD) to initiate Registry of NMD patients, besides establishing a DNA bank and DNA diagnostics at the two centres. It is also proposed to establish a NMD Muscle Bank at NIMHANS.

- **Indo-French Collaboration in Neurosciences**

Based on priority areas identified by Indo-French (ICMR-INSERM) group for joint collaborations, three have been completed and newer areas would be undertaken.

- **ICMR- EU Collaboration: Cooperation in health research between ICMR and the Health Directorate of the European Commission's DG RTD**

Neurodegenerative diseases causing childhood dementia such as mitochondrial disorders, amino- and organic acid disorders, NCL and leukodystrophies.

DIABETES

- **Registry of People with Diabetes in India with Young Age at Onset**

The phase II of the study would continue involving additional centres.

- **Genetic Analysis of MODY and Neonatal Diabetes in India**

The project would complete its duration in next plan.

- **ICMR-Indian National Diabetes Study (ICMR-INDIAB)-North East**

The study is aimed to determine the prevalence of diabetes and pre-diabetes in India by conducting a nationwide study on a representative sample of India; validate Indian Diabetes Risk Score [IDRS] at the national level; (iii) determine normal distribution of lipid parameters at the national level; (iv) assess the association of some known candidate genes as well as novel genes with diabetes in Indians and (v) determine the prevalence of diabetes related complications in self-reported diabetic subjects. The subjects are being recruited covering the North-East regions representing eight states in India namely Sikkim, Assam, Meghalaya, Tripura, Mizoram, Manipur, Nagaland and Arunachal Pradesh and would continue during XII plan.

OPHTHAMOLOGY

- **Risk factors for anophthalmos/ microphthalmos**

Epidemiological study in affected districts of Bihar would continue during XII plan.

ENVIRONMENTAL AND OCCUPATIONAL HEALTH

- **Task Force on Global Climate Change**

The projects on vector borne diseases and climate change; eye health and environment and respiratory diseases would continue during XII plan.

- **CAR on Environmental Health- Air Pollution**

The ICMR has setup a Centre for Advanced Research on Environmental Health – Air pollution at Sri Ramachandra University in Chennai. The activities of the Center are centered on three primary objectives (a). Conduct of longitudinal epidemiological studies to examine the associations between indoor and outdoor air pollution exposure and health outcomes (b). Development and validation of air pollution exposure indicators that can be routinely used in environmental epidemiological investigations (c) Capacity building activities in the areas of exposure assessment and environmental epidemiology.

- **Indo-US Joint Program on Environment and Occupational Health**

Seventeen projects are undertaken under this program and Program would continue its activities in next plan as well.

- **Indo-German collaboration in Environmental toxicology**

Several areas of mutual interest were identified and collaborative proposals were conceptualized on traffic exhaust's genotoxic effects, bio-monitoring and biomarkers of pesticides and poison information centres and treatment protocols. These projects are now ongoing and are likely to continue into early part of XII Plan period.

NON COMMUNICABLE DISEASE SURVEILLANCE

- **Development of a model for Integrated Management of Non-Communicable Diseases Through Existing Health System in India**

The study is being done in the rural areas at Ballabgarh, Haryana through the Comprehensive Rural Health Services Project, AIIMS using the health workers and exploring the involvement of private practitioners and NGOs, and the urban component is being done in Delhi by St. Stephen's Hospital and an NGO AHEAD. The project has developed the training manuals for Health workers, Medical Officers and Counseling. It is proposed to replicate and extend the model in several other sites as well for validating its usefulness.

- **National Infobase for Non-communicable Diseases**

This tool will be used for advocacy, health planning and policy making. It would be one stop source for information on NCD risk factors in the country.

- **ICMR-MRC Collaboration Building Indo UK Collaboration on Chronic Non-Communicable Diseases**

Initiated in 2009; the activity would continue in next plan also.

- **Surveillance of Non-Communicable Diseases, Risk factors and Determinants**

This activity will continue.

GASTROENTEROLOGY

- **Celiac Disease**

A Task Force project titled “Prevalence of Celiac Disease in indigenous populations of Southern, Northern, and North-Eastern parts of India and identification of reasons for difference in its prevalence” has been initiated at CMC Vellore, AIIMS, New Delhi and Govt. Medical College, Guwahati and would continue.

- **Non Alcoholic Fatty Liver Disease (NAFLD)**

Studies being initiated will continue in the XII plan.

OBESITY AND METABOLIC SYNDROME

- **Overweight and Obesity in Childhood**

The 5 site multicentric study aims to determine the prevalence of overweight and obesity in the unbiased population (5-18 year old) across several sites in the country, identify the best anthropometric measure and “cutoff” that relates to percent body fat and risk factors through generation of primary data in prepubertal (7-8 year) and post pubertal (16-17 year) children from diverse ethnic and socio-cultural backgrounds and undertake formative research in different socio-cultural regions of the country to identify environmental, societal and family determinants of food intake and physical activity (*obesogenic environment*).

OBESITY & METABOLIC SYNDROME

Based on the advice of experts, a new subject area named as “Obesity and Metabolic syndrome” was started in February 2009 under the Division of NCD, ICMR. The area aims to promote research on overweight, obesity and metabolic syndrome in a holistic manner. It will study the mechanistic pathways, epidemiology, screening and diagnosis, clinical management, implementation research, and public health needs.

- **ICMR-CIHR Collaboration on Childhood Obesity**

Under the ICMR-CIHR, Canada MoU, childhood obesity was identified as a major area of collaboration. The joint expert group approved 3 projects for funding which was initiated between November 2010 and February 2011 and are scheduled to be completed till 2014.

ORAL HEALTH

- **Capacity Building for developing the research proposals in the area of Oral Health**

Research methodology workshops in the area of oral health will be carried out across the different areas of the Country for young and middle level. It is proposed to develop a Country wide plan of undertaking Project Development Workshops/Trainings to make

the Dental Professionals aware of Research Methodological techniques and to create an ambience of research environment in the country.

OTOLARYNOLOGY

The projects initiated/being initiated would continue in next plan and Programme would be expanded.

BASIC MEDICAL SCIENCES

About 300 (Taskforce, ad-hoc and fellowship studies on basic biology aspects) have been estimated to spill over to XII Plan.

- **Human Genetics :** Mental retardation, cleft lip, neurological disorders including autism, migraine, cystic fibrosis, mutations and microdeletions, predicting cardiovascular events, osteogenesis imperfecta, COPD, nephritic syndrome, Bardet –Biedl Syndrome, hearing loss & pre-eclampsia.
- **Genomics and Molecular Medicine:** Breast cancer, antinutritional stress factor for better human nutrition, regulation of gene expression, metabolic network, cancer genetics and genomics, bipolar affective disorder cerebral ischemia, Insulin resistance, miltefosine resistance associated genes of *Leishmania donovani*, *Bacillus anthracis* etc.
- **Pharmacogenomics:** An advanced research & a study on identification of predictive genetic markers for variable drug response in epilepsy patients.
- **Anatomy:** Sacral measurement, Surgical anatomy of vasculo-biliary apparatus.
- **Haematology:** Novel cell surface molecules of therapeutic significance in central nervous system leukemia, Screening of Fanconi's Anemia, gene expression and its correlation with HbF thalassemia, coagulation factor IX in treatment of bleeding, Indo-German Hemophilia A phenotype project.
- **Stem Cell Research:** National Task Force on SCRT, ad hoc projects and Centre for Advanced Research.
- **Allergy:** *Parthenium hysterophorus* growing near railway tracts, immunological studies for rheumatoid arthritis, allergenic potential of leguminous crops, proteins involved in human contact dermatitis and asthma, aspergillus in atopic patients.
- **Immunology:** Characterization of genetic diversity and neutralizing antibody, receptors in pathogenesis, diagnostic potential of Phosphoproteomics in various disease conditions.
- **Biochemistry:** Cell apoptosis, alzheimer's disease, coronary artery disease, derivation of pathologically significant proteins, haemorrhoids, latent, persists and drug resistant tubercle bacilli, oxidase activities, metastasis and cell death, thrombosis, arthritis, COPD, liver cirrhosis and hepatocellular carcinoma, sepsis, type-2 diabetes mellitus, alcohol induced toxicity, retinopathy, essential hypertension, Hormonal disturbances etc.
- **Cellular and Molecular Biology:** Stem cells, hemoglobinopathies, chronic progressive disorders.

- **Nanomedicine:** Potentiality of Muga Silk as Biomaterial for Nano-medicine, ocular drug delivery system, suicidal gene therapy, cardiovascular disorders, targeted radionuclide therapy of Neuroendocrine tumors, Cancer siRNA therapy by tumor selective delivery with ligand targeted nano particles, silver nanoparticles for anti-HIV activity, electrical conductor composite as intra vas deferens reversible contraceptive, stealth immunoliposomes, Biodegradable nanofibers for Neural regeneration, ultra fine gold nano particles- a novel x-ray contrast agent, bone tissue engineering, dental applications, alzheimer's disease, system for alcohol-induced liver injury, nano particles for controlled release of insulin-design, fabrication and evaluation Iron Oxide nanoparticles (SPIONs), visceral leishmaniasis and latent tuberculosis.
- **Physiology:** Reference standards for spirometry, pulmonary functions, anti-allergenic drug, anti allergenic ligands, adapting receptors and oxidant antioxidant status.
- **Medicinal Plants and Traditional Medicine:** Bone health, Diabetes, anti-lipidemic, antihypertensive antioxidants, cancer, antoparacytic *i.e.* Malaria, ingredients from medicinal plants.
- **Pharmacology:** Formulation and screening, Development of newer drug, Design, synthesis and bio-evaluation of molecules in vector borne, communicable and non communicable diseases.

HEALTH SYSTEMS RESEARCH

The ongoing projects in the area of HSR will be continued and strengthened during the XII Plan. These areas include:

- Public, public-private and NGO partnership for improving RCH services.
- Health insurance for population living in rural areas and urban slums.
- Strengthening research capacity and effective knowledge utilization.
- Reduction of gap in the health system manpower & service delivery.
- Reduction of gap in the health system utilization.
- 17 other areas identified as priority areas under HSR.

SOCIAL AND BEHAVIORAL RESEARCH

- Ongoing four multicentric task force and newly approved ad-hoc research projects mainly in the area of gender discrimination, illegal abortion, diseases with social stigma would be continued.
- Studies on behavioural and social aspects especially attitudinal changes towards chronic infections like HIV/AIDS *etc.*
- In the changed economic scenario study issues of stigma associated with HIV/AIDS, leprosy, tuberculosis *etc.* to help policy makers plan strategies for integration with health services.

MEDICINAL PLANTS UNIT

The following activities would be continued and strengthened:

- The ongoing Task force and adhoc studies.
- Standards of Medicinal Plants (multicentric).
- Quality standards of Indian medicinal plants.
- Quality standards of extracts of medicinal plants.
- Generation of markers and development of repository.
- Knowledge base development.
- Databases on various aspects relating to medicinal plants.
- Review Monographs on medicinal plants.
- Integration of data from ancient knowledge/wisdom/ concepts/allopathic system of medicine and scientific data generated.
- Medicinal plants Monographs on diseases of public health importance.
- Human resource development and resource through training programs and Workshops *etc.*
- Interagency programmes (DST, DBT, AYUSH, CSIR, ICAR *etc.*)

XII PLAN PROPOSED ACTIVITIES: INTRAMURAL

Budgetary Requirement: ₹ 1500 crore

Intramural research efforts of the council are carried out currently through 32 disease / discipline specific research institutes/centres/units. These include: 26 mission-oriented national institutes located in different parts of the country addressing to research on specific areas such as tuberculosis, leprosy, cholera and diarrhoeal diseases, viral diseases including AIDS, malaria, kala-azar, vector control, nutrition, reproduction, immunohaematology, oncology, medical statistics, *etc.* Six Regional Medical Research Centres that address regional health problems, and also aim to strengthen or generate research capabilities in different geographic areas of the country. Field Units Centres dealing with food & drug toxicology, viral diseases, vector borne diseases, handling microorganisms of highly infectious nature, prenatal diagnosis for neonatal retardation *etc* and supply of various animal models and feeds for research purposes. The proposed activities in XII Plan are follows:

Centre for Research in Medical Entomology (CRME), Madurai

Basic Research

- DNA barcoding and mapping for biodiversity of arthropod vectors.
- Microbial diversity in the breeding habitats of *Aedes aegypti*.
- Detection and isolation of compounds attractive to mosquitoes (*Aedes aegypti*).
- Identification of most suitable envelope protein for development of DNA vaccine against Chikungunya virus (CHIKV).
- Development of a multiplex real time PCR method for the detection of flaviruses (Japanese encephalitis, West Nile and Dengue) and Alpha virus (Chikungunya) in the vector mosquitoes.
- Development of single step diagnostic kit for simultaneous detection of dengue and chikungunya infection using recombinant soluble antigens.
- Cloning and expression of certain immunodominant genes of Chikungunya virus and its application in the diagnosis of Chikungunya fever.
- Rapid detection of Japanese encephalitis using improved new/molecular tests.
- Studies on mosquito taxonomy and systematics on emphasis on revision of FBI Monographs on Indian mosquito fauna.
- Development of a practical field application of pictorial taxonomic key for dengue/chikungunya vectors (*Aedes* mosquitoes).

Clinical Research

- Multi-centric evaluation of L3 stage specific RT-PCR assay for the detection of infective stage (L3) *Wuchereria bancrofti* in Vector.

Epidemiological/ Operational Research

- Mosquito faunal biodiversity in Nilgiri Hill ranges at Western Ghats.
- Prevalence of molecular markers of drug resistance.
- Monitoring susceptibility status of vectors.
- *Aedes aegypti* pupal surveys in three different physiographic ecosystems.
- Tracking the effect of secondary infection causing bacteria of ADL patients on certain immune genes of the filariasis vector, *Culex quinquefasciatus*.
- Mosquito faunal biodiversity in Nilgiri Hill ranges (Western Ghats): Taxonomy prospective.
- Assessment of the economic cost of dengue in India.
- Entomo-serological surveillance of Chikungunya/Dengue vectors in the Lakshadweep Islands.
- Virological and entomological surveillance of West Nile virus in Tamil Nadu using improved molecular methods.

Translational Research

- National Net-work for genotyping of human lymphatic filarial parasite, *Wuchereria bancrofti* from different endemic areas.
- Community based Master Plan to combat Mosquitoes in Urban Areas.
- Community-directed control of lymphatic filariasis in Tamil Nadu.

Desert Medicine Research Centre (DMRC), Jodhpur**Basic Research**

- Study of inheritance pattern of 200 kDa protein and transovarial transmission of dengue virus across mosquito generations.
- Study of interaction of structure and orientation of membrane proteins of mosquito cells and human leucocytes, versus dengue virus.
- Molecular and genomic studies on DEN types, their dynamics and possible risk for dengue hemorrhagic fever.
- Studies on functional genomics of mosquitoes for studying the transmission and maintenance of dengue.
- Study of nucleotide sequences of the c-DNAs of viral RNAs and epidemiology of H1N1 viruses with respect to their transition across host population in a time trend manner.

- Determination of pyrethroid knockdown resistance (kdr) gene frequency in *Anopheles stephensi* populations in western Rajasthan.
- Molecular identification of *Anopheles culicifacies* malaria transmission potential and bionomics of five species A, B, C, D and E.
- Development of anthropological and molecular genetics markers of Type 2 Diabetes Mellitus among highly prone (Mathur and Bhargava) endogamous population.
- Screening of different indigenous desert plants and their active ingredients for their adulticidal/larvicidal effects, repellent actions and use as attractants either in ovi- and gravid traps.
- Determination of synergistic, antagonistic and additive toxic effects of binary mixtures involving phytochemicals alone and in combination with other synthetic insecticides and microbial control agents.
- Studies on insecticide susceptibility/resistance in different vector species prevalent in desert area.

Clinical Research

- Assessment of the utility of mass vitamin D supplementation to effectively reduce the incidence of tuberculosis in vitamin D deficient population.
- Study of prevalence of drug resistance developed by *P. falciparum* among BSF troops and their relatives: Clinical, Parasitological and Molecular biological studies.
- Study effect of tobacco use and smoking on human health & mortality.
- Study on impact of zinc supplementation on under nutrition, ARI, diarrhoea and fever.
- To assess the impact of fortification of wheat and millet flour with iron on health.
- Study to identify the metabolic abnormality and risk factors associated with urolithiasis in desert population.
- Study of effect of magnesium oxide on absorption of fluorides in human population to prevent development of dental fluorosis in children.

Epidemiological/ Operational Research

- Preparation of diet atlas of different foods available and consumed in desert region of Rajasthan and analysis of their nutritive values.
- Study of the geographical pattern of malaria transmission in Jaisalmer district and to identify the associated factors influencing malaria using GIS and statistical techniques.
- Studies to assess the prevalence of coronary artery disease and to identify socio-demographic characteristics, risk factors and type of ischemic heart disease, treatment delay and related complications.
- Evaluate the effect of community intervention program on the hypertension knowledge and lifestyles of rural residents.
- Study to identify factors contributing to reduction of the incidence of obesity.

- Assessment of micronutrient deficiency to develop nutrition package for pregnant and lactating women.
- Study of current rate of irregular treatment, defaulters and drop out in the treatment of tuberculosis and its causes and remedial steps.
- Surveillance of genetic and biochemical mechanisms of pyrethroid resistance in *Anopheles stephensi* strains to improve their efficacy.
- To determine the optimum method(s) of contact tracing for new emerging diseases in the desert part of Rajasthan such as swine flu.
- Assessment of the level of air, water and soil pollution at industrial areas in Jodhpur.
- Studies to prevent as well as limit the burden of diabetes mellitus.
- Studies to ensure need based services by disease wise mapping of the districts.
- Investigating the cultural specific differentials of disease burden due to communicable diseases.
- Study of the association of ecological variations with burden of diseases.
- Development of strategies in meeting the challenges of epidemiological transition in deserts.
- Studies on clinical decision making to minimize risk, cost and duration of suffering.
- Studies on behavioral aspects of patients towards treating doctors, health facility and disease control programmes.
- Studies to inculcate general public basic knowledge and a sense of responsibility in reducing the breeding of mosquitoes -Use of COMBI Approach (Communication for Behavioural Impact)

Translational Research

- Development of alternate strategies for surveillance and control of container breeding vector mosquito species by using trapping methods for gravid females.

Enterovirus Research Centre (ERC), Mumbai

Basic Research

- Studies on pathogenesis of enteroviruses.
- Development of rapid diagnosis reagents for enteroviruses.
- Development of EV71 vaccine candidates.

Clinical Research

- Immunogenicity of Sabin-IPV.
- Monitoring circulation of Sabin OPV strains in IPV immunized populations.
- Investigate role of CD155 polymorphism in susceptibility to paralytic poliomyelitis.
- Clinical studies on anti-enterovirus agents.
- Enterovirus infections in CNS and cardio-vascular diseases.

Epidemiological/ Operational Research

- Investigations into outbreaks of diseases caused by enteroviruses.
- Geo-prevalence of enteroviruses in India.
- Polio vaccination in post-wild poliovirus eradication era.
- Re-initiate rotavirus surveillance in Mumbai.
- Establish sentinel surveillance for viruses causing common cold in children.
- Further improvement of supplementary surveillance methods to achieve polio eradication goal in India.

Translational Research

- Development of formalin and β -propiolactone inactivation protocols for enteroviruses.
- Studies on measures to stop circulation of Sabin OPV viruses, Vaccine Associated Paralytic Poliomyelitis (VAPP), polio in immunodeficient patients and outbreaks in poorly vaccinated population.
- Develop rapid diagnosis protocols for enteroviruses.

Human Resources Development

- Training Polio Network Laboratory personnel in bio-safety, cell culture, virus culture, serological methods and molecular diagnostics.
- Training in bio-safety, cell culture techniques, virus identification and immunological methods and Sequence analysis for post graduate students.
- Dissertation project work for Masters Degree courses in Microbiology, Biochemistry, Biotechnology and Bioinformatics.
- MSc and PhD courses.

Food and Drug Toxicology Research Centre (FDTRC), Hyderabad

Basic Research

- New studies on safety testing of food supplements, nutraceuticals, and genetically modified foods.
- Safety assessment of chemicals used in packaging material of foods.
- Development of analytical methods to detect organo phosphorous (OP) pesticides in body fluids and fruits and vegetables.
- Studies on molecular and immune-toxicology based testing of allergenicity.

Clinical Research

- Evaluation of minor cereals like sorghum, maize for their beneficial effects in control of blood sugar.

Epidemiological/Operational Research

- Studies on consumption of processed and non-processed food in India for calculating risk assessment due to exposure to contaminants through processed foods.
- Establishment of a surveillance system for monitoring of food borne diseases in India.

Genetic Research Centre, Mumbai**Basic Research**

- Cytogenetic and molecular studies on mental retardation.
- Establishing biochemical assays and molecular tests for postnatal and prenatal diagnosis of metabolic disorders.
- Mutation analysis for genodermatoses by genes sequencing to identify genetic basis for those with unknown etiology.
- Mutation analysis for skeletal dysplasias.

Epidemiological/Operational Research

- Establishment of National Database for Genetic Disorders.

Translational Research

- Setting up of pre-implantation genetic diagnostic (PGD) facility for intervention research.

Infrastructure development

- Setting up of Rural Genetic Health Centre.

Institute of Cytology and Preventive Oncology (ICPO), Noida**Basic Research**

- Bioinformatics based studies:
 - Data mining and generation of small molecule chemical libraries for cancers.
 - Pharmacophore modelling and virtual screening for discovery of new leads with potent anticancer activity.
 - Epitope identification and vaccine design using *in silico* methods.

Infrastructure and Human Resource Development

- Development of Cellular and Molecular Diagnostic National Facility.
- Initiating a school of cytology, diploma courses in cellular and molecular oncology for medical PGs, training in cancer detection and school of behavioural oncology.

Microbial Containment Complex (MCC), Pune

Basic research

- Basic/molecular studies on new emerging high risk viruses.

Epidemiological/Operational Research

- Guidelines for safe handling of viruses in laboratory and field.

Translational Research

- Development and testing of diagnostic, preventive and treatment methods for high risk pathogens.

National AIDS Research Institute (NARI), Pune

Basic Research

- Studies on the role of innate and mucosal immune responses in HIV disease.
- HIV vaccine development studies: Neutralization Epitope Mapping in HIV-1 Envelope of Indian Origin and Construction of Envelope-Based Peptide Immunogen for Generation of Broadly Cross-Reactive Neutralizing Antibodies.
- Studies to understand the vulnerability of HIV virus to neutralizing antibodies and cytolytic T cell responses.
- Studies related to neuro-AIDS.

Clinical Research

- Development of new /alternate treatment strategies for HIV-TB co-infections as well as other viral co-infections like- HPV, hepatitis viruses, HSV-2 and other opportunistic infections.
- Clinical trials to study adherence, side effects, potency of the regimen, likelihood of emergence of drug-resistance, drug-drug interactions and cost assessment for HIV treatment.
- Studies on pharmacokinetics, pharmacodynamics and pharmacogenomics, host genetic factors, care, support, neurological manifestations, immunopathogenesis of HIV, co infections and chronic morbidities.
- Research on treatment of chronic diseases, metabolic conditions and cancers associated with HIV.

Epidemiological/Operational Research

- Development of a database for HIV-DR with reference to HIV1 subtype C.
- Studies on sub-optimal response to ART in HIV patients.
- To develop new behavioral models to enhance and sustain HIV prevention efforts.

Translational Research

- Development and testing of efficacy of methods for anti-HIV testing *in vitro* for diagnostic tools.
- Identification and testing of novel, effective new indigenously developed anti-HIV drugs/ microbicides.

Infrastructure

- Establishment of HIV biology laboratory devoted to basic studies.
- Establish a Centre of Excellence for HIV clinical trials related to HIV treatment.

National Centre for Disease Informatics and Research (NCDIR), Bangalore**Basic Research**

- Studies on molecular aspects of different types of cancers of stomach, oesophagus, breast, lymphoma, leukaemias *etc.* and their correlation with epidemiological data.

Epidemiological/ Operational Research

- Development/Strengthening of population/hospital based registries for diseases like cancer, diabetes, CVD and stroke.
- Descriptive/clinical/analytical epidemiological studies based on linkages with these registries.
- Development of a National Electronic Disease Surveillance System that creates and generates a national disease research database. The output will be in the form of usable software modules.

Translational Research

- Generate documents to assist the policy in control activities and programmes for cancer, diabetes, CVD and stroke at state or national levels.

Infrastructure and Human Resources Development

- Training in cancer registration and epidemiological research.
- MPH and PhD programmes in Epidemiology and Health Informatics.

National Centre for Laboratory Animal Sciences (NCLAS), Hyderabad

- Use animal models to test the efficacy of anti-diabetic and anti-obesity drugs.
- Studies on linking asthma and obesity as well as nesfatin and obesity.
- Behavioural research, genetics and epigenetic work using obese rats.

National Institute of Cholera and Enteric Diseases (NICED), Kolkata**Basic Research**

- Studies to address the critical requirement of Porin of *Shigella dysenteriae* to elicit type 1 mediated immune response.

- Studies on the mechanism of pathogenesis of rotavirus.
- Mechanism of action of heat stable enterotoxin in regulation of cytoskeleton rearrangement in colon carcinoma.
- EPAC Signaling: A new insight into the mechanism of epithelial chloride secretion and its impact in diarrheal diseases.
- Studies of the molecular pathophysiology of tight junction function in infectious diarrhea.
- Identification of novel anti-diarrheal compounds on the basis of potassium (K) and chloride (Cl) channel targeting.
- Studies on humoral and cell-mediated immune responses among hospitalized patients with cholera or infected with *Shigella sp.*
- Understand intricate mechanisms that control expression/suppression of virulence gene in pathogenic *V. cholerae* strains grown under various growth conditions.
- Structural analysis of *V. cholerae* hemolysin by cryoelectron microscopy.
- Studies on three dimensional structure of vibriophages.
- Studies on *V. cholerae* cytolysin/hemolysin (VCC), chitinases and chitin-binding proteins.
- Studies on colonization factors expressed by enterotoxigenic *Escherichia coli*.
- *Helicobacter pylori* and Gastroesophageal reflux diseases.
- Arsenic toxicity in fishes.
- Purification of recombinant Tat (BC) protein and its role in IL-10 production.
- Study of immune response generated by the nef gene of HIV-1 and its role during HIV-1 infection.
- Role of microRNA in immune system of HIV infected patients.

Epidemiological/Operational Research

- Evaluation of health programme pertaining to diarrhoeal disease in different locations of West Bengal.
- Role of non-climate factors on diarrhoeal diseases.
- Studies on behavioural factors and social stigma among the HIV infected people.
- Operational research on different facets of HIV control programme in West Bengal.
- Establishment of community-based malaria surveillance programme at Jalpaiguri district.

Infrastructure and Human Resource Development

- Establishment of a field unit at northern part of West Bengal (Siliguri).
- Establishing a repository on pathogenic bacteria that cause diarrhea as well as gastrointestinal tract diseases.
- Training of community health workers & supervisors on control of communicable diseases for strengthening public health system of West Bengal.

- Initiate M.D. (Infectious Diseases) Course in Infectious Diseases Hospital campus Govt. of West Bengal.
- Conduct training programme of diagnostic methodology of enteric infection for doctors, microbiologists and Technicians.
- Conduct Ph.D. courses/short term training courses for MBBS/M.Sc./B.Tech/M.Tech.
- Conduct workshops/seminars/trainings for national and international participants on clinical aspects and laboratory diagnostic procedures for diarrhoea, HIV/AIDS.

National Institute of Epidemiology (NIE), Chennai

Clinical Research

- Study to determine the role of various macro and micro nutrients in hypertension.
- Establishment of reference values for spirometry to monitor the progression, effectiveness of the treatment of various chronic respiratory conditions.

Epidemiological/ Operational Research

- Epidemiology of leprosy in India with focus on socio-cultural factors.
- Assessment of community needs and their preparedness to accept new HIV prevention technologies.
- Prevalence of mental disorders, osteoporosis, chronic pulmonary obstructive disease, cardiovascular diseases and health seeking behavior among rural and urban population.
- Development of guidance manual for clinical research in AYUSH focussing on issues unique to trials in traditional medicines/procedures.
- Sero-epidemiology of re-emerging Rickettsial diseases.
- Assessment of facilities and access to health services by different tribal groups in Western Ghats.

Human Resource Development

- Teaching and training in application of statistical methods in epidemiology, design and data analysis for cultural epidemiological studies, training public health professionals in the newly emerging challenge of non-communicable diseases, research methodology training for medical colleges, Health district management course, GIS sensitization and orientation, Issues in counseling, capacity building in counseling, Qualitative Research methods, Application of statistical methods in epidemiology-Web-based data management.

National Institute of Immunohaematology (NIIH), Mumbai

Basic Research

- A high resolution quantum-dot nanosensor based approach to characterize the role of dengue virus non-structural protein NS1 in virus replisome assembly and phosphoinositol signalling pathways.

- Gene expression studies for novel missense mutations in coagulation factor and platelet receptor genes.
- Catalytic antibodies in immune mediated and infectious conditions: physiopathological relevance and therapeutic implications.
- Genome wide association studies for development of inhibitors in hemophilia A patients.
- Study of Fanconi anemia pathway defects in acute myeloid leukemia.
- Clinical and biological significance of micro-RNAs (miRNAs) in chronic myeloid leukaemia.
- Study of mechanism of hyperdiploidy by centrosome aberration and mitotic spindle check point gene mutation study in hyperdiploid ALL patients.
- DNA methylation study in hematological malignancies.
- Pattern of globin gene expression in *in-vitro* stem cell culture system exposed to the malaria parasite *Plasmodium vivax*.
- Genome wide association study to find out common variants/genetic modifiers of hemoglobinopathies.
- Role of matrix metalloproteinase (MMP-2 and -9) tissue inhibitors (TIMP-1 and -2) in Myelodysplastic Syndromes.
- Molecular genetics and functional studies in hereditary spherocytosis and elliptocytosis associated with red cell membrane defects.
- Cytokine gene polymorphisms in Indian SLE patients and their association with clinical expression of the disease.
- Induced pluripotent stem cell as a disease model for understanding the pathophysiology for primary immunodeficiency disease.
- The role of circulating microparticles and the coagulation system in sickle cell disease and β thalassemia.
- Iron metabolism and involvement of genetic variations in anemia and hemochromatosis.
- Role of cytokine gene polymorphism in G6PD deficiency.
- Genetic polymorphism in bilirubin metabolism genes and its association with unconjugated hyperbilirubinemia amongst adults.
- $\beta 2$ microglobulin gene mutation in HLA-B27 related arthritis.
- Molecular genotyping of Kell, Kidd and Duffy blood group systems.
- Studies on human genetic polymorphisms and malaria in tribal population of Maharashtra.
- Genetic variations in Gardos channel and effect of clotrimazole (as blocker) on red cell dehydration in sickle cell anemia patients.
- Development of fixer molecule to prevent sickle hemoglobin polymerization.
- Studies on dendritic cell subpopulation in ANCA associated vasculitis.

Clinical Research

- Role of microparticles in recurrent fetal loss.
- HLA-DRB1 alleles association of anti-cardiolipin (ACA) and anti-2GPI antibodies in Indian patients with Systemic Lupus Erythematosus.
- A study on HLA-DRB1 antigens in systemic lupus erythematosus from western India and its association with specificity of autoantibody responses to nuclear antigens
- Diagnostic potential of anti-cyclic citrullinated peptide (anti-CCP) antibodies and its association with HLA DRB1 alleles in Indian rheumatoid arthritis patients transfusion medicine.
- Genetic variation in iron metabolism leading to iron overload in hemoglobinopathies patients of North East.
- Dendritic cell subpopulation in ANCA associated vasculitis.
- Hydroxyurea and Valproic acid in the management of severe HbE- β thalassemia.
- Non invasive fetal Rh D typing in Rh D negative antenatal women.
- Bioinformatic approach to develop entities to prevent sickling in sickle cell anemia (SCA).

Operational Research

- Development of immunoinformatics in relation to inhibitor development in haemophilia A patients.
- Studies on association of nutritional factors with severity of malaria in North East region of India.
- Development of DNA banking facilities (to archive DNA samples) and the formation of a Registry for different haematological disorders

Translational Research

- Newborn screening & molecular characterization for red cell enzyme defects and hemoglobinopathies in North-East India.
- Establishment of basic red cell serology techniques as a part of pretransfusion investigations in the North East region.

Infrastructure/Human Resource Development

- Establishment of Center of Excellence for primary immunodeficiency disorders.
- Development of pharmacogenomic facilities in Institute.
- Vascular biology laboratory- to study pathobiology of many biological disorders like myeloma, myelofibrosis, lymphoma and TB to name a few.
- Expansion of the hybridoma laboratory.
- Development of the training facilities for establishing cytogenetic laboratories in eastern states of India *i.e.*, Assam, West Bengal, Bihar, Jharkhand and Orissa to study the genetic defects and also implementation of counselling programme.

National Institute of Malaria Research (NIMR), New Delhi

Basic Research

- Studying evolutionary genetic pattern on the two human malaria parasites (*P. falciparum* and *P. vivax*) and candidate genes governing host invasion and drug resistance.
- De novo whole genome sequencing of several malaria vectors.
- Development of genetically modified mosquitoes for potential use in malaria control.
- Evaluation of repellent/attractants for control of malaria.
- Characterization of artemisinin resistant parasites.
- Study of genetic polymorphism in *Plasmodium falciparum* antigens (Pfhrp2 and Pfhrp3).
- Studies on the dynamics of Th cell subsets during malarial infection to determine differential macrophage/dendritic cell activation in malaria infection.
- Development of monoclonal antibodies against *P. vivax* and assays for immunodiagnosics.
- Development of a rapid and economical diagnostic assays.

Clinical Research

- Studies on changing clinical profile of malaria.
- Studies on complications of *vivax* malaria and drug resistance.
- Studies on interactions of malaria with other infectious diseases like HIV, tuberculosis.

Epidemiological/Operational Research

- Mapping malaria receptivity in tribal areas of district Ranchi, Jharkhand using GIS.

Human Resource Development

- Training to District Malaria Officers, biologists, entomologists, lab technicians, initiate M.Sc in Medical Entomology and Parasitology.

National Institute of Medical Statistics (NIMS), New Delhi

Biostatistical/Epidemiological/Operational Research

- Development of data hub of health surveys and use the information for trend analysis.
- Modelling and Analysis of Health Data: (a) RCH and Nutrition; (b) NCD Risk Factors.
- Analysis of Socioeconomic and Behavioural Dynamics of health.
- Population estimation and projection for India.

- Study of morbidity and mortality in the population for different geographical areas.
- Estimation of maternal mortality ratio and underlying factors in different population groups.
- Geo-statistical modeling and Spatial Analysis.
- Assessment of knowledge, attitude and practice of AYUSH in India.
- Development and evaluation of statistical methods for genetics and bioinformatics and pharmaceutical sciences.

Human Resource Development

- Training in research methodology
- Sampling methods in health Research
- Clinical trials and statistical computing
- Evaluation of diagnostic kits using new statistical methods.
- Epidemiological and bio-statistical methods using various statistical packages, viz. EpiInfo, SPSS, STATA, 'R', SAS *etc.*

National Institute of Nutrition (NIN), Hyderabad

Basic Research

- Study of the molecular basis of the complications of diabetes; development of biomarkers (proteomic and genomic studies); nutritional profile of diabetic complications; screening and testing molecular target-based nutraceuticals.
- Generation of newer scientific evidence on food fortification strategies, updating the nutrient requirements and recommended dietary allowances (RDAs)
- Assessment of biochemical and molecular changes underlying/associated with the phenotypic changes in the offspring of micronutrient restricted animal models to explore the role of epigenetics and accelerated cell senescence.
- Identification of the molecular and biochemical basis of accelerated ageing among WNIN obese rat mutants.
- Identification of different food sources rich in polyphenols that act as proteasome inhibitors and characterization of active component(s) from a few food ingredients.
- Development of an *in-silico* to characterize CpG and CGI methylation sites in different genes associated with / regulating obesity.
- Studies on the role of the different proteolytic pathways in vitamin D deficiency induced muscle atrophy.
- Studies on the role of vitamin A in controlling obesity and associated disorders (glucose-tolerance, insulin resistance and dyslipidemia).
- Role of dietary PUFA on development of obesity and insulin resistance in diet-induced obese rat model.

- Analysis of 82 nutrients in various Indian food items for developing National Food and Nutrient Data Centre.
- Role of stromal vascular fraction in the development of insulin resistance as fatty acids induces ER stress in the stromal vascular components.
- Study of role of miRNA profiles and their contribution in development of obesity and diabetes using the WNIN obese rat models.
- Study of role of dietary aldose reductase inhibitors in human cancers, maternal Vitamin B₁₂ restriction induced changes in adiposity, hyperglycaemia and insulin resistance.
- To explore using embryonic stem cells to study effects of maternal undernutrition in fetal programming for adult diseases.
- Studies on pancreatic disease in model systems and clinical conditions.
- Use of nano technology based preparation of nutrient embedded biological scaffolds as three dimensional matrix for the propagation of stem cells and their *in vivo* application.
- Investigating the effects of phytoestrogen rich foods on the osteoblastic and Osteoclastic activity *in vitro* and the possible role of vitamin D in the bone formation.

Clinical Research

- Studies on pregnant women to reduce low birth weight babies.
- Studies for reducing stunting and under nutrition in children by understanding direct and indirect causes of undernutrition.
- Food-based approaches to prevent and manage osteoporosis.
- To determine the association of vitamin D status with clinical manifestations in HIV patients.

Epidemiological/Operational Research

- Generation of scientific evidence on food fortification strategies as means to combat malnutrition and to operationalize / implement such strategies.
- Assessment of the diet and nutritional status of urban population and prevalence of obesity, hypertension and diabetes among urban adults.
- Developing appropriate intervention strategies for prevention and control of obesity and associated non-communicable diseases like diabetes, hypertension and cardiovascular diseases.
- Studies on physical, physiological profiles and estimate energy requirements of different groups of athletes based on their energy expenditure levels and to test the concept of desirable body composition for optimum performance.
- Development of multilevel models for interpretation of data collected in 2 rounds of Integrated Behavioural and Biological Assessment (IBBA) in high HIV prevalence.
- Nutrition Extension, Education & Communication using space technology enabled village resource centres (VRCs) developed by Indian Space Research Organization (ISRO) for dissemination of nutrition knowledge in rural areas.

Infrastructure and Human Resources Development

- Periodical training and capacity building for health and nutrition work force in India.
- To carry out regular training programmes and scale up the intake of participants/ research scholars.
- To conduct need-based ad hoc training programme to build capacity of staff of government, national and international organisations.
- Creation of a Centre of Excellence in Micronutrient Research for facilitating basic research in terms of biomarkers, clinical research in terms of bioavailability and programme and policy related activities.
- To revamp the existing nutrition museum and develop a mobile nutrition exhibition.

National Institute of Occupational Health (NIOH), Ahmedabad**Basic Research**

- Prospective studies on pesticide residue analysis in environment and foodstuff.
- Study on endocrine disrupting chemicals.
- Development of biomarkers in occupationally exposed populations and mechanisms of pesticide interaction with human cells.
- Estimation of metals levels in biological fluids and experimental studies on various toxic metals.
- Study on adverse effect of different chemicals and food materials on reproduction.
- Neuro-behavioural toxicology studies to establish occupational standards.
- Computational biology-to predict mechanistic aspects of the toxicants and generating hypothesis for future research.
- Application studies on new technologies to mitigate problems at different workplaces.

Clinical Research

- Assessment of biohazards of agricultural workers with special reference to dairy farm, poultry farm and cattle handlers.

Epidemiological/ Operational Research

- Studies on communicable and non-communicable diseases in different occupational groups.
- Operational research for establishing a sustainable programme on human bio-monitoring for environmental and occupational toxicants.
- Studies on dermatological problems related to different occupational and environmental exposures.
- Occupational health and safety studies in Northern India for glass bangle industry, brass manufacturing, carpet and wool industry, tanning, footwear, stone quarry, paper works, small engineering works like bicycle, spare parts manufacturing.

- Studies on increased risk of epidemic of psychophysical, psychosocial as well as psycho-physiological stresses in the emerging occupational groups.

Translational Research

- To evolve research based analysis and guidelines on different regulatory requirements for suitable suggestions to different national bodies.

Infrastructure and Human Resource Development

- Establishment of an occupational clinic as an outreach facility for providing regular services to the workers and updating trend of occupational diseases, disorders and injuries.
- Development of a multiple disciplines workforce- NIOH plans to emerge as a source to train pool of experts, training and awareness activities.
- Development of a centralized source of information regarding nature and severity of different toxic exposures.

National Institute of Pathology (NIOP), New Delhi

Basic Research

- Study on identification of gene expression, microRNA and DNA methylation profiles of cancer stem cells to identify potential molecular targets for novel therapy for cancers.
- Study on micro-environment and various cytokines secreted by the adipose tissue in the mammary fat pad to assess their role in the development and progression of breast cancer.
- Targeted sequencing of breast cancer specific genes in early-onset breast carcinoma to identify biomarker for prognosis/ diagnosis.
- Mutations and copy number variation of mitochondrial DNA using super-arrays to find their role in early-onset breast carcinogenesis.
- Study on protein biosignature and its characterization in gall bladder cancer to identify biomarkers.
- Delineation of molecular changes and potential role of innate immunity in *Chlamydia trachomatis* associated spontaneous abortion.
- Attenuated parasite as vaccine candidate for VL, with safety and efficacy tested in animal models, ready for human trials.
- Biochemical alterations in experimental paromomycin resistance.
- Characterization of molecules involved in the entry of *Leishmania* parasites into host cell.
- The study of immunohistochemical expression and localization of various neuropeptides in leprosy lesions for understanding their role in neurodamage.
- Isolation and characterization of the proliferating fraction of human epidermal keratinocyte stem cells in Mebiol gel.

- Study of putative urinary proteins as potential biomarkers for recurrence and invasion in urinary bladder carcinoma.
- Diagnostic biomarkers for differentiating neurofibroma from neurilemmoma using a tissue microarray based approach.
- Identification of putative candidate proteins in the fallopian tubes of *Chlamydia trachomatis* infected women undergoing ectopic pregnancy.
- Simplified and reliable molecular assay for VL/PKDL diagnosis, without the need for post PCR.
- Diagnostic test for PKDL based on slit aspirate as a non-invasive sample.

Clinical Research

- Correlation of genetic and epigenetic profile of acute myeloid leukemia with genetic alterations and other adverse prognostic factors of AML to search for potential therapeutic targets.
- Protective immunomodulation during treatment of PKDL with miltefosine as monotherapy or in combination therapy.
- Clinical trial with cultured epithelial autograft in burns patients.

Epidemiological/Operational Research

- Elucidation of oxidative stress in tea garden workers exposed to pesticides to understand maternal and foetal morbidity and mortality at the time of delivery.
- Delineation of morphological alterations in placenta of tea garden workers exposed to pesticides.

National Institute for Research in Environmental Health (NIREH), Bhopal

Basic Research

- Study of mechanisms of lung injury in MIC exposure (epithelial injury, airway hyper responsiveness and airway remodeling).
- Study of functional genomics of MIC-induced acute lung injury and systemic injury.
- Study of specific biomarkers for acute and chronic exposure to MIC as well as other chemical agents.
- Development of inhalation models of MIC as well as other chemical toxicity for testing potential pharmacologic (or therapeutic) agents.
- Study of the role of airway nociceptive sensory neurons in chemical sensing and to study the role of antagonists to transient receptor potential (TRP) ion channels in chemical exposures.
- Studies on cancers, genetic disorders, health status of second and third generation children in the MIC exposed population.
- Cellular and molecular mechanisms and profile of damage due to exposure to different chemicals.

Clinical Research

- Studies on endothelial dysfunction on exposure to MIC associated with acute or chronic cardiovascular disease.
- Study of long-term consequences of toxic gas related lung injury and defining the types of pathological and physiological changes in the lungs, heart, eyes and others.
- Study of the ocular lesions especially corneal abnormalities and the pattern of cataract in the exposed population.
- Study of the occurrence of any other ocular lesions in the MIC exposed people.

Epidemiological/ Operational Research

- Studies on systemic injuries that might have occurred due to gas-exposure.
- Assessment of health status of children born to gas exposed mothers and also second generation children in the gas exposed area.
- Studies to assess the occurrence of genetic and congenital disorders in the gas-exposed population.
- Health systems research to study different dimensions of the medical services available vs. required to MIC affected population.
- Occurrences of irritant-induced asthma in gas-exposed population.
- Study on chronic renal disease in the gas exposed population.
- Studies to examine the neurological status to unravel any neurological disorders that may occur in the population post exposure to occupational insults.
- Studies to understand the reproductive problems focusing on maternal health and pregnancy outcomes post exposure to occupational insults.
- Studies on mental health interventions for health care and the training of general health personnel for providing psychosocial interventions and specialist services in distressed individuals.
- Generation of data for chemical substances or agents of potential public health concern for bringing them to public attention for preventive measures.
- Development of guidelines for post-exposure treatment and long term rehabilitation of cases exposed to different chemicals.

Translational Research

- Development of guidelines for post-exposure treatment to different chemicals including pulmonary rehabilitation.

National Institute for Research in Reproductive Health (NIRRH), Mumbai

Basic Research

- Pre-clinical toxicity and clinical trials with n 80 kDa/R17.
- Study on role of collectins, homeobox genes *etc.* in the female reproductive tract, with special reference to endometrial function.

- Role of receptor for advanced glycation endproduct (RAGE) in endometrial physiology and pathology.
- Effect of metformin on hormonal, metabolic and endometrial profiles in obese bonnet monkeys (*Macaca radiata*).
- Structure-function studies of Follicle stimulating hormone (FSH) receptor and Prostate Secretory Protein 94 (PSP94).
- Studies on significance of key residues of FSH receptor in receptor expression, post translational modification, hormone binding, G-protein coupling and down stream signalling.
- Role of $\alpha 4\beta 7$ integrin in HIV-pathogenesis.
- Development of genetically modified animal model for cellular innate immune functions.
- Development of well characterized cardiac and pancreatic progenitors by directed differentiation of hES cells for pre-clinical studies.
- Studies using transgenic animal models of male infertility to understand the basic mechanism in the blockade of spermatogenesis.
- Studies on newer antimicrobial peptides for reproductive tract infections and sexually transmitted infections HIV and microbicides.
- Characterization of biofilm formation in *Gardinerella vaginalis*.
- Elucidation of the role of primary structure of peptide-1 & 2 on their microbial activity.
- Investigations on role of SP-D in vaginal innate immunity and as a vaginal microbicide.
- Study comparative proteomics of monocytes, precursor of osteoclasts, in order to look for newer biomarkers of osteoporosis and novel protein targets for newer therapeutic agent.
- Effects of oxytocin exposure on reproduction in adult male and female rats.
- Investigation of the role of estrogen receptors in the pathogenesis of prostate cancer
- Studies on the association of endometriosis with ovarian cancers and understanding the mechanism and risk factors underlying transformation of ovarian endometriosis to ovarian cancers.
- Development and evaluation of PCR test for HPV detection.
- Development of indigenous ELISAs for biomarkers of bone turnover.

Clinical Research

- A gonadal tissue bank will be established to preserve gonadal tissue of individuals with gonadal insufficiency including cancer patients. A pilot study will be undertaken in collaboration with oncologists, transplant surgeons, IVF experts and gynecologists.

- Investigating the spectrum and frequency of CFTR gene mutations in Indian congenital bilateral absence of vas deferens (CBAVD) males and in female partners of CBAVD males to assess the carrier risk.
- Studies on racial/ethnic variations in sex steroid hormone concentrations and its relation to bone mineral density and association with polymorphisms in CYP 17 and CYP 19 genes; which encode for key enzymes in estrogen biosynthesis pathways.
- Parturition, cervical remodeling and preterm labor: to study the molecular mechanism at the cervical level in women under progesterone supplementation for preterm labor.
- Development and evaluation of a PCR based test on menstrual blood for endometrial tuberculosis and infertility.
- Evaluation of HIV +ve mother's milk for markers of HIV infectivity.
- Detection of HIV infection at birth and beyond neonatal period in infants.
- Development of newer methods for delaying pregnancies and spacing of births.
- Evaluation of the association of host immunogenetic factors with human papillomavirus (HPV) infection and predisposition to cervical cancer.

Epidemiological/ Operational Research

Prospective studies to test:

- Newer and conventional methods of contraception.
- Adolescent sexual and reproductive health: (a) Up-scaling ARSH service delivery model in other districts of Maharashtra and replicate this model to other states with linkages between HIV and ARSH services (b) Multicentric study on prevalence of PCOS.
- Socio-behavioural interventions with respect to reproductive health.
- Impact of healthy lifestyle modifications including pharmacological intervention towards bone health, fall prevention and quality of life among postmenopausal women.
- Development of new RTI/STI management guidelines and training material.

Infrastructure and Human Resources Development

- Setting up of a model clinic for improving access for medical abortion and for developing dose finding studies for pregnancies beyond 7 weeks of gestation.
- Training programs conducted regularly at the Institute relate to molecular biology techniques, insertion and management of complications with IUCDs, ultrasonography, assisted reproductive technologies, gynecological cytology and colposcopy, management of infertility and reproductive disorders, and detection of reproductive tract infections, stem cell biology, preclinical reproductive and genetic toxicology.
- NIRRH is designated as a WHO Collaborating Centre on Research and Training in Reproductive Health.
- The Institute is recognized by University of Mumbai for M.Sc and Ph.D degrees.

National Institute for Research in Tuberculosis (NIRT), Chennai**Basic Research**

- Studies on bacteriophage lysin gene: biology and its large scale production.
- Quality assurance studies of anti-TB drug content in tablets / capsules.
- Characterization of viral and host factors responsible for clinical differences seen in HIV-1 and 2 infections.
- Characterization of neutralization specificities of sera of HIV-1-infected individuals in Chennai.
- Role of NK cells in HIV-TB co-infected patients.
- Immunoproteomically identified *M. tuberculosis* T-cell antigens for diagnosis.
- Newer biomarkers for diagnosis of childhood TB.
- VDR gene polymorphisms and sputum conversion during anti TB treatment.
- Cytokine gene polymorphisms in HIV-1 infection.
- Role of Tregs in tuberculous immunity.
- Bioprospecting of Lichens for antimycobacterial activity.
- Role of the complement system in the pathogenesis of pulmonary tuberculosis.

Clinical Research

- Pharmacokinetics of first-line anti-TB drugs in TB patients receiving treatment according to RNTCP guidelines.
- Pharmacokinetics of protease inhibitors for HIV.
- Pharmacokinetics of rifabutin during lopinavir/ritonavir co-administration.
- Pharmacokinetics of moxifloxacin in PTB patients.
- Clinical trials for shortening treatment of tuberculosis (TB) using newer drug molecules.
- Phase I and II trials for new TB vaccines and drugs.
- Randomized clinical trials using newer regimens for treatment and prevention of TB in HIV-infected persons.
- Alternate regimens for HIV-TB and Neurocognitive studies.

Epidemiological/ Operational Research

- Socio behavioural studies for development of new models for intervention in TB and HIV.
- Feasibility study looking at isoniazid as preventive therapy for TB in HIV infected individuals.
- STREAM Study - Investigating efficacy of new study of Regimens effective against MDR-TB regimens

- Studies on extra pulmonary TB and smear negative TB for comprising diagnosis and management.
- Operational research on impact of methods of integration of HIV and TB control programs.
- Impact of ART on economic and health status of HIV positive individuals.
- Estimating the burden of TB and co-infections and their impact on endemic communities.
- Exploring the links between poverty and communicable diseases.
- Prevalence of PTB in selected settings of different parts of India.
- Community participation study to improve the health system in south India.
- Economic modelling and forecasting of public-private mix (PPM) for TB care and control.
- Introduction of new drugs/regimens for patient care.
- An integrated approach for rapid detection of drug resistant tuberculosis.

Translational Research

- Newer methods for TB drugs.
- New methods for drug resistance.

Human Resource Development

- Short Courses on Research Methodology for UG and PG medical students.
- Ongoing GCP and GCLP and Ethics training for NIRT staff – one course per year by a certified training institute.
- Training in Statistical Methods for scientists

National Institute of Virology (NIV), Pune

Basic Research

- Development of antiviral compounds for dengue.
- Screening of antiviral compounds from different sources.
- Determination of sero-prevalence of dengue in different parts of the country.
- Role of host and viral factors in different vector borne viral diseases.
- Studying the influence of variability in HLA and Cytokine genes on immune response to Measles vaccine.
- Genotyping of rubella virus strains circulating in various parts of India.
- Role of possible zoonosis in spread of enteroviruses responsible for Acute Encephalitis Syndrome (AES).
- Screening of different compounds to determine their efficacy in inhibition of Chikungunya virus.

- Cloning and expression of Ev71, CA-16 and CA-6 isolated from Hand Foot and Mouth Disease patients from India.
- Identification of the etiologic agent for non-A-E hepatitis
- Evaluation of microRNAs (miRNAs) for inhibition of virus replication *in-vitro* and *in-vivo*.
- Inhibition of chikungunya virus in vero cell cultures with Morpholino Oligomers.
- Screening of medicinal formulations for antiviral activity against influenza and other viruses.
- Identification of factors in host-virus interactions during Influenza infection.
- Genomic analysis of enterovirus strains, with a special reference on possible recombination and its effect on pathogenicity and emergence of newer viruses.
- Dengue, Chikungunya - a study on host gene expression using microarray, protein analysis and epigenetics.
- Development of group A rotavirus serotype specific immunoassays.
- Development of group B rotavirus specific immunoassays.
- Development of immunoassays against Coxsackie A-24 (CA-24) isolated from patients with acute hemorrhagic conjunctivitis.
- Development of norovirus genotype specific immunoassays.

Clinical Research

- Studies in AES in Gorakhpur (U.P).
- Studies on immunological correlates of morbidity, severity, and multiorgan involvement in AES cases.
- Pathophysiology of AES and development of management protocols.

Epidemiological/Operational Research

- Surveillance of different viral diseases in Kerala state to determine the dynamics of transition.
- Transcriptome analysis for the tribes showing high and low HBV/ HCV carrier rate and comparison with high-risk categories from general population.
- Environmental monitoring of etiological agents responsible for causation of AES in Eastern Uttar Pradesh.
- Development of Predictive algorithms for AES using remote sensing and ground level data collection in eastern UP.
- GIS based data acquisition and software development portals for rapid reporting and recording of AES cases.

- Molecular diagnosis and epidemiology of arbovirus infections in Karnataka.
- Molecular diagnosis and epidemiology of respiratory virus infections in Karnataka.

Translational Research

- Field demonstration of preventive methodologies for water borne encephalitis in eastern Uttar Pradesh.

National Jalma Institute for Leprosy and other Mycobacterial Diseases (NJILOMD), Agra

Basic Research

- Genomic and proteomic approaches for development of diagnostics for leprosy, tuberculosis and other mycobacteriosis.
- Comparative study of markers of nerve damage in leprosy, diabetes and chronic alcoholism.
- Studies on mechanisms of pathogenesis in mycobacterial infections using morphological, immunological, cellular, molecular and *in vivo* approaches.
- Studies on host-parasite interactions specially in case of interventions with newer therapeutics and vaccines.
- Studies on lipid biosynthesis and other pathways in mycobacteria using biochemical, proteomic and molecular approaches.
- Development, evaluation and introduction of newer assays for diagnosis, monitoring of tuberculosis, leprosy including assessment of drug resistance.

Clinical Research

- Studies on better analysis of clinical profile of TB, leprosy and related diseases; and correlation with newer immunological, hormonal, molecular and other relevant markers.
- Trials using newer drugs or alternate/improved regimens.

Epidemiological/ Operational Research

- Expanding and strengthening the networks between MRHRU Ghatampur, satellite centre Banda and other states to study the trends in epidemiology of relevant diseases- leprosy, TB *etc.*
- Studies on understanding the dynamics of transmission and various factors responsible for continued endemicity of leprosy by classical epidemiological and molecular epidemiological approaches.
- Study the effect of various interventions including the use of alternative drug regimens for TB and leprosy on their transmission dynamics.
- Study the utilization of the local health facilities and develop models to improve the same.

- Study the impact of social, economic and environmental factors on the epidemiological trends of the TB, leprosy and other prevalent diseases.
- Comparative studies on general health profile, diseases like leprosy and TB in Banda as well as other selected areas with varying geographical and social conditions.
- Development of a data base for different aspects of leprosy and tuberculosis research from published as well as other information.

Translational Research

- Implementation research for evaluation of different strategies of prevention, treatment in Model Rural Health Research Unit so as to generate information for improving the effectiveness of various health programmes.
- Translational programmes for utilization of leads observed from genomic and proteomic based studies for development of improved techniques/methods for diagnosis (detection/drug resistance), monitoring and development of more effective therapeutics for diseases like leprosy and TB.

Human Resource Development

- Ph.D. and MD programmes.
- MSc project dissertations and Summer training for MSc students.
- Training of medical and paramedical personnel in basic technology, EQA, re-orientation, drug resistance surveillance *etc* in leprosy and TB.
- New programmes for specialized trainings in emerging areas.

Regional Laboratory for Infectious Diseases (ICMR Virus Unit), Kolkata

Basic Research

- Molecular characterization of herpes virus strains isolated from clinically diagnosed genital herpes patients.
- Identification of miRNA as a candidate biomarker for liver disease progression and development of miRNA based therapeutic options.
- Understanding the mechanism of occult HBV infection by using molecular, functional and Bioinformatics approach.
- Studies on emerging and reemerging viral infections (hepatitis viruses/HSV) to look at genetic pattern of the circulating strains of the viruses.
- Study of hepatitis viruses/HSV and other viruses for developing effective antivirals.
- Biochemical role of HCV genotype 3 core protein in liver pathogenesis in north east states.
- Development of anti-HCV drug based on HCV protease and RNA dependent RNA polymerase.
- Studies on mechanism of HCMV infection.

- Development of siRNA Targeting Different Sites of Human Hepatitis B Virus.

Epidemiological/ Operational Research

- To develop a database of opportunistic infections in HIV-AIDS.
- Entomological surveys for investigating the outbreak and develop rapid diagnostic kits for identification.

Human Resource Development

- Conducting training programme of diagnostic methodology of viral infection for a) Doctors, b) Microbiologists, c) Technicians, Ph.D., training courses for MBBS/ M.Sc./B.Tech/ M.Tech students and conducting workshops/seminars/trainings.

Regional Medical Research Centre, Belgaum

Basic Research

- Studies to assess adverse drug reactions and recognition of the beneficial effects of selected Herbal formulations.
- Evaluation of herbal formulations against highly resistant micro organisms from different types of infections.

Clinical Research

- *In vivo* studies to establish the safety and efficacy of selected herbal leads for prioritized conditions like metabolic and hepatic disorders, arthritis, ulcers and enteric diseases.

Epidemiological/ Operational Research

- Studies on demography of patients utilizing services of traditional healers.
- Studies on cost benefit analysis of usages of herbal vs. modern drugs.
- Understanding the epidemiology of diseases of regional importance with the aim of designing intervention.

Translational Research

- Developing of protocols for *in vitro* propagation of plants and *in vitro* production of bioactive compounds with high medicinal value.

Human Resource Development

- Manpower development in the form of generation of Ph.D/M.Phil
- Training to students and faculty of students and faculty of Botany, Pharmacy, Microbiology, Molecular Biology and Natural Product Chemistry.

Regional Medical Research Centre (RMRC), Bhubaneswar

Basic Research

- Assessment of anti sheath antibodies as alternate tools to determine immune status in human filariasis.

- Characterization of host and parasite factors among residual microfilaraemic individuals following mass drug administration (MDA) programme in filariasis.
- Impact assessment of MDA on reduction/reversal of morbidity in high risk pockets of filariasis in the endemic areas covered under MDA.
- Identification and characterization of the plasmodium genes responsible for Artemisinin resistance.
- Search for immunological markers for early detection of cerebral malaria in tribal population.

Clinical Research

- Studies on use of nitric oxide (NOx) as an adjunct therapy in the treatment of cerebral malaria due to *P. falciparum*.
- Studies on anemia among adolescent girls using weekly single dose of iron-folic acid with vitamin B12, de worming and nutrition education.
- Introduction of alternate regimen with uniform low dose (100mg) of DEC with albendazole (400mg) to enhance compliance in MDA for filariasis.

Epidemiological/ Operational Research

- Vector control mapping strategies for perennial malaria transmission in selected areas.
- Development of comprehensive vector control strategy for vector borne diseases in irrigation canal area.
- Development of a specific strategy for urban mosquito control in changing slum distribution.
- Development of preventive intervention strategy against Hepatitis C virus in primitive tribes.
- Assessment of determinants of under-five mortality and development of intervention plan to modify the current package covered in RCH programme.
- Home-based management of severe acute malnourishment among under-five children in Rayagada district, Odisha.
- Studies on locally produced/producible foods to address malnutrition and child mortality in inaccessible areas.
- Modified strategy by convergence of programmes in maternal and child health and nutrition at grass root level in tribal areas.
- Study of demographic distribution of types of drug resistance in TB in a tribal district of Odisha using modern biological techniques.
- Pattern and distribution of sexually transmitted infections in tribal population and development/validation of strategies for control for incorporation in state services.
- Assessment of micronutrient deficiency, morbidity pattern and identification of major causes of mortality among primitive tribes of Odisha.

- Development of strategy for early detection of diabetes mellitus (Type II).
- Studies on obesity related health problems in children in Odisha: school-based interventions to prevent weight gain.
- Validation of newer diagnostic methods for laboratory diagnosis of tuberculosis in tribal population.
- New tools (GIS and xenomonitoring) for monitoring MDA and identification of endemic areas of filariasis.

Regional Medical Research Centre (RMRC), Dibrugarh

Basic Research

- Gene flow and population genetics of malaria vectors in NE India.
- Antimalarial drug resistance in NE India.
- Development of diagnostics for neurocysticercosis.
- Host innate immunity and persistence of Hepatitis B in NE India

Epidemiological/ Operational Research

- Prospective studies on malaria transmission dynamics and impact of control programme.
- Expanded programme for GIS mapping of vector borne diseases in NE India.
- Epidemiology of visceral leishmaniasis, JE, dengue in Assam.
- Transmission pattern of bancroftian filariasis in NE India.
- Monitoring of human influenza viruses in NE India.
- Molecular epidemiology of human respiratory syncytial virus.
- Epidemiology of HIV, HCV and STIs among female injecting drug users in Manipur.
- Impact of paragonimiasis on tuberculosis control programme.

Human Resource development

- M.Sc. (Bioinformatics) and M.Sc. (Biotechnology) in collaboration with Dibrugarh University (to continue).
- Trainings of Medical Officers and Paramedicos of different cadres of medical colleges and state health services.

Regional Medical Research Centre for Tribals, Jabalpur

Basic Research

- Identification of genetic markers associated with severity of sickle cell disease and its molecular characterization.

- Interaction of host-genetic factors and anti-malarial drugs.
- Evaluation of nutritive value of unconventional traditional foods of Madhya Pradesh.
- Molecular characterization and *in vitro* evaluation of natural products/novel drugs for the control of bacterial vaginosis in the State of Madhya Pradesh.
- Molecular characterization of hepatitis C (Indian isolate) and production of an *in vitro* system for screening of natural products with anti-hepatitis C activity.

Epidemiological/ Operational Research

- Prevalence of pulmonary TB among tribal population of Chhattisgarh.
- Retesting safe drinking water and nutritional supplementation model through estimation of fluoride burden in Madhya Pradesh a new initiative.
- Estimation of various micronutrient deficiencies among primitive tribes in unexplored areas of Madhya Pradesh.
- Identification of risk factors of infant mortality rate and immunization practices among Baiga primitive tribe of M.P.
- Study of neo-natal, post natal and infant health along with child immunization practices among Baiga primitive tribes of M.P.
- Prevalence of infertility in Madhya Pradesh.
- Demographic survey in tribal areas of Madhya Pradesh.
- Study of maternal health care among Baiga primitive tribes in Dindori District of M.P.
- Maternal and child health care among Bharia primitive tribe in Chhindwara District of M.P.
- Impact of RNTCP on tuberculosis prevalence among tribal population of M.P. and Chhattisgarh.
- Feasibility of introduction of bivalent rapid diagnostic test (RDTs) kits for *Plasmodium vivax* and *P. falciparum* malaria control in a remote Primary Health Centre of District Jabalpur, Central India.
- Clinical and molecular surveillance for monitoring the emerging resistance to anti-malarial drugs in *P. falciparum* in central India.

Clinical Research

- Therapy of cerebral malaria by targeting NFκB and ROS.
- Chemoprevention of squamous cell carcinoma and evaluation of a new anti-cancer agent: Dimethylaminoparthenolide.

Infrastructure and Human Resource Development

- Strengthening of following:
 - Apex referral laboratory for chickungunya and dengue.
 - State Reference Laboratory for HIV.

- State Reference Laboratory for H1N1.
- Intermediate Reference Laboratory for Tuberculosis.
- Malaria detection and treatment at Malaria clinics in tribal areas of CG (Jagdalpur) and MP (Medical College, Jabalpur) and through Camps.
- Clinic for detection of sickle cell disease (NSCB Medical College, Jabalpur).
- Capacity building of Medical Officers/Paramedics for malaria, fluorosis and tuberculosis

Regional Medical Research Centre (RMRC), Port Blair

Clinical Research

- Studies on profile and progress of NCDs in Andaman and Nicobar islands.

Epidemiological/Operational Research

- Newer studies on ecology of leptospirosis in India.
- Study of trends: Proportion of febrile cases caused by leptospirosis in India – a reassessment.
- Rotaviral diarrhoea surveillance and molecular epidemiology of rotaviral diarrhoea.
- Community based intervention for chronic non-communicable diseases risk reduction among Nicobarese and also other section of population of Andaman and Nicobar.
- Social anthropological studies among the tribes.
- Evaluation of diagnostics for introduction in leptospirosis control.
- New methods of disease control for introduction into public health control programmes.

Translational Research

- Monitoring the process of eliminating the lone foci of diurnally sub-periodic filariasis from Nancowry group of islands by administration of DEC fortified salt and creating scientific evidence for mid term correction.

Human Resource Development

- Training of technical/scientific manpower for disease surveillance, laboratory diagnosis and biomedical research.

Rajendra Memorial Research Institute of Medical Sciences, Patna

Basic Research

- Studies on basic biology of *Leishmania donovani* using genomic and proteomic approaches to study host-parasite relationship, search new targets and molecules for drug and immunoprophylaxis.
- Analysis of whole genome of drug resistant and sensitive isolates of *L. donovani* by next generation sequencing.

- Protein modelling and crystallization of key proteins to identify new ligands for vaccine/ drug targeting.
- Investigation on the mechanism of disease pathogenesis using microbiological, biochemical, immunological, structural and genomic approaches.
- Develop new diagnostic tool for symptomatic and asymptomatic cases of kala-azar.
- Identification of genetic polymorphism and its correlation with host susceptibility in kala azar.
- Search for newer natural products to be used as anti-leishmanial agents and their mode of action.
- Study of mechanism of immuno-suppression and identification of new targets to revert immune function in diseased condition.
- Study of factors responsible for subcutaneous accumulation of *Leishmania donovani* in PKDL cases.
- Development of new chemotherapeutics, drug modalities and establishment of effective drug delivery system for cure of unresponsive and co-infected cases of kala-azar and PKDL.
- Biochemical, immunological, molecular biology approaches in development of surveillance and diagnostic tool for kala-azar coinfection specially HIV, tuberculosis and their treatment modalities.
- Development of cost-effective, highly sensitive non-invasive diagnostic tool for kala azar with potential to introduce at peripheral level.

Clinical Research

- Studying underlying mechanism of multidrug resistance in *L. donovani* infection.
- Development of low cost drug/ combination therapy for treatment of kala azar and PKDL.

Epidemiological/Operational Research

- Studies on prevalence of multi-drug resistant tuberculosis in Bihar.
- Studies on behaviour change communication (BCC) to make people aware of the diseases and community participation in the elimination programme.
- Vaccine trial for kala-azar.
- Improved strategies for vector control for elimination of kala-azar.
- Implementing research to help the state Government, health workers, PHC and social worker with new technologies by transferring the modern technologies for surveillance, diagnosis & treatment of disease.

Infrastructure and Human Resource Development

- Establishment of sentinel sites in highly endemic districts of kala-azar with emphasis on pharmacovigilance.

- Set up a surveillance team to assess and disseminate the real situation in case of any epidemic.
- Impart training to the scientists working in the field of TDR, especially to kala-azar.
- Doctors of different speciality will be trained for tropical diseases for the upcoming TDRC (an extension of RMRI) for different tropical diseases.
- Manpower development for future ART plus and MDRs, XDRs diagnosis of tuberculosis.
- M.D./Ph.D. programme will be initiated in the field of epidemiology, medicine and pathology; Masters degree in specific subjects like medical biotechnology and medical microbiology.
- Setting up of nursing training centre.
- Start a WHO reference centre for GCLP.

Vector Control Research Centre (VCRC), Puducherry

Basic Research

- Studies to understand the role of difference in individual host defense mechanisms to contain infections and disease progression.
- Studies to understand the aetio-pathogenesis of filariasis in children (Age < 14 years).
- Dynamics of resurgence of lymphatic filariasis during post-MDA period
- Molecular basis of vector competence and behaviour.
- Resistance to synthetic pyrethroids and its mechanisms in malaria vectors
- Malaria parasite: drug resistance–distribution and mechanism.
- Search for new microbial agents for vector control - characterization and development.
- Identification of new lead molecules from plants and marine animals for vector control.
- Development of newer mosquito attractants / repellents.
- WHOPES sponsored evaluation of pesticide products for vector control.
- Development of Point of Care (POC) diagnostics, molecular and seroepidemiology and xenomonitoring for dengue, chikungunya & JE.

Clinical Research

- Community based clinical trials for LF morbidity prevention / management.

Epidemiological/Operational Research

- Application of lymphatic filariasis quality of life (LFQoL) instrument to assess the impact of morbidity management in filariasis patients in operational settings.
- Effectiveness, cost and feasibility of morbidity management of lymphatic filariasis.

- Epidemiology of infection, disease and transmission of filariasis in communities with at least five rounds of MDA under LF elimination programme.
- Development of post-MDA surveillance and management strategies.
- Development of new simulation models for lymphatic filariasis: adaptation, validation and application for Indian situation.
- Socio-economic determinants of malaria prevalence in tribal areas.
- Faunistic survey, biology, ecology and behavior of vectors in areas of persistence and new foci of Leishmaniasis.
- Eco-epidemiology of leishmaniasis among forest tribal settlements of Western Ghats of Thiruvananthapuram district, Kerala.
- Leishmaniasis: vector resistance to insecticides.
- Epidemiological and entomological surveillance for dengue/chikungunya during inter-epidemic periods.
- Geo-environmental risk of dengue/chikungunya/JE/Scrub typhus in relation to climate change.
- Transmission dynamics, clinical and seroepidemiology & control of scrub typhus and other typhus fevers.
- Development and validation of sampling strategies for monitoring arbo-viral infection in vectors.
- Molecular and seroepidemiology of dengue

Human Resource Development

- Two-year M.Sc. Course in Public Health Entomology, Formal training on Comprehensive Vector Control (CVC) / Integrated Vector Management (IVM) for students, faculties & Public Health Personnel from various Institutions.

ICMR HEADQUARTERS

International Health Division

- Enhancing capacity building to facilitate training of mid/senior level researchers.
- Establishment of International collaborative Centres of Excellence/international facilities / international collaborative labs for common use.
- Initiate new collaborations with developing countries in Africa, Asia and Latin America *etc.* to initiate joint medical/health research programs of mutual interest.
- Programme for attracting young overseas Indian researchers to take up research as a career.
- Promote sharing of advanced research facilities to neighbors in the region to promote collaborative partnerships.
- Create suitable bilateral/multilateral structures with countries of the region to promote R&D in areas of interest.

- Harmonization of national laws, standards and regulations with other countries/agencies.
- Extend assistance to neighboring, regional and other developing countries through exploratory missions and initiate dialogues for research collaboration.

Human Resource Planning and Development

- ICMR Centenary Post Doctoral Fellowship Programme – to foster high quality research by fresh PhD/MD/MS holders in the cutting edge areas of basic science, communicable and non communicable diseases, reproductive health including nutrition at ICMR Institutes/ Centers.
- Scheme to help middle aged women scientists to return to mainstream science and work as bench-level scientists, especially on problems of societal relevance and to take up S&T-based internship followed by self-employment.
- Establish a merit-based fellowship program for financial assistance to candidates who have not qualified any national exam but registered for Ph.D. in a recognized University/institute .
- Up-scaling of ongoing schemes and increase number of institute.

Publication, Information and Communication

- Bring out special issues/special sections of IJMR on topics of current interest
- Provide web-access to all the Hindi publications of the Council
- Create national resource centres for respective disease/disciplines in ICMR Institutes/ Centres.
- Develop institutional repositories through digitization of the institutional content.
- Enhance the scope and content of the ongoing scientometric analysis of ICMR publications.
- Updation of the Compendium of Health Research Institutions including Medical Colleges.
- Strengthen the ICMR e-journal subscription with more journals and databases.
- Create disease/discipline information repositories to serve as national resource centres.
- Initiate setting up of a comprehensive biomedical/medical journal consortium.
- Set up a virtual training centre using existing high-speed internet and video conferencing facilities with training modules on Biomedical Informatics to conduct interactive training sessions.
- Establish a ICMR data centre for data storage and analysis particularly of high throughput data with high performance computational infrastructure and trained manpower for biomedical informatics work.
- Task-force on Medical Applications of Systems Biology, Medical Genomics and Biomedical Informatics to help understand, prevent and combat major complex diseases.

- Expand the video conferencing facilities to all locations of ICMR and improve facilities at the existing locations..
- Computerization of Administration and Finance will be done using customized administration and finance modules developed by NIC.
- The ICMR-NIC Centre would develop databases of national public health importance and also design and develop a web-based editorial management system, under the project 'National Databases of Indian Medical Journals'. More interactions would be held with medical journal editors.

Strengthening of Network of ICMR Libraries and Consortium of Journals for ICMR Institutes/Centres/Medical Colleges

It is proposed to upgrade the available library facilities of the ICMR Institutes/Centres in the XII plan to address critical gap in the development of IT Infrastructure and other equipment to provide quality services to users. Among the other activities the information resources will be up-scaled. The library and information centers will digitize their resources like thesis collection, institute publications *etc.* In addition, the electronic journal subscription would be segmented and strengthened. Disease/discipline-specific databases on areas of national priority like infectious diseases, non-communicable diseases, reproductive health, nutrition *etc.* will be developed to facilitate quick and easy retrieval of the information to users. Finally, a strong nation-wide consortium of medical/biomedical journals will be set up to facilitate access to current data/information from global biomedical journals.

Intellectual Property Rights Management

- Expand and strengthen techno-legal assistance at the Institute level.
- Extend the techno-legal assistance to all biomedical inventors in India, especially individual inventors.
- Create a support system to provide techno-legal and financial assistance to non-ICMR inventors/institutes for the development and delivery of health products of public health importance.
- Formulate a national policy frame-work in place for protecting, preserving, exploiting and benefit-sharing systems in place for all biomedical inventions in India.
- Establish a system of rewarding innovations for both ICMR and non-ICMR technologies.
- Formulate policies for responding to national and international IP policy needs to make India globally competitive.
- Intensify the IP and technology transfer appreciation programmes country-wide.
- Conduct studies on various WTO / TRIPS and other issues on R&D in health to help India become globally competitive.

ONE TIME UP-GRADATION INFRASTRUCTURE DEVELOPMENT AT VARIOUS ICMR INSTITUTES/CENTRES

Budgetary Requirement: ₹ 1700 crore

Intramural research activities of the ICMR, which includes basic, clinical, applied, molecular diagnostics as well as clinical and field trials of various products, drugs and insecticides and herbal formulations are being done by the network of 32 Institutes of the ICMR located in different parts of the country. Besides, they also support to state health authorities in outbreak investigations and emerging health issues due to natural calamities and extend research support to national health policies and programmes. To carry out effective and meaningful research and to meet the needs of the people many of the laboratories/field units of the ICMR institutes need to be strengthened/upgraded. Some new centres are also to be established to expand research and outreach, which will require equipments, capital work and additional manpower to achieve the objectives. Institute wise requirement for the XII plan is projected below:

Centre for Research in Medical Entomology, Madurai

Establishment of an Arthropod Containment Laboratory (ACL)

The CRME proposes to undertake research investigations on various physiological and genetical aspects of vector arthropods (e.g., mosquitoes) where a foolproof arthropod containment environment will be absolutely necessary.

Establishment of animal house facility, cell line culture, a molecular entomology laboratory and an insect physiology laboratory

The Centre needs invariably a good animal house facility to conduct its various JE and dengue related research activities. Besides, centre also performs several investigations using cell line culture, but in the want of a proper laboratory this is often difficult to achieve the targets. The centre has advanced into molecular aspects of biology of both the vectors and pathogens, however a good, self sufficient molecular laboratory is still wanting, such a laboratory will provide a much needed platform for unraveling many physiological riddles in vector biology. The Centre needs to undertake many research activities related to response of sensory organs to molecules of repellents/attractants for developing effective mechanisms or products for disease control, hence, an insect physiology laboratory will therefore be highly useful for future research work.

Capital work and Equipment

- **Construction of Main Building for CRME:** The Centre has undertaken the construction of new CRME Laboratories and Administrative buildings near Vadapalang village/MK University. The work is understood to be completed in late 2012. Such a new Campus will provide basic infrastructure to laboratories to carry out all the scientific activities as per the mandate of the Centre.

Desert Medicine Research Centre, Jodhpur

This is a unique institute dealing with the health problems of desert population. These health problems include nutritional, infectious and chronic diseases. Further, the institute is also focusing on exploring the use of herbal medicine which is available as a traditional knowledge. The building has been constructed, the laboratories need to be provided with appropriate equipment.

Capital work and Equipment

- Constructions of Director Bungalow, Canteen and Animal House are required for the optimal functioning of the Institute.
- Virological laboratory expansion for serological and molecular diagnosis of H1N1, Dengue and Chikungunya viruses *etc* in coordination with state health department/ medical colleges.

Enterovirus Research Centre, Mumbai

This is an important institute of ICMR and was so far operating from the campus of Haffkine Institute. As the land within the campus could not be allotted to ICMR for various reasons, the plot has been obtained at Khar, Navi Mumbai. This centre has contributed immensely for the control of Polio and will play greater role in understanding the dynamics of infections due to various other enteroviruses. For this purpose, an appropriate laboratory building with required infrastructure is a must and has been proposed below :

Capital work and Equipment**Construction of Laboratory Building of EVRC at Kharghar, Navi Mumbai**

A plot measuring 4000m² has been obtained at Kharghar Navi Mumbai for construction of the Laboratory Building with BSL III facility of the Enterovirus Research Centre.

Genetic Research Centre, Mumbai**National Referral Center for specific genetic disorders**

Setting up National Referral Center for specific genetic disorders at GRC, Mumbai for single gene disorders *viz.* inborn errors of metabolism, genodermatosis, skeletal dysplasias and X-linked mental retardation *etc.* The Centre will be establishing the mutation analysis for these disorders by sequencing the genes already known to be involved in these disorders. This will help in diagnosis.

Capital Work and Equipment

It is proposed to make the Centre a state-of-the art referral center for metabolic diseases and hence, complete renovation of the center during the XII plan is proposed.

ICMR Virus Unit (Regional Infectious Disease Laboratory), Kolkata**ICMR Virus Unit to be renamed as Regional Infectious Diseases Laboratory**

With a view to define its public health research mandate, it is proposed to rename the ICMR Virus Unit as Regional Infectious Diseases Laboratory. This has been decided to create a

proper research infrastructure dedicated to carry out epidemiological and operational research programmes on viral/ other infectious diseases which are responsible for outbreaks and /or are of immense public health importance due to their endemicity.

Capital work and Equipment

- Taking together the increase in the emerging and reemerging viral diseases in recent years, the geographical location of eastern India near the southeast Asia, where a number of new viral diseases like SARS, bird flue, swine flue originated, in addition our studies establishing emergence of new viral strains of existing viruses in eastern India from southeast Asia underscores the urgent need for setting a full fledged Regional Virus Research Center in eastern India.

Institute of Cytology and Preventive Oncology, Noida

ICPO is in the process of expanding its research programmes so as to deliver publically usable outcomes. In order to harness the available knowledge/new information generated about the cellular and molecular mechanisms, the Institute plans to expand and strengthen cellular and molecular diagnostic divisions as well as create a biomedical information centre. As per the mandate of the Institute, ICPO should have a well developed clinical set up for patient care in cancer which is also essential for its research programmes. For this purpose, the following capital work and equipments will be required :

Capital work and Equipment

- Main activities would be construction of a twenty five bedded Cancer Research Hospital at ICPO, NOIDA: This small hospital complex will be essential for the clinical & the laboratory research programme of the Institute.
- Upgradation of existing laboratories and offices : As discussed above, this upgradation is essential to optimally utilize the laboratory space for undertaking the plan research work.

Microbial Containment Complex, Pune

Capital work and Equipment

The country's first BSL-4 facility in human medicine is nearing completion and will be commissioned before the end of XI plan. Some of the facilities which will require construction and commissioning as a part of this MCC Complex are enumerated below:

- Construction of Scientist Type C and D Quarters, Technical Type C and D Quarters and Staff Quarters type A & B
- Construction of Centralized washing, Packing and Storage Facility
- Construction of Centralized ware housing facility
- Construction of Laboratory building for Computational biology
- Modernized EM Facility, Bio matrix Lab
- Construction of Primary Health Centre & 4 Bedded Hospital
- Construction of Bio Repository, Maintenance block and utility services and other miscellaneous capital works

National AIDS Research Institute, Pune**Centre of Excellence for Clinical trials and testing related to HIV and Co-infections in India**

This Center of Excellence would focus on drug trials, vaccine trials and other prevention intervention trials. The center would aim at conducting phase I / II / III trials in India. NARI is globally recognized for its excellent expertise in the conduct of clinical trials both therapeutic as well as prevention. However this expertise has been developed predominately using external funding. To sustain the infrastructure significant support would be needed from the XII plan. The expertise developed at NARI should be converted to a national resource. In the XII plan, it is aimed to provide leadership in the conduct of clinical trial nationally by strengthening the main clinical facility at NARI as well as establishing capacity and linkages across ICMR and non ICMR institutions in India for the conduct of multi-centric clinical trials. This centre of excellence in clinical trials will be a key stone for translational research and facilitate “bench to bedside” research. This envisages the building of clinical research facility in the premises of NARI which was earlier proposed in the XI plan as well.

Anti HIV testing centre of excellence (Continuation from XI plan)

Anti HIV testing facility was initiated under the ICMR extra mural funding scheme which was later upgraded for testing microbicide candidates with support from Department of Biotechnology, Government of India. During XI plan a high throughput assay for screening large number of indigenously developed preparations as well as microbicide specific models (cervico-vaginal explants, cultures, trans wells epithelial systems) and assay for testing activity against other STI pathogens have been developed. Currently, NARI has created liaison with industries and experts in anti-HIV drug development field. The institute has been receiving several collaboration offers from research institutes, universities, pharmacy colleges, private companies for screening anti-HIV activity using cell based systems. Therefore, during the XII plan this activity needs to be sustained and it is proposed to identify this activity as “Centre of Excellence and continue screening on a very large scale (at least 500/yr). It is also proposed to introduce additional molecular assays for determining mode of action, efficacy testing using *in vivo* most recent humanized mouse models and upgrade the existing facility to a bench mark facility.

National HIV Virus Repository (Continuation from XI plan)

NARI had established first largest collection of Indian HIV strains and generated national resource for HIV research with the support from the Department of Biotechnology, Govt. of India. The Institute has been able to give a platform for molecular studies of Indian HIV-1 and HIV-2 strains and generated database of Indian HIV-1 strains. This repository was maintained with NARI intra-mural resources and now has a collection of over 200 HIV-1 and HIV-2 strains. However, this activity has been at a very low key due to lack of adequate funding and availability of permanent staff. NARI would like to rejuvenate and expand this national research resource in the XIIth plan.

School of Public Health

NARI has been identified as an ICMR Institute that would additionally function as an ICMR School of Public Health. NARI has established a collaboration/affiliation with Maharashtra University of Health Sciences, Nasik for providing the MPH degree. The school of public

health building with lecture halls and public health laboratories are already in existence. A student's hostel for this school and other training programme conducted by NARI is proposed in the XII plan.

Expansion in Rural Settings: Establishment of rural satellite unit in collaboration with local partners

NARI has been primarily focused in urban areas in and around Pune. NARI Scientific Advisory Committee has recommended that NARI expands its activities in rural areas. With this in mind the establishment of a satellite rural unit of NARI is proposed in XII plan. It is planned to establish this centre in Udgir in Latur district which is well placed for HIV research. This under developed category A district of Maharashtra borders with the states of Andhra Pradesh and Karnataka. The village witnesses extensive inter state mobility of around 10,000 people everyday. This village also has thriving entertainment industry and migrant population. This centre would focus on socio-behavioral studies and establishment of various cohorts for prevention and care in rural settings. This centre would also focus on studies among migrants and mobile populations.

Animal House (Continuation from XI plan)

Development of Animal House as per global standards: Handling of animals in the sterile conditions, water facility for animal, feed and for housing of animals and ensuring bio safety procedures while handling infected animals.

Capital work and Equipment

- **Clinic Building**
- **Renovation of Laboratory Building**
- Hostel building, Staff Quarters, Canteen & Recreation Hall

Hostel Building: NARI has been identified to conduct the Masters of Public Health (MPH) programme of ICMR School of Public Health at NARI, Pune. At any point of time there will be at least 20 students for this course. Additionally around 20 PhD scholars are also expected. In addition, NARI provides lot of training support to the National AIDS Control Organization [NACO] in conduct of different types of training programs.

Staff quarters: Recently many senior and junior staff members have joined NARI as permanent employees as well as in various projects. The existing residential quarters are already full and there is still demand for additional staff quarters on the premises. Therefore, residential quarters of various types are also proposed as a part of the proposed Hostel Building.

Canteen and Recreation Hall: With the massive expansion in the permanent and temporary staff employed under various projects of NARI and the number of staff members reaching almost 400, there is a growing need of creation of canteen and recreational facility.

National Centre for Disease Informatics and Research, Bangalore

Creation of National Centre for Disease Informatics and Research at Bangalore and establishment of different Departments and Molecular Biology Laboratory at NCDIR, Bangalore.

The National Centre for Disease Informatics and Research (NCDIR) was sanctioned as a new permanent institute of the Indian Council of Medical Research in March 2011. The new centre is the outcome of the sustained and successful run of the National Cancer Registry Programme since December 1981. The main objective of the NCDIR is to sustain and develop a national research data-base on cancer, diabetes, CVD and stroke through recent advances in electronic information technology with a national collaborative network, so as to undertake aetiological, epidemiological, clinical and control research in these areas.

Capital work and Equipment

Molecular Biology Laboratory

To correlate epidemiological parameters with laboratory findings a state-of-the-art molecular biology laboratory is required and will be setup at the centre.

National JALMA Institute of Leprosy and Other Mycobacterial Diseases (NJILOMD), Agra

Mycobacterial Repository & Diagnostic Complex plus National BSL3 facility for Animal Experiments

The NJIL&OMD, Agra has a long experience and record of service to the Country by providing well characterized strains through an mycobacterial repository created earlier and has also served several national projects by making its BSL-III lab for animal experiments available to other investigators across the country for testing of various drugs, immunopotentiators and vaccine candidates. Various departments of Govt. of India, including ICMR are in the forefront of developing new generation diagnostics and vaccine candidates against tuberculosis. NJIL&OMD is already serving as national reference lab for tuberculosis and a national reference centre for drug resistance surveillance in leprosy. The Institute is in the process of developing a national facility which will serve as a state of the art mycobacterial repository, a repository of well characterized samples of tuberculosis, leprosy and other mycobacterial diseases. This complex will also have a dedicated facility to serve other projects on new generation vaccines and therapeutics. This facility is likely to become fully functional within next two years and is greatly needed by ICMR and the Country.

Strengthening of Model Rural Health Research Unit

As a part of its various research programmes on leprosy and tuberculosis in the field situation, a Model Rural Health Research Unit has been established by NJILOMD, Agra at Ghatampur, Kanpur and with partnership of the state it has developed into a model of bringing technology to the people. Besides completing 8 extramural studies funded by various agencies, 12 extramural projects are ongoing in addition to providing treatment to more than 5000 leprosy and 1500 TB patients of the area. It has served as a model for bringing technology to the people and in partnership with the state health facilities. The NRHM model for training and utilization of health services is being adapted for providing better services incorporating newer technology to the rural areas.

Strengthening of this MRHRU at Ghatampur & its satellite centres is proposed for undertaking studies on the trends in epidemiology of relevant diseases *viz.*, leprosy, TB, *etc.*; studying the effect of various interventions such as, alternative drug regimens in the area. During the XII

Plan, it is planned to conduct studies on the utilization of the local health facilities and study the impact of social, economic and environmental factors on the epidemiological trends; role of the health system, Non Communicable Diseases, Maternal & Child Health.

AIDS Surveillance centre

It is proposed to further strengthen the AIDS laboratory/Centre to continue studies on sero-surveillance of HIV in different population groups. The centre continues to provide latest information about the trends of HIV sero positivity in different risk groups. In the studies carried out at this centre, common epitopes between HIV and mycobacterial proteins have been identified. The centre will be further strengthened to carry out operational research to generate knowledge from this area to improve the management of HIV/AIDS cases.

Centers for molecular detection of drug resistance and surveillance

It is proposed to strengthen the infrastructure for establishment of long term research programmes, molecular detection of drug resistance; trends in the transmission of leprosy and tuberculosis and effects of various interventions to improve the efficacy and effectiveness for the national programme in both leprosy and tuberculosis at NJILOMD, Agra.

New / Extended Laboratory Block

It is proposed to extend the present laboratory block or add a new laboratory block to create at least six additional laboratories for optimum functioning and also expansion of present programmes as per approved mandate.

Capital work and Equipment

- **Construction of new Mycobacterial Repository and Diagnostics Complex:** This is essential for creation of the national facility for augmenting the translation of tuberculosis research.
- **Construction of security wall, water harvesting and landscaping:** This is important for the development of the campus and its security.
- **Modernization of Inpatient Ward:** The wards have to be modernized keeping in view the current norms in the hospital structure and requirement of good quality patient care which has been the strength of the institution for the last 45 years. Hence it is absolutely essential to improve this infrastructure.
- **Construction of Conference Hall complex (Building and furnishing etc):** The institute is in the forefront of various academic programmes for the Human Resource Development of clinical as well as modern biology disciplines for health/medical research. For this purpose, a conference hall complex is absolutely required.
- **Construction of waiting hall and facilities for patients:** The Institute enjoys very good reputation for high standards of medical care since its inception. Patients come from far and wide areas and a waiting hall and suitable amenities for them are required before they are seen and investigated in the OPD/admitted to the indoor of the hospital.
- **Electrification / Solar lighting along boundary and roads for security:** The institute has a big campus with ravines. The lightening up of the boundary and the roads has been found to be very important in the light of several untoward incidences and thefts.

- **Hostel Complex:** The institute has started the process of construction of a hostel complex for both male and female students who come for Ph.D degree and various trainings. This is expected to be completed in the first year of the XII Plan.
- **Strengthening of the Library Infrastructure:** The library of the institute needs to be upgraded so as to provide adequate space for the books and for the readers and other facilities. This is again proposed to be completed in the first year of the XII Plan.
- **Extended or New laboratory Block:** This laboratory space is absolutely essential for implementation of current and proposed important programmes on translation pertaining to development of diagnostics and other applied aspects.

National Institute for Research in Environmental Health, Bhopal

The ICMR set up its 31st permanent research centre on October 11, 2010 at Bhopal. This National Institute of Research in Environmental Health at Bhopal will serve the survivors of Bhopal Gas Disaster and eventually will become a Centre of Excellence to improve environmental health research and play a leading role in tackling environmental health issues in India and globally.

Bhopal Memorial Hospital and Research Centre

Bhopal Memorial Hospital & Research Centre, if transferred to DHR and ICMR will serve as a clinical wing of the National Institute for Research in Environmental Health (NIREH).

Capital work and Equipment

- Construction of the main institute building at Bhauri, Bhopal. The main building will be consisting of various research laboratories, administrative block, director office, library, canteen, animal house guesthouse and director & staff quarters.
- A separate dedicated laboratory and Animal House is proposed to be constructed for conducting research on various experimental exposures to the chemicals.

National Institute for Research in Reproductive Health, Mumbai

National Center for Pre-clinical Reproductive and Genetic Toxicology

During XI five year plan, National Center for Pre-clinical Reproductive and Genetic Toxicology has been established at the Institute in a project mode with the mandate to undertake research, capacity building and providing services to the public and private agencies. The project has been a joint venture of Department of Science and Technology (DST), Government of India and ICMR, on a cost sharing of 70:30 of the approved budget, respectively. It is also with the understanding that ICMR will continue supporting the project after the completion of initial funding by DST and ICMR. Further, the centre will be strengthened by: establishing modernized rodent facility for genetically modified animals, immune-deficient mice, expansion of existing marmoset colony (*Callithrix jacchus*) and development of transgenic and knockout animal facility at the NIRRH, Mumbai.

During the XI plan, several core facility such as 1. Biomedical Informatics Centre, 2. Proteomics Facility, 3. Confocal Facility and Flow cytometry facility have been established at NIRRH, Mumbai to support the research. During the XIIth five year plan some of these core facilities particularly proteomic and flow cytometry needs to be upgraded with new technology.

The library and information center (LIC) of this institute will digitize its resources which includes thesis collection, institute publications *etc.* Presently the library is subscribing to 60% of electronic journals. In the next five years library and information centre intend to entirely shift to electronic journals and also plan to get e-books for the readers. Following up on the idea of digitization of information, a national informatics database on reproductive health had been initiated in the last five year plan, the work is still ongoing. It involves collection of relevant available information on India in the area of reproductive health, processing it to a common format thus making retrieval of the information easy and timely and finally making it available to information seekers.

Capital work and Equipment

- **National Centre for Primate Breeding and Research (NCPBR)**

The **National Center for Primate Breeding and Research (NCPBR)** is being established to provide non human primates (Rhesus monkeys) for biomedical research. The center aims to breed the rhesus monkeys for the testing of drugs, vaccines, other biological molecules and to understand the basic mechanism of various biological processes. The facility will be utilized by the researchers in India as well as outside India. The Institute acquired 25 acres of land to construct this facility which will provide high quality non-human primates for biomedical research.

This is an ongoing activity of the XI plan and phase II & III activities will be completed during XII plan. Phase-II include I. Non infectious/SPF animal facility wing, II. Infectious facility wing, III. Administration wing, IV. Research wing, V. Auditorium and Phase III include construction of residential staff quarters/guest house.

- **Renovation activities**

- i. Construction of additional floors over animal house wing
- ii. Construction of additional floors over International Guest House
- iii. Renovation of Staff Quarters/Clinics/ Guest House

National Institute for Research in Tuberculosis (NIRT), Chennai

This Institute is on the forefront of research on TB as well as HIV/TB- co infection. In order to implement various proposed research programme, the up-gradation will be required as under:

- Establishment of a Laboratory Animal Facility.
- Establishment of BSL 3 facility for HIV-TB related work.
- Infrastructure facility for bacteriology laboratory.
- Liquid nitrogen facility.
- Establishment of new divisions/sections such as Biomedical Engineering Division, Biomedical Informatics Division and Health Economics.
- Up-gradation of Library and information services, Expansion of LAN and internet facilities and Data management Centre.

Capital work and Equipment

The major capital works planned during the XII plan are:

- Construction of patient care research facility at TRC unit at Government Rajaji Hospital, Madurai.

- Construction of research facility at Tiruvallur.
- Up-gradation of existing facilities such as waste disposal system, expansion of LAN and internet facilities, data management centre and cold room facility.

National Institute of Cholera and Enteric Diseases (NICED), Kolkata

Field unit of NICED, Kolkata at Siliguri (Regional field station at North Bengal)

Ecologically as well as geographically, North-Bengal is quite different and shares several problems with adjoining north-eastern states. It has been felt that setting up of a field unit is very much essential for studying diarrhoeal diseases, HIV/AIDS and other communicable diseases. Hence above initiative is to be made. Siliguri is a transit point of all north eastern states such as Sikkim and neighboring countries like Bhutan and Nepal. Large number of population from neighboring areas transit through Siliguri and lead to rapid spread of diseases amongst themselves and local population. There is no Institute in that area which can address these issues. The scientists of the institute are regularly involved in routine epidemic investigations of diarrhoeal diseases in different parts of the country, in order to provide immediate assistance to the local health authorities to tackle the epidemic of diarrhoeal diseases/HIV/AIDS *etc.* The NICED Scientists have been working on different areas of North Bengal. It is desirable to have field station at Siliguri which will help NICED Scientists to investigate the dynamics of these diseases. This station will be adequately staffed with equipments and facilities necessary for laboratory activities.

Up-gradation of Library Facilities

It is proposed to upgrade the available library facilities of the Institute in XII plan in terms of Infrastructure development and catering to information services.

Capital work and Equipment

- **Establishment of Department of Drinking Water Quality Monitoring**

Drinking water contamination is the major factor for causing epidemics of diarrhoeal diseases, typhoid fever and some of the infective hepatitis. The State health authorities often request this institute to investigate the epidemics and also to monitor the drinking water quality of the affected areas. In this situation, it is required to have a separate department which will solely be engaged for research on drinking water quality maintaining and maintain the liaison with the state health authorities. This will also be useful for the country as well on long term. Environmental and water quality monitoring has already been set up and needs further extension for referral activities.

- *Establishment of Metagenomics centre, Proteomics centre and Structural Biology laboratory.*
- *Furnishing the renovated lab room and guest room of NICED building I.*
- *Installation of fire fighting system, gas generation system and deep tube well of NICED building I and II.*
- *Renovation of clinical wards at B.C. Roy Children Hospital and I.D. Hospital, JICA building, NICED building I and II and auditorium and canteen at NICED building I.*
- *Construction of Staff quarters for core staff.*

National Institute of Epidemiology (NIE), Chennai

Establishment of Clinical trials centre

To conduct/co-ordinate clinical / vaccine trials, especially trials involving traditional medicines and prepare guidelines and set bench-marks for conducting clinical trials of Traditional medicines that will be considered at par with standard clinical trials of allopathic drugs.

Establishment of viral diagnostic laboratory at NIE as one of the reference laboratories

Establish grade II viral diagnostic laboratory at NIE to carry out classical, serological and molecular diagnosis and characterization of viral pathogens isolated from outbreaks.

Establish Infectious Diseases Hospital

It is proposed to establish an Infectious Diseases Hospital at NIE, Chennai in partnership with the Government of Tamil Nadu.

Strengthening and expansion of library and information services

It is proposed to modernize the Institute library with state-of-art library management tools, upgrade the library facilities to meet the requirements of expanding training and research activities, disseminate library information to users by publishing newsletters and emerge as an ISO certified library as a commitment to provide quality services of international standards.

Up-gradation of electronic data processing and data management facilities is considered important.

Capital work and Equipment

- Land acquisition and construction of additional infrastructure for expansion of research and academic activities.

National Institute of Immuno-haematology, Mumbai

This Institute has played significant role in the development of new methods for genetic diagnosis of various blood disorders as well as their infrastructure. The institute is currently in the mode of establishing satellite centres in various parts of the country so that the technology/ being developed could be evaluated and put to use for public health through a well conducted operational and health system research. For this purpose, the following satellite centres have been planned which will be linked with other ICMR activities in that area :

- **Centre at Kolkata:** West Bengal Government is providing the land in the vicinity of NICED, Kolkata for a Transfusion Medicine Research centre under NIIH, Mumbai. A sum of 1.3 acre of land has been offered for the same.
- **Centre at Tripura (Agartala):** North Eastern state of Tripura has lots of challenges in haematological diseases like Hb E thalassemia, nutritional anemia, interaction of various infections and nutritional deficiency haemoglobinopathy. A total of 5 acres of land has already been offered by the Govt to ICMR and this centre will be part of ICMR complex.
- **New Centre of NIIH at Nahur:** NIIH has acquired 1.4 acres land at Nahur near Bhandup and hence, a new building of NIIH will be constructed at Nahur.

- **Satellite centre of NIIH in Chandrapur, Maharashtra:** It is proposed to establish a satellite centre of NIIH in Chandrapur, Maharashtra as haemoglobinopathies and other blood related problems have been reported to be quite prevalent in this area.

Center of Excellence for Primary Immunodeficiency Disorders

It has been planned to develop a research capability for identification and management of PIDs in India. As this aspect is not developed at all in this Country, the centre assumes importance.

Establishment of Digital Library and Bioinformatics station

Complete Bio-informatics workstation for molecular modeling studies for different genes of importance in hematological disorders. Computational biology for population genetic studies will also be undertaken.

Capital work and Equipment

Renovation/Upgradation of the Institute's present campus, Repairs and Maintenance Works: The Institute has a very small space. All the laboratories as well as library and seminar hall were designed as per the requirements 25 years back. There is urgent need to renovate these laboratories so that maximum space in each laboratory can be utilized effectively. Modular furniture needs to be made to accommodate all the administrative staff in the small administrative office.

National Institute of Malaria Research, New Delhi

Establishment of climate change and vector borne disease cell

It is proposed to establish a Climate Change and vector borne disease cell at NIMR, New Delhi to accelerate research in this area. The cell would also impart training to concerned public health institutes/personnel and would strive to serve as WHO Reference Centre in South East Asia. NIMR has been pioneer in studying the impact of climate change on malaria and dengue in the country and has contributed for National Action Plan on Climate Change (2008). Two Generic protocols for studying the impact of climate change on vector borne diseases (retrospective as well as prospectively) have also been contributed by NIMR for WHO SEARO. NIMR has also developed capacity on Climate Information for Public Health from International Research Institute, Columbia University (USA). The efforts on studying the impact of climate change on different types of malaria and other disease vectors and development of Adaptation strategy in view of climate change would be strengthened in the proposed climate change cell. The cell would also impart training to concerned public health institutes/personnel and would strive to serve as WHO Reference Centre in South East Asia.

Upgradation of IDVC field Units

NIMR is having 10 field units in different parts of the country and they are engaged in various entomological, epidemiological and operational studies leading to vector and disease control. Besides, they are also involved in field testing of various products such as insecticides formulations, anti-malarial drug combinations, *etc.*, and also support to state health authorities as and when required. In order to improve their efficiency for implementation research these have to be upgraded in phased manner during XII plan.

IEC and training division

Institute imparts training to District Malaria Officers, biologists, entomologists, Lab Technicians etc. There is no specific scientific staff. Further, it is proposed to initiate M.Sc in Medical Entomology and Parasitology to cater the need of country in vector borne diseases.

Digitization of Indian Journal of Malariology (renamed as Journal of Vector Borne Diseases) (1947-2002)

Indian Journal of Malariology (IJM) is available in digital form w.e.f 2003 only. It is proposed to digitize all the issues of the journal from Volume 1 (1947) to volume 39 (2002). It is also proposed to increase the periodicity of the Journal from Quarterly to Bimonthly during the XII plan.

Capital work and Equipment

- During XI Plan, construction of animal house was begun at NIMR New Delhi which will require additional funds for completion and to be fully functional.
- Construction of additional floor, auditorium, guest house, hostel and Director's bungalow are also proposed.

National Institute of Medical Statistics, New Delhi**Strengthen the National Clinical Trial Registry**

Continuation of National clinical Trial Registry at NIMS, New Delhi and its strengthening is proposed during XII plan.

Capital work and Equipment

- **New Building Complex:** The mandate of the Institution has been expanded and one exclusive laboratory for training has been added. The existing building of the institute is very small. Therefore, a new building will be constructed at NOIDA with the additional following wings of the institute :
 - National Clinical Trials Registry
 - Development of Human Resource Centre
 - Development of Data Hub
 - Training Hostel

National Institute of Nutrition (NIN), Hyderabad**Nutrition Extension, Education & Communication at NIN, Hyderabad**

Nutrition communication through space technology enabled village resource centres (VRCs) – A study in Andhra Pradesh, Evaluation of nutrition reports based on research studies in popular Indian newspapers and organization of a workshop for Journalists on reporting scientific findings in newspapers, Effect of communication intervention on reading of food labels among urban adolescents. *Oorja* (Nutrition) Club initiative in about 300 Schools in the state of Andhra Pradesh.

Computer Centre & Bio-Informatics at NIN, Hyderabad : This facility needs to be upgraded so as to implement various network programmes by proper recording and analysis of data. Further, this will also strengthen various research programmes in which molecular and other data is being used.

Capital work and Equipment

- Modernization and renovation of the existing infrastructure and facilities at National Centre for Laboratory Animal Sciences: This facility is to be upgraded in view of the increasing/already increased work on toxicology and other nutrition related research which is often mandated by different national agencies.
- Establishment of a Centre of Excellence for Micronutrient Research is required to augment the research on micronutrient which are considered very important in health & diseases.
- Establishment of a “Centre for studies on nutrient-gene interactions is required in the context of importance being attached to research on the effect of nutrition in the intrauterine life and afterwards on various conditions like obesity, chronic diseases *etc.*
- Establishment of National Food and Nutrient Data Centre is required to develop guidelines and ready to use information by common people on various foods, additives *etc.*
- Establishment of Sports Nutrition Cell is required in view of the national goal of improving the standards of our sports.
- Establishment of Centre of excellence in computing and internet and bio-informatics is required for strengthening the capabilities to analyze various basic and applied data in a better fashion.

National Institute of Occupational Health (NIOH), Ahmedabad

This institute plays a very important role in terms of various occupational disorders due to working in different kind of industries. Quite often Ministry of Labour, State Departments of Labour as well as courts mandate the Centre to investigate new health problems possibly associated with occupational and environmental exposures. For this purpose, the strengthening of its main institute at Ahmedabad, regional centres at Kolkata and Bangalore as well as opening of other regional centres/laboratories has become absolutely essential.

Regional centres/laboratories of NIOH in other regions of the country

Proposal is to explore possibilities of establishing regional centres/laboratories of NIOH in other regions of the country. ROHC (S) and ROHC (E) had been able to complete landmark studies of their respective regions namely pneumoconiosis in coal miners, epidemiological studies of arsenic exposed population, occupational hazards in coir and tea plantations, *etc.* These centres require large-scale reinforcement of human resources.

Capital work and Equipment

- Training cum convention facility at NIOH, Ahmedabad: This is required in view of the

objective of the institute to train large number of professionals on the application value of the new and conventional knowledge about occupational health.

- New laboratory expansion at NIOH: Expansion of the laboratories at NIOH is progressing so as to fulfill its research agenda and is likely to be completed in the beginning of XII Plan.
- Laboratory extension (vertical) of ROHC (E), Kolkata: This is being undertaken to provide adequate laboratory space for the research programmes of the institute.
- Research & Training centre at ROHC (S), Bangalore is to be upgraded to carry out its research and training activities at an optimal level as this centre fulfills a major need of carrying out research on occupational diseases of public health importance in South India.

National Institute of Pathology, New Delhi

Establishment of Tumour Tissue Repository

Biological resources are the essential raw materials for the advancement of Biotechnology, Human health, Research and Development in Life Sciences and ensuring the proper maintenance and supply of biological resources for future advancement of Biotechnology and its contribution to human health is essential. Hence preservation of biological specimens for ongoing and future research, collection of tissue from rare diseases and the provision thereof to the Researchers is the need today. Tumour tissue is a scarce source of research material. The tumour tissues removed at surgery are discarded after diagnosis and are wasted due to lack of infrastructure support. It is evident that a bank of well-characterized tissues, *i.e.* a tissue bank will help researchers in their research protocols

Capital work and Equipment

- A cGMP facility would be required for the purpose of manufacturing clinical grade cultured epidermal autograft. Since, cell culture based therapeutic technologies are relatively new and the regulatory requirements towards such cell therapies vary from country to country, there is a need to create a cGMP and cGTP (current Good Tissue Practices) compliant clean room facility for producing clinical-grade graft material to undertake phased clinical application with CEA in burns patients.
- **Establishment of Proteomics and Cytogenetic laboratories :** These facilities are essential to understand the mechanisms of various cancers, find reliable bio-markers and develop improved methods for their diagnosis.

National Institute of Virology, Pune

Capital work and Equipment

- **Proteome Analysis Platform**

The frontiers of modern infectious disease research have moved beyond simple molecular biology tools. Understanding host-pathogen interactions involve more detailed studies at the transcriptome level and can be only achieved through the tools of high resolution

proteomics. Currently this is a need-of-hour requirement at NIV and development of this facility will provide newer dimensions in the study of virology.

- **Computational Biology Laboratory**

The Institute currently has a functional bioinformatics group carrying out research in the areas of sequence and structural bioinformatics. It is proposed to further extend the activities in areas of advanced computational biology, specially molecular dynamics, simulation studies, drug and vaccine design and also provide a platform for high throughput whole genome sequence analysis and systems biology in collaboration with experimental groups of the institute.

- **Integrated Microscopy and macromolecular imaging resource**

The major objective of the integrated microscopy and macromolecular imaging centre is to integrate advanced electron, live cell, cryo TEM, atomic force, scanning probe and high resolution live cell imaging systems as a core facility for research in areas of structural virology, pathogenesis and drug development.

- **Antiviral Testing Program**

Antiviral are being recognized as a major intervention strategy for most viral diseases. The development would involve identification of novel targets, molecular modeling, drug designing and screening of candidate drugs for inhibitory activity. This would involve development of infrastructure for virus cultivation, understanding of replication strategies, bioinformatics and cell-free, cell-based and *in vivo* systems for assessing virus inhibitory activity.

- **Clinical Trial Program**

So far, there was no platform for vaccine trials at NIV. This will be developed and trials for candidate hepatitis vaccines developed at NIV will be conducted.

- **Construction of Modern Animal Facility for breeding experimental and rehabilitation centre**

This facility is important to improve the capability to handle larger essential number of different type of animals for use by NIV and scientists outside NIV.

- **Construction of Lab building for NIV Gorakhpur Unit**

ICMR has already strengthen this unit to make it independent to diagnose JE , other virus as well as other infectious agents in the eastern part of U.P. and adjoining areas. The ICMR proposes to further expand the facilities so that this centre serves as a Centre for Excellence to investigate various infections in this region. The following upgradation will be essential for this purpose:

- BSL –III
- Lab For Influenza respiratory viruses and Measles
- Staff Quarters Type III -8, Type IV-4

- **Strengthening of the infrastructure of NIV Field station at Alappuzha**

During the XI Plan, ICMR has invested in the development of this unit so as to make

it a category 1 laboratory to deal with various infectious diseases. During XII Plan, the infrastructure will be fully developed to serve this purpose.

Regional Medical Research Centre, Belgaum

This Institute of ICMR is unique of being dedicated for focusing on research on medicinal plants so that alternate modes of therapy could be developed for the chronic diseases, cancer and drug resistant infections. The institute does not have any building and has started its programmes in the staff quarters which were constructed years back. The Institute after careful deliberations has taken up various research programmes and has embarked upon the development of following essential facilities :

- Establishment of Herbal Garden & Museum for Medicinal Plants of Western Ghats for creating awareness among visitors, serving as gene pool repository and a centre of traditional medicine system in the region by RMRC Belgaum.
- Establishment of Molecular Biology/Microbiology Laboratory for testing of Herbals against highly resistant bacteria at RMRC Belgaum
- Establishment of animal cell culture facility at RMRC Belgaum
- Establishment of Division of Pharmacoepidemiology at RMRC Belgaum

For this purpose, the essential capital work and equipment required for the same is described below

Capital work and Equipment

Construction of Main Building for RMRC, Belgaum

Construction of the main building of RMRC that was scheduled to be taken up in the XI Plan period could not be achieved. The main building is expected to be completed during the XII Plan period. The proposed work has been planned in two phases.

- Phase I consists of construction of the main laboratories, museum and offices
- Phase II consists of construction of the Animal House Facility, both of which are planned to be completed by the end of the XIIth plan period.

Regional Medical Research Centre, Bhubaneswar

Modernization of Laboratory

The existing laboratories of different divisions were set up some 25 years back. Presently, the research activities of the centre has been expanded and more expansion is expected in future. Where some laboratories have been modernized, many laboratories still need upgradation to meet the current technology activity. Hence, modernization of existing laboratories is planed to cater the present and future research activities.

BSL-3 Laboratory

The Centre has recently established a BSL-2 Laboratory, first time in Orissa state for diagnosis of H1N1 influenza virus. However, for laboratory investigation of virulent organism like Anthrax, Avian flue virus and other emerging bacteria and viruses, which are apprehended

in coming days, a higher grade lab. with biosafety is essential. Hence, BSL-3 Laboratory is essentially required which is not available in this region and dependant on national institutes which are over burden. This was proposed in XI plan document of ICMR. Since there is no adequate space for BSL-3 in present laboratory and land space is available, it is proposed to be undertaken in XII plan. The work is recommended by Technical Building Maintenance Committee of this Centre.

Establishment of New Laboratory at IDSP building, Rayagada district

New field unit has been established at Rayagada district, Orissa after signing of MOU by State Government and ICMR. The unit of ICMR will address on (i) Improving the health parameters of the region in collaboration with state (ii) Capacity building in form of imparting training and workshop (iii) Technology transfer to state. The communicable diseases will be addressed to develop cholera control strategy, surveillance and monitoring network for diarrhoeal disorder, mapping of MDR TB in the district and distribution and pattern of sexually transmitted diseases in the tribal population.

Similar facilities will be provided at Kalahandi and other locations wherever partnerships will be established.

Disaster Management Cell /Epidemic Cell

These cells are required to provide research capability to manage disasters in the region.

E-Library (Knowledge Resource Centre) at RMRC, Bhubaneswar: In XII plan period the E-library is planned to be expanded to Knowledge Resource Centre by procuring 10 more computers and Servers, one digital scanner and LAN printer. In addition to that 2 more library trainee will be recruited for the purpose. Institutional Publication Repository and Data bases on various diseases will be created for need of the researchers as Information Services. Besides fulfilling need of the centre, it will provide information support to the local medical colleges and scientific institutions.

Capital work and Equipment

- Construction of two-storied building for OPD service and indoor beds, Lift facility at Lab-cum-Admn. Building, Construction of car shed in campus for parking, Lecture/ Training Hall, Construction of two more floors on the existing three storied Laboratory-cum-Admn. Building, Construction of Administrative Block, Construction of one block of Type-IV quarters (6 nos.), Laying of water connection pipes from deep tube well to water sump of Lab-cum-Admn. Building, Modernization of Laboratory.
- Renovation of Institute Lab-cum-Admn. Building, Auditorium, Guest House, hostel and Animal house and land scaping.
- Renovation of residential quarters and land scaping, BSL-3 Laboratory Face lifting of Lab. cum-Admn. Building.

Regional Medical Research Centre (RMRC), Dibrugarh

Establishment of peripheral units of RMRC, Dibrugarh at Guwahati (Assam) and Agartala (Tripura)

Due to operational problems of distance, remoteness, poor surface communication associated with north-eastern region of India it is problematic to carry out effective research from

Dibrugarh. Therefore, it was felt that establishment of peripheral units of RMRC, NE, one each at Guwahati, Assam and Agartala, Tripura will facilitate better administrative and technical coordination between state health authorities and ICMR besides providing quick diagnostic facilities and easing operational constraints in executing research activities. Accordingly, MOUs between ICMR and Govt. of Assam and Govt of Tripura are in final stages of signing wherein it is envisaged that land will be provided by the two governments for establishing the units.

Establishment of Public Health Research/Operational Research units for all 8 north-eastern states by RMRC, Dibrugarh

Dibrugarh is the Head quarter of RMRC, North East that looks after 8 states. Due to the geographical peculiarities and land scape of the region the distances among various constituent states of NE region are too large and creates operational problem to carry out research activities effectively from Dibrugarh in various north-eastern states. In view of this it has been decided to establish Public Health Research/operational research units involving and located in State Medical Colleges / Institutions for all 8 north-eastern states for better research output.

Other activities proposed for infrastructure strengthening are:

To start a Medicinal Chemistry section

Strengthening of Tuberculosis and Virology laboratories at RMRC, Dibrugarh

Capital work and Equipment

- **Infrastructure strengthening in medical Colleges and State health facilities (where no medical college exists) of NE**

Three of the 8 north-eastern states viz. Mizoram, Nagaland, Arunachal Pradesh do not have any medical college. Because of this constraint advance medical treatment and research facilities are by and large lacking in these states which further strains the already strained existing state health services. Further, the facilities in existing medical colleges of the region need strengthening Therefore, ICMR has decided to strengthen the infrastructural facilities in the medical colleges of NE region and strengthen state health facilities of NE states lacking medical colleges by establishing multidisciplinary research units.

- **Construction of residential quarters at RMRC, NE for the new recruits to be appointed for new projects**

Activities of RMRC, Dibrugarh are spread over 8 north-eastern states. Staff members while deputed for field activity do not want to leave their family members in the town/ outside the campus due to the prevailing situation in NE region and always look for accommodation within the campus. Staff members of RMRC, Dibrugarh face many problems accommodating themselves in rented house. Work suffers when staff members while on tour/field duty feel insecure for the safety of their family members. Therefore, the staff quarters more than the normal allowable limit are essential for this centre in view of prevailing law and order situation. In view of this, 4 nos. of Type V quarters and 8 nos. of Type IV residential quarters are proposed to be built in phases during the XII plan.

- **Improvement of existing drainage system of RMRC, NE Campus**

RMRC, Dibrugarh is situated in low land as a result the drainage system is faulty and water does not get drained out easily during rainy season. Due to the faulty drainage system the centre witnesses flood almost every year. The residential quarters and laboratory areas get inundated every year during monsoon. In the year 2004 and 2008 the Campus was under 2-3 feet water for several days causing severe difficulties and loss to the Govt. property. Therefore, the existing drainage system need to be improved immediately.

- **Provision of corridor between different blocks of RMRC, NE**

There is no link between the existing Administrative Block and the Laboratory Block in RMRC, Dibrugarh and one has to commute under the sky for going from one building to another. The movement between these buildings becomes very problematic especially during rainy season and in Assam it rains during most part of the year. Therefore, it is essential to have a proper covered corridor to link these two buildings.

Regional Medical Research Centre, Port Blair

Strengthening of the field stations for tribes in Nicobar district

Field stations established at Car Nicobar and Kamorta in Nicobar district need to be strengthened

Strengthening of field stations in Nicobar District would enable to undertake studies on health problems of marginalized communities where infectious diseases such as falciparum malaria, diurnally subperiodic filariasis (unique form prevalent only in the Nancowry group of islands), high prevalence rate of hepatitis b & hypertension and child hood obesity and tuberculosis are significant public health problems.

Establishment of Drug Sensitivity Testing (DST) laboratory for tuberculosis

Recently the Centre has established facilities for culture of *M. tuberculosis* as such facilities are not available in Andaman and Nicobar Islands. However, as suggested by the expert team that inspected the set up, it is necessary to establish a separate wing with clean room and other safety installations to develop this into a full-fledged DST laboratory, so that routine culture and drug sensitivity testing of *M. tuberculosis* isolates could be undertaken to support the Revised National Tuberculosis Control Programme.

Establishment of an Animal House

Many of the studies envisaged in XII Five Year Plan such as pathogenesis studies, DNA vaccine development *etc.* require the use of laboratory animals. The Centre doesn't have a proper animal house for rearing laboratory animals. Therefore, setting up a state-of-the-art animal house is a priority capital work.

Establishment of Medicinal Plant Garden

Compilation of knowledge of tribal and non-tribal communities about the use of plants and other natural products for healing practices is a project envisaged by the Centre for the XII Five

Year Plan. Many of the plants with medicinal properties may be facing threat of extinction and therefore there is a need to make efforts to conserve these. Establishment of a medicinal plant garden will ensure that these plants are conserved.

Capital work and Equipment

- **Construction of hostel for students and Ph. D Scholars**

The number of Ph.D scholars undergoing doctoral programme in the Centre has increased substantially and a large majority of them are from various places in mainland. Besides, students undergoing graduate and post-graduate programmes also come to the Centre for short-term trainings. Finding accommodation for them is a difficult task. Construction of a hostel for the students and scholars will solve the accommodation problem faced by them and will encourage students to opt to undergo training in the Centre.

- **Rainwater harvesting, storage and purification system:** The Institute proposes to establish a rain water harvesting system for ecological purposes as well as its use.
- **Extension of existing building for laboratories:** Extension of the building space for the laboratories is required for improving the working space and facilities in different laboratories keeping in view the proposed programmes of the XII Plan.

Regional Medical Research Centre for Tribals, Jabalpur

The Institute proposes to expand its infrastructure to conduct studies on various infectious diseases, drug resistance, cancer and parasitic diseases, specially malaria. For this purpose, a BSL-3 laboratory and additional laboratory space will be required. This improved structure will help the clinical and translational research at the Centre.

Capital work and Equipment

- **Laboratory for Research on Cancer**

A Cancer Biology laboratory at RMRCT Jabalpur is expected to aid in pursuing investigations and approaches for inhibiting incidence of Cancer either directly by identifying novel/natural drugs or indirectly by developing intervention studies primarily with the following objectives.

- Identifying the causal factors of pre-cancerous/cancerous lesions in Tribals.
- Development of Intervention studies to reduce the incidence of Cancer.
- Identify and develop novel/natural drugs with anti-cancer activity.

- **Parasite biology Laboratory (Malaria)**

The parasite biology laboratory will be responsible to carry out researches in understanding the host-parasite interactions and their regulation in parasitic diseases particularly malaria as well as to conduct studies on various related issues that would lead to development of newer drugs, eliminate shortfalls in existing drugs and devise new strategies for better management to reduce disease burden in the community.

National Reference Laboratory/ centre of Drug Resistance: This centre is essential to galvanize research on drug resistance by providing coordination, networking, quality

assurance, reference strains and forum for coordination for action at public health level.

- **Other activities**

Construction of Staff Canteen, Animal House, Room for Bank at Main Gate, Laying of water Pipe Line in the Campus/Gardens, Renovation/reconstruction of Kitchen Platform of Residential Quarters, Water Proofing treatment of Residential Quarter, Purchase of New Submersible Pumps, Centralized air-conditioning of the laboratory building, Landscaping and development of unused land, Pest control unit and Repository *etc.*

Rajendra Memorial Research Institute of Medical Sciences, Patna

The Institute is in the different stages of improving its infrastructure. Construction of a new tropical disease hospital and other facilities is nearing completion. These facilities will need expenditure with a view to augment clinical and therapeutic research, Establishment of repository of *Leishmania* parasites and sera bank, establishment of structural Biology, Cell Biology, and a Diagnostic Centre lab & Establishment of QA/QC unit. For this purpose, expenditure will be required on various items listed below:

Capital work and Equipment

- Building of a new Tropical Diseases Research Centre, an extension of existing 50-bedded hospital, under construction
- Construction of Hostel for nursing staffs is under construction
- Construction of B and D type quarters
- Construction of Training centre
- Modernization of existing animal House
- Renovation/modernization of indoor patient -ward
- Furniture and fixture for newly proposed setup like Structural Biology, Cell Biology labs *etc.*
- Renovation of existing quarters
- Renovation of Block A, B, C and D
- Library modernization
- Renovation of Drainage System

Vector Control Research Centre, Puducherry

This institute of ICMR is a national and internationally recognized research centre contributing to various aspects of vector management. Several leads from this centre are already being converted into products for vector control. As the laboratory space is inadequate, the Institute has planned the upgradation and renovation of existing laboratory and also construction of a new lab building. This expansion/upgradation will also improve the research and training for the masters and Ph.D programme.

Capital work and Equipment

- Up-gradation and renovation of the existing laboratories
- Purchase of new land and construction of new building for modern labs

CREATION OF NEW INSTITUTES/CENTRES

Budgetary Requirement: ₹ 1450 crore

In the area of infrastructure development various initiatives were undertaken and new programs, laboratories, centres were established/upgraded and many schemes were launched. ICMR also established in the XI plan new Institutes/Centres of advanced research. Because of the non-availability of funds, administrative difficulties, logistics of locating a suitable place and signing of MOU, actual work of the some of the proposed institutes during XI plan will be started during XII plan. Following Institutes/Centres are proposed to be established in the XII plan.

Creation of New Institutes/Centres in Intramural mode

New Building of ICMR HQs

There is acute shortage of space in ICMR Hqrs. for the scientific and other support staff. The carpet area required for existing sanctioned staff and other essential facilities is 60,250 sq. ft. whereas the total available space is 26,690 sq. ft. thus additional space of 33,560 sq. ft. is required. Ministry of Health & Family Welfare, DHR accorded SFC approval at the estimated cost of ₹ 50.93 crore (excluding furniture & fixture). An amount of ₹ 15 crores is proposed to be spent during XI plan period and balance of ₹ 35.93 crore shall be required during XII plan in 2 equal installments. In addition to above furniture and fixture for new building and renovation of main building, annexe building, guest house block, general renovation and other related repair work will also be undertaken.

Setting up of New Regional Medical Research Centres

Regional Medical Research Centres (RMRCs) have been established by the ICMR primarily to address the local/regional health and research problems in remote and other areas that are underserved by the Institutional network of the Council. The six RMRCs are located at Belgaum, Bhubaneswar, Dibrugarh, Jabalpur, Jodhpur and Port Blair in the States of Karnataka, Odisha, Assam, Madhya Pradesh, Rajasthan and Andaman and Nicobar Islands respectively. Over the last several years, the RMRCs have been very successful in their mandate primarily because they have been closely working with the local/State administration with a clearly focused mutually agreed health agenda. As in addition to addressing local needs, the RMRCs have also been carrying out high quality research on the disease prevalence, carry out outbreak investigations and undertake interventions as needed and network with the local institutes to improve the local/regional research capacity building that would help the State administration in the long run. In the light of these successful collaboration with the State governments, there has been a demand for setting up of new ICMR centres from other States also. It is therefore proposed to set up Regional Medical Research Centres in the following states where there is

no institute/centre of the ICMR or the State still is underserved due to various reasons. The following States are being considered: Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Punjab, Haryana, Jharkhand, Chhattisgarh, Kerala, Karnataka, Rajasthan, Madhya Pradesh and all the six north-eastern states *viz.*, Meghalaya, Manipur, Tripura, Nagaland, Mizoram and Assam. To address the critical issue of limited or inadequate infrastructure and qualified and trained staff at the new sites with, these Centres will be established up in a phased manner. In the first phase, the RMRC would be set up in a local Medical College or a suitable institute in consultation with the State government. In the second phase, depending upon the progress, these centres will be upgraded into a full fledged RMRCs. In States, where there is already a functional centre of the Council like Gorakhpur (Uttar Pradesh) and Alappuzha (Kerala) these Centres are proposed to be upgraded into full fledged RMRCs.

Establishment of Science Centre Complex of ICMR

It is proposed to set up a Science Centre of ICMR Hqrs. at ICPO, NOIDA Campus. This centre will be of futuristic nature to have space to cater to the needs for the coming 25 years. To begin with about 40 Scientists will be shifted to this center, where they will carry out immediate policy relevant extramural health research in all priority areas of biomedical research. In addition to the scientists from different divisions/units of the ICMR Hqrs., visiting scientists / guest researchers from ICMR Institutes and Centres and other organizations and consultants will also be provided required facilities for carrying out their research in their assigned areas. The centre will have the supporting staff for all the proposed activities. Such staff will be technical, scientific project staff, related administrative, finance and maintenance staff to provide necessary back up support. In order to plan and carry out programmatic relevant research with immediate policy and public health implications, the following five institutes/centres are proposed in this Science Centre Complex:

1. **Centre for Social and Behavioural Research:** The optimal utilization of existing health services and technologies by the community remains a major challenge for the policy and programme managers alike. Further, acceptance of newer technologies and developing preventive behaviour of the people poses added difficulties for programme success. To understand health seeking behaviours and devise behavioural change strategies so as to improve utilization of services and acceptance of new interventions, the proposed centre will carry out targeted research on social and behavioural issues.
2. **Centre for Health Systems Research:** The way services are organized, the strategies to deliver different services targeting vulnerable sections of the society, communities involvement and beliefs about the health system and the response of the providers of services have a big role in the delivery and utilization of services and technologies/interventions. The proposed center will focus on all these important areas related to health systems research.
3. **National Institute of Health Economics and Policy Research (NIHPER):** The Institute will do cutting edge research in the areas of micro and macro health economics for making the delivery of various medical and health services in a more economical way. It will also be able to suggest ways for reducing out of pocket expenditure and thus making the health system affordable to common people of India. It will also be able to develop manpower in the areas of health economics, health financing and health policy research. This Institute will work on to identify relevant areas in Health Economics,

Health and Medical Care Financing, Health Policy Research, Health Care Management, Operations Research for improving Public Health and also development of human resources and physical infrastructure for medical & health care in more economical ways. This Apex core centre will also be interlinked with Centre for Policy Research in Non Communicable Disease (CRPN), to cater to special needs of NCD's as well as to undertake coordinated, multicentric, interdisciplinary activities for boosting research and providing vital information for policy formulation and implementation. The Institute will also be linked with regional issue specific Advance centres in ICMR as well as non-ICMR centres which will be funded extramurally depending upon needs.

4. **Centre for Promotion of Nutrition Research and Training:** Proposal for converting ICMR "Centre for Promotion of Nutrition Research and Training with special focus on North-East, Tribal & Inaccessible Population" currently located at Tuberculosis Association of India Building, New Delhi as an Intramural permanent centre during the XII Five Year Plan at Science Centre, ICPO (ICMR), Noida.
5. **National Registry for ART Clinics in India:** As per the draft ART (Regulation) Bill the Council has to establish a "National Registry for ART Clinics in India" to accredited and supervise the ART services in the Country. The Council has initiated a project to establish National Registry for ART Clinics in India through which details of all the ART clinics including nature of services provided by them, outcome of the services and other relevant information will be obtained from all the IVF clinics in the Country. Since this is a continuous activity and the data generated from this registry will be utilized for making policies in this area, it is therefore proposed to transform this registry in to a full-fledged activity of the Council during the XII plan.

Directorate of Recruitment and Assessment

As recommended by Performance Appraisal Board, ICMR is in the process of streamlining the induction and promotion of staff in a schedule manner. To streamline the process of induction of manpower and holding of the promotion boards it is necessary to establish a separate independent Directorate of Recruitment and Assessment to be chaired by an outsider eminent scientist. The Directorate will be equipped with adequate man power to look after day to day activities.

Deemed University

There is a acute shortage of manpower in the medical/health areas like epidemiology, bioethics, socio-behavioural, bioinformatics, stem cell, genomics, proteomics, bio-safety *etc.* ICMR Institutes are well equipped to guide research work and offering postgraduate courses in some of the above discipline. In order to manage the shortage in critical areas, it is proposed to make ICMR a deemed University for offering postgraduate course/Ph. D degree in specific discipline to fill the gap. The University will have the appropriate manpower needed for its smooth functioning.

Institute for Research in Ageing

It is proposed to set-up an Institute for Research on Ageing (IRA) at Hyderabad in the XII plan. In the coming decades elderly population will constitute the substantial proposition of our population. In view of the higher life expectancy the problems of the elderly are very peculiar and require special efforts. The multi specialties centre will address the problem in

comprehensive manner by doing epidemiological research, management of the sick elderly, neurobiology and social and behavioral issues relating to the elderly. The institute will also address the re-habiting component of the elderly including the physical, mental and social rehabilitative issues. The IRA would be a multidisciplinary and multi-specialty centre with the capacity to undertake research and provide services to the older persons.

ICMR's Schools of Public Health

There is an urgent need to generate a reliable data on different aspect of public health in the country. It is also necessary to create skilled and trained man power to interpret the data in a manner which can be used for making plans and policies for improving the health of the community in given set of facilities in the country. The schools of public health will offer specialized training facilities in collaboration and partnership with other established medical colleges and institutes as well as will collaborate with international public health schools to accomplish the above goals. It is proposed to start such a School at Kolkata during XII plan.

Centre for Research on Pesticides and Food Safety

An expert committee suggested that ICMR should have a cell on the risk assessment of pesticides on the human health as well as to conduct research on various issues related to food safety to conduct epidemiological studies and risk assessment analysis. Food safety is very important to India. The technological necessities of using pesticides, fertilizers and use of adulterants such as food colours, preservatives *etc* by traders for aesthetic purposes and better shelf life make food vulnerable for contaminants and adulterants. With setting up of FSSAI and existing powerful media many issues related to food safety is getting momentum. Some of these issues are ripening agents such as calcium carbide, ethephon, use of oxytocin for increasing yield of buffalo/cow milk *etc*. Limited information is available on various issues of food safety and a lot of researchable issues are emerging out. The proposed centre will review the existing knowledge in various areas of food safety, particularly newer challenges like acrylamide, trans fatty acids and newer generation of pesticides and will identify researchable issues and would conduct/co-ordinate studies on epidemiological and risk analysis. The centre will also be responsible for risk analysis, risk management and risk communication. Capacity building and manpower development by imparting training to State food laboratories personnel, researchers and traders would be other useful activities of the centre. The centre may be located at National Institute of Nutrition, Hyderabad in partnership with NIOH/RIOH in ICMR set up/ IITC, Lucknow or any other appropriate centre outside ICMR system.

National Animal Resource Facility (NARF) for Biomedical Research at Genome Valley Hyderabad, Andhra Pradesh

This is an XI plan activity but could not be initiated during the XI plan. After obtaining clearance from the Planning Commission the MOHFW then asked ICMR to develop detail EFC. The detailed EFC was prepared and submitted to the MOHFW, GOI which was examined by Integrated Finance Division (IFD) of the Ministry. The Council revised the EFC based on the comments of IFD. Again based on the comments of the Planning Commission and other concerned Ministries the EFC has been revised and submitted to MOHFW, GOI for further necessary action in this matter. However, to prevent encroachment of the land a boundary wall

around the land has been constructed at the site of NARF-BR at Genome Valley Hyderabad. After obtaining approval from all the concerned Ministries and of the Cabinet the activities to establish the NARF would be initiated. EFC paper is under consideration. While the activity is proposed to be initiated in XI plan, actual work will be undertaken in the XII plan.

Centralized Culture Collection Centre of ICMR

ICMR proposes to develop a centralized culture collection centre with a facility for storage of reference strains that can be maintained and provided on demand to any researcher in the country/outside the country for developing vaccines, diagnostics *etc.* The proposed structure would be:

- Centralized culture collection which will require a 2-3 layer staff structure with varied expertise.
- People trained to work with viruses, bacteria, parasites and Molecular Biologists will have to be recruited for the facility.
- Feeding centers for this facility will be ICMR as well as non-ICMR institutes. Exotic strains should be maintained by respective institutes, whereas non-exotic strains representative of the common nation-wide genotypes should be stored in the central facility.
- Stored strains should be classifiable in terms of geographic distribution, patient type, drug resistance profile, serotypes and genotypes.

Translation Research Centres

In its long and distinguished history, the ICMR has significantly contributed towards promoting better health for the Indian public through the development, evaluation and delivery of various public health technologies. The Council has also played a key role in assisting the Government of India during disease epidemics, like bird flu *etc.*, wherever they occur, through laboratory support by providing diagnostics. Focused R&D for the generation of new drugs, diagnostics, vaccines, devices and other tools of public health significance did not receive adequate attention until recently. The post-TRIPS era and the new product-patent regime have thrown up new challenges for the country especially in the health sector as the affordability of health products is under serious threat. There is a serious need to give strong impetus, and urgency for the creation of indigenous products and processes. To that end there is now a paradigm shift in the ICMR and the Department of Health Research through the initiation of a strong and vibrant Translational Research Programme. Several leads have been identified and some efforts are on towards conversion of these leads into products and processes for public good. There is a need for increased synergy between focused laboratory research targeted to product development through strong and vibrant partnerships with the Indian industry to quickly bring products for public health use. All the systems and procedures for the identification, protection, preservation and exploitation of the IP generated with Council's support, have long been in place. Besides the Intellectual Property Rights Unit at the ICMR Headquarters that provides a single-window support for ICMR sponsored research from concept to commercialization, Translational Research Units have been established in all ICMR institutes/centres to take these leads to a stage of converting them to products/processes and other tools for public health benefit. Commercialization of patents and other intellectual property into products is a complex process and has to traverse several stages of preclinical toxicity, testing in human being through

various phases of clinical trials. Less than one percent patents are commercialized into products world-wide. It is therefore necessary to have a strong translation research facility in the ICMR/DHR structure which will be augmented and further expanded.

Centralized Biobank Facilities

It is well recognized that the risks of developing different diseases are due to the complex interplay of different factors: lifestyle and environment; individual's susceptibility (genes); and the play of chance. Also a vast understanding of the level of heterogeneity within the Human Genome and the distribution of this genetic diversity across major populations is now available through The SNP Consortium and Hap Map project. But, despite this available knowledge, there is no clarity on the combined effects of different factors on the risks of different diseases in different circumstances. This can be realized by investigating how these genetic variations, environmental and lifestyle factors interact to develop chronic conditions such as heart disease, diabetes, cancer, neurological disorders, *etc.* both at individual and population level and then translating the knowledge gained into novel early markers of disease with far reaching public health implications as well as in novel biomolecules for treatment and prognosis of these diseases. This aim can be realized through undertaking large biological sample based prospective epidemiological study with a detailed follow up of cause specific morbidity and mortality. However, the establishment of a biological sample repository with predefined purposes as mentioned above is often accompanied by many challenges including: collection, processing and storage of precious biological material so as to maximize the amount of information from limited number of biospecimens; allowing the use of data and biological samples for future research by the research community at large at minimal costs; storing these samples in a manner so as to allow their usage by current as well as emerging technologies, and protecting the interests of specimen donors. As many factors affect the quality of samples and stability of various analytes/biomarkers in these samples, therefore running a pilot study is an important step to assess the best collection strategies that may affect the quality of biomarkers to be tested in these samples. These pilot studies are now considered to be an integral part of large Biobank facilities being established worldwide and are a must before actual sample collection is carried out. A prior standardization of such kind reduces the inappropriateness of the sample for the particular analysis less likely. ICMR has initiated a pilot study under ICMR INSERM collaboration. The protocol and standard Operating procedures for this study have been designed and are being used to collect, transport and store a range of biological samples from three different sites in the country (New Delhi, Chandigarh and Bangalore). The Biobank facility for this pilot study is available at ICPO, NOIDA. The results of this pilot project will be utilized for creation of a Biobank facility at ICPO, NOIDA.

National Institute for Molecular and Transplant Immunology (NIMTI)*

The proposed institute will have five main functional components, each having structured areas of research and laboratory related activities. These components will deal with the tissue typing and histocompatibility, transplant immunobiology, Clinical immunogenetics, Stem cell research and Unrelated Donor Marrow Registries. The institute will also develop modules of teaching and training as an integral part of capacity building and world class high throughput laboratory services in relation to optimum donor selection and post transplant monitoring. In the Phase I of development, the above components will be established by

recruiting minimal scientific, administrative and technical staff in hired premises. A physical facility with combined diagnostic and research laboratories will be established as a part of the phase II of development. The institute may be located at New Delhi.

Centre for Research on Maternal and Child Health

Maternal & Child health problems continue to be quite challenging for our country. It is important that these problems are addressed from the point of view of environmental, nutritional, genetic and clinical as well as operational angles. It is proposed to establish a Maternal and Child Health Centre in collaboration with DBT for carrying out comprehensive research on related health issues.

Centre for Research on Drug Resistance

India has a significant problem of infections due to drug resistant organisms. These infections belong to two broad categories, first are the infections due to inadequate hospital infection control procedures. The second is due to rampant and many times irrational use of antibiotics leading to selection of mutants due to drug pressures. As both the situations are manageable, a consertive and well focused research programme will provide the assessment of the factors involved in both type of the drug resistant mechanisms operating in the community. ICMR has created a special group to create networks to carry out research on these aspects. These networks will interface with the application of the national policy prepared by DGHS and suggest measures to them for implementation. The expert committees have felt that a reference laboratory to provide technical support and platform for dynamic review will be required. ICMR proposed to set up such a reference centre in the XII Plan at RMRCT Jabalpur.

National Centre for Clinical Pharmacology*

Clinical Pharmacology needs a major thrust in the current scenario as Indian Pharmaceutical Industry is changing from being traders to innovators. Government institutions have also developed technologies, but many are not translated into products. On the other hand rural as well as far flung areas with paucity of healthcare delivery & infrastructure need innovative drugs with stability, safety and ease of administration. Standard treatment guidelines with supporting data from outcome research, pharmaco-vigilance & rational use of drugs are required to avoid side effects & microbial resistance to drugs. To improve health indices, cater to the projected growth of industry, the discipline needs to grow exponentially. Centre for Clinical Pharmacology, with high impact research for development of specialized products for rural & remote areas, national data bases, outcome research, Pharmaco-vigilance, Pharmacogenetic and evaluation of Alternative Systems of Medicine (ASM) is proposed to cater all these emerging issues. The centre will be interdisciplinary, public health oriented with country wide coverage, with a vision for expertise, information, knowledge, services, training with safe and economic products for rural and remote areas to improve health indices, linking with other Govt. of India departments. The main objective of the centre will be to assess need, translate new & existing technologies from bench to public health, evaluate products, packing, and package inserts for children, women, old age, specially for emergencies, life threatening situations for remote & rural areas. The centre will also provide the information on deficiencies of available drugs, devices and vaccines, and will also help in capacity building for globally competitive, interdisciplinary teams, skilled researchers for new drug development, optimizing old drug, infection control and antibiotic use, drugs and

therapeutics committees, regulatory reviews, research in colleges and institutes. This will act as a core national centre in this specific area and also co-ordinate with other adhoc projects and Centre(s) for Advance Research in the country to galvanize science in this area.

National Centre for Research on Allergies*

Allergic diseases are a cause of morbidity and mortality globally, rising to epidemic proportions with a profound increase in their complex nature, especially in the youth. India is presently in a stage of transition in which there is a growing burden of allergic diseases on top of the ongoing problems of communicable diseases. To combat this growing burden, it is important to put allergic diseases as a health priority and make concerted efforts towards research, education and training on allergic diseases in India. Currently, there is a major gap in research and education/training on allergic diseases in India and there are very limited and fragmented efforts by individual investigators and institutions on very specific areas and/or particular disease conditions. To cater to this challenge, there is a true need for an apex center /institute of excellence to deal with the various allergic diseases gaining insight into the genetics, epigenetics, early influences, molecular mechanisms and various underlying factors responsible for these complex allergies in a holistic manner as well as basic education and training on allergic diseases. It is proposed to set up a National Centre for Research on Allergies dedicated to carry out world class fundamental and translational research in this particular area as well as to provide education and training in this specialized field. The proposed center will be an apex/core center of excellence with a vision to conduct high quality fundamental and clinically relevant translational research and education/training dedicated to allergic diseases contributing to novel, affordable and innovative treatment and preventive strategies for allergies, building expertise and bridging the knowledge gap. The center will also be a nucleus center of excellence and provide support to other institutes and centers, and work in collaboration towards a more integrated, holistic and affordable approach to treatment thereby benefiting the community at large. Since this field of expertise is still very new in India, such a center of excellence will require the expertise and dedicated efforts of an expert of international repute in the field of allergic diseases who will have the motivation and dedication to help set up and lead this center. This initiative will be a major step towards reducing the burden of allergic diseases in India.

Centres on Nano Medicine

Various government science departments have been investing in the development of nanotechnology for various applications. The fruits of such advances in medicine are yet to be harvested. For this purpose, dedicated specialized centres need to be opened in medical and other life science institutions in which such applications in diagnostics and therapeutics are tested and identified for applications in clinical medicine. ICMR plans to establish a sound coordination mechanisms with other science agencies to stimulate the growth and open such centres that would provide required infrastructure as well as human research base for achieving these targets.

*Depending upon the approval of the expert committee these institutes/centres may either be in ICMR or shifted to DHR

XII PLAN PROPOSED ACTIVITIES: EXTRAMURAL

Budgetary Requirement: ₹ 1900 crore

Medical Colleges are the back bone of both teaching and providing specialized services to patients as they can set the trends in the thinking process and innovations to improve our understanding of the diseases and their management. However, over the years there has been a discouraging trend as a majority of medical colleges have merely confined themselves to routine patient care and teaching based on conventional methods. Therefore, quality medical research has been largely confined to a handful of institutions and medical colleges in the country that too in few States only. This is evident from the research output in terms of quality of papers published in international journals as also number of research projects undertaken by the students of post-graduate courses M.D./M.S./Ph.D. *etc.* The reasons could be absence of new infrastructure/equipment, for conducting research and a general lack of motivation and knowledge on the part of faculty and students in Medical Colleges for taking up research seriously. There is, therefore, an urgent need to promote and encourage quality medical research in the country through competence building programmes for the faculty of Medical Colleges.

However, medical professionals in the public health system, especially those working in the periphery, lack access to current information on advances in a regular fashion in their settings. In addition, medical doctors working in the public health system do not get opportunity to get orientation on modern advances on a regular basis in their settings, the transfer of technology to the end users becomes very difficult. Also, there are wide variations exist in the disease pattern necessitating innovation's at the local level that requires both availability of modern technology for diagnostic purposes and trained young people to face the challenge.

To address these issues, it is proposed to strengthen the extramural support system both in terms of outreach as also intensity of participation of medical college faculty to bring them into the mainstream of national medical/health research.

These initiative are expected (i) to assist ICMR and other national bodies to forge an integrative academic, clinical and translational science that can synergize multi-disciplinary and inter-disciplinary efforts; (ii) to catalyze the application of new knowledge and techniques to clinical practice at the front lines of patient care at the periphery; (iii) to develop and nurture a cadre of well-trained multi- and inter-disciplinary investigators and teams for research in relevant areas of public health; iv) help in knowledge management, to support studies addressing the problems of technology access to marginalized and underprivileged groups by focusing on issues pertaining to gender and health, tribal health, maternal and child health; and v) create a overall synergy for accelerated knowledge generation for application in national good.

Various steps would be taken to enlarge the outreach and ensure the geographical spread of health research infrastructure by selecting judiciously the institutions to be supported under the

scheme. This will be done through bridging the gap in the infrastructure which is impeding the health research in the Medical Colleges by setting up systems for establishing multidisciplinary research laboratory and animal house facility with a view to improving the basic as well as applied health research and health services. In addition there should be a focused programme for human resource development in medical colleges receiving support for these medical colleges that would have multidisciplinary research facilities.

Epidemiology and Communicable Diseases

Strengthening ICMR Networks of- Virology laboratories, reference laboratories for antimicrobial resistance, epidemiological and laboratory surveillance network for Rotavirus, bacterial diarrhea & meningitis, vector science forum, Tribal Health Forum.

Viral Diseases: Strengthening of diagnostic laboratories will be done to undertake research to generate data & enhance capabilities to handle outbreaks due to viral diseases.

- **Viruses transmitted by respiratory route:** Measles, Rubella, Mumps, Influenza viruses (A, B and C), Parainfluenza virus, Adenoviruses, Respiratory Syncytial Virus, Rhinoviruses, and Coronaviruses.
- **Viruses transmitted by intestinal route:** Hepatitis A, E, Rotavirus, Astroviruses, Calciviruses, Norwalk viruses, Enteroviruses. including Polio Virus.
- **Vector Transmitted Viruses:** Dengue, Chikungunya, Japanese encephalitis, West Nile, Kyasanur Forest Disease, Chandipura.
- **Zoonotic viruses:** Rabies, Nipah virus, Hanta virus, *Crimean Congo* haemorrhagic fever virus.
- **Viruses transmitted by body fluids:** HIV, Hepatitis B & C.

Other viral diseases:

- Studies to estimate incidence of **Congenital Rubella** Syndrome and the social and economic burden resulting from it.
- **Hepatitis virus:** Studies to assess the role of newer therapeutic regimens in the removal of Hepatitis B and C viruses; Clinical trials with a combined vaccine for Hepatitis A, B and E; Clinical trials with indigenous vaccine for HEV.

Acute Encephalitis viruses

Basic Research: Host immune response to causative agents of encephalitis.

Clinical Studies: Development of uniform clinical guidelines for examination, investigation and management of encephalitis patients, management guidelines for long-term sequel and movement disorders in encephalitis patients. Establishment of sample bank for CSF, sera, rectal and throat swabs from encephalitis patients.

Epidemiological studies: Disease burden evaluation & development of model projects for environmental interventions.

- Multicentric projects focusing on **Novel pathogen discovery** for simultaneous detection of pathogens, known to be causative agents of encephalitis.

Translational Research: Development of newer diagnostic technique.

Newer therapeutic approaches: Clinical trials for drugs like Pentoxifylline and Minocycline (which have been observed to decrease JE viral load in *in vitro* studies) as well as others will be carried out.

HIV/AIDS & STDs

Clinical Research

- **HIV/AIDS Co-morbidities:** Development of safe, effective and acceptable prevention strategies as biochemical, pharmacological and biological factors affecting susceptibility and progression to HIV/AIDS disease could alter the potential effectiveness of interventional prevention strategies in at-risk individuals or populations.

Operational/ Epidemiological Research

- **Evaluation of Burden and role of Behavioral and Social Sciences:** Primary and secondary prevention strategies addressing behaviors and social contexts of at-risk persons.
- **Alcohol Abuse and Alcoholism, Drug Use and Abuse studies:** associated with the acquisition and/or progression of HIV/AIDS, STIs associated with HIV acquisition and HIV/AIDS co-morbidities.
- **Prevention of Mother-to-Child Transmission (MTCT):** Role of antenatal care or antenatal HIV counselling and testing, effective regimens (*e.g.*, single dose nevirapine plus short course zidovudine); home delivery (emphasizing evaluation of innovative methods for providing single-dose nevirapine), and breast feeding.
- Studies on cancer as a co-morbidity of HIV infection and other STDs.

Vaccine Development Programs

- Studying the mechanisms responsible for effective protective immune response of candidate vaccines such as for leishmania, TB, malarial parasite.
- Studies to identify and validate correlates of protection for new candidate vaccines and facilitate prediction of efficiency.
- Development of standardized tool kits of validated assays, reagents and operating procedures to enable comparison of results from models, field trials and other experiments for specific new vaccines under development.
- Capacity building of sites for clinical trials on vaccines.
- Conduct clinical trials for new vaccines such as rotavirus, influenza, meningococcal meningitis, pneumococcus, HPV, malaria, cholera, JE, HIV, typhoid, TB.
- Studies on use of adjuvant to improve immunogenicity of vaccines.
- Studies on optimal schedules for vaccines under the UIP.
- Studies on IPV including schedule and formulations for identification of post polio eradication strategies.

- Studies on alternate delivery of vaccines such as aerosol, mucosal application of vaccines.
- Operational research on introduction of new vaccines.
- Social and behavioural research on acceptability of different vaccines.

Bacterial Diseases: Antimicrobial Resistance & Related Studies

Basic research

- Genetic analysis of microbes to determine sequences of genes and reveal vulnerable areas in a microbe's genome which could be used as potential drug targets or aid in the development of better diagnostic tests.
- Mechanisms of emergence and transfer of resistance genes among pathogens *in vivo* (in the host), and the distribution and dissemination of specific antimicrobial resistance genes over time.
- **Host factors:** *In vitro* studies to determine the host factors and immune modulators (e.g., cytokines) in normal flora, serving as resistance determinants to antibiotics.
- *In-vivo* correlations between resistance determinants in normal flora and the prevalence of resistant pathogens;
- **Environmental factors:** Contamination of water and soil by pesticides, heavy metals and antibiotic residues and its relationship to drug resistance.
- **Ecological factors:** Role of normal flora and probiotics in the emergence/control of drug resistance.
- **Improved Diagnosis :** Strengthening of ICMR as well as non-ICMR Institutes involved in drug susceptibility tests.

Clinical Research

- Improvement of existing treatment modalities and development of new treatment modalities.
- Treating infections by non-antibiotic methods: natural peptides, vaccines, monoclonal antibodies.
- Generate new ideas for ways to get around resistance mechanisms, by restoring efficacy to existing drugs, use of combination regimens or by identifying new antimicrobial drug targets for the design of new antimicrobials.
- Re-emphasize the use of cheap and conventional antibiotics in a rational way and also the principle of rotation of antibiotics to minimize antimicrobial resistance.
- Develop new methods for targeted drug delivery.
- Explore alternate regimens to reduce the number of doses/day of the existing antibiotics in order to improve the patient compliance.

- Studies to understand the causes of Pyrexia of Unknown Origin (PUO), which contributes to a major chunk of patients in which antibiotics are indiscriminately used without establishing a certain diagnosis.

Epidemiological/Operational Research

- Surveillance of antibiotic resistance and use at each level of health care, *i.e.* primary, secondary and tertiary and correlate with antibiotic resistance and use.
- Establishment of a National Antibiotic Resistance Reference and Monitoring Laboratory and Centre of Excellence/Advanced Centres. There would be no need to transport isolates to overseas and generate unwarranted comments.
- Community based studies on the prevalence and susceptibility patterns of the circulating microbes (ESBLs, MRSA, NDM-1 *etc.*) in population treated/untreated with antibiotics.
- Studies on age related/gender related differences in antibiotic use.
- Attributable mortality to MDR infections including NDM-1 type of resistance.

Translational Research

- Introduce Information Technology (IT) enabled softwares in selected hospitals to improve the quality of data on pathogenic microbes and their susceptibility patterns and see its impact on timely reporting and reduction of drug resistant micro-organisms in these hospitals.
- Analysis of outcome data correlating *in vitro* resistance, antibiotic used and outcome using computerized patient record.

Leprosy and Tuberculosis

Basic Research

- Use of immunomodulators in treatment of leprosy and tuberculosis in children.
- Laboratory studies on complications of leprosy, TB and its management.
- Studies on basic immunology using genomics, proteomics and other approaches on host-parasite interaction and pathogenesis of Leprosy and Tuberculosis.
- Tools to identify leprosy susceptibility.
- Osteoarticular Tuberculosis: It is proposed to study freshly diagnosed cases of osteoarticular tuberculosis for identifying the particular strain of Mycobacteria using PCR. This will help in knowing the actual incidence of atypical tuberculosis in osteoarticular tuberculosis.

Clinical Research

- Use of chemoprophylaxis in household contacts.
- To generate data on current status of drug resistant tuberculosis in India and find out key challenges to controlling the spread of drug resistant strains and develop innovative strategies to advance and harmonize local and international efforts to prevent and treat drug-resistant TB.

- Evaluating effect of newer anti-leprosy drugs/molecules.
- Studies addressing leprosy relapse and reactions.
- Detection of early bacteriologically positive MB leprosy and its early management.
- **Drug resistance studies:** Resistance to anti-leprosy drugs & studies on use of second line newer drugs for resistant and relapse cases.
- Improve standard of ulcer care in leprosy.
- **Surgical aspects:** Evaluation of different surgical procedures for leprosy and introduction into the health system.
- Research on disability prevention and identification of predictors of early nerve damage in leprosy & identification of pre-clinical disease markers.
- Studies addressing issues related to changing profile of disease.

Operational / Epidemiological Research

- Estimating trends/prevalence/incidence in India with special emphasis on biological reasons and genetics of Leprosy and TB.
- Behavioural and social factors influencing the epidemiology of diseases.
- Development of indicators for stigma at community level and evaluation of participation scale for wider use.
- **Studies related to National Leprosy Eradication Programme (NLEP):** Transmission dynamics of leprosy to identify sources/genotypes, its presence in soil and water and establish chain of transmission in endemic pockets.

Translational Research

- Health Systems Research & Operational Research on integration issues in Leprosy and Tuberculosis.
- Studies evaluating current IEC strategies in increasing community awareness, addressing psychosocial issues for formulation of newer approaches to reduce the stigma, for encouraging early detection through self reporting and completion of MDT.
- Effect of inclusion of leprosy in a community based integrated rehabilitation disability care programme.
- Translational research including newer technology for detection of *M. leprae* from environment.

Vector Borne Diseases

Malaria

- Strategies to prevent malaria during pregnancy.
- Epidemiological impact of DDT in villages/sub-centre with different levels of resistance.
- Safety and efficacy of clinical trials to evaluate new drugs.

- Therapeutic efficacy trials for monitoring and mapping drug resistance.
- Evaluation of diagnostic kits/ assays for parasite detection.
- New and improved tools for identification of vaccine candidate antigens.
- Evaluation of vaccine candidates for their efficacy.
- Development of methods for measuring drug resistance.
- Impact of inequity of accessing drugs on disease control/elimination.
- Role of socioeconomic, environmental and behavioral risk factors in disease transmission.

Filariasis

- Clinical trials of existing and newer anti filarial drugs especially in pediatric age group
- Development of drugs and drug combinations against adult filarial worms.
- To compare the efficacy and accuracy of strategies for monitoring the progress of LF elimination.
- Sustainable morbidity management strategies, Impact of MDAs on prevalence and incidence of ADL, lymphodema and hydrocele.

Dengue, Chikungunya & Japanese Encephalitis

Molecular Entomology

- Genome mapping of vector species for identification of the relative role of vectors and their ecotypes and target the potential vectors for controlling the disease.
- Evaluation of currently available diagnostic kits, and to develop assays/kits for improved early detection of antibody, antigen and RNA is of importance in the dengue control programme.
- Control of deaths due to DHF/DSS by developing effective treatment strategies.

Dengue early warning system: Development of Dengue and Japanese Encephalitis (JE) vaccines, Mapping of JE Prone areas using Satellite Remote Sensing, Early Warning System for JE Epidemics.

- Taxonomic validation of sibling species under the *Anopheles culicifacies* complex, in accordance with the international code of zoological nomenclature.
- Role of dissolved oxygen in water in forming virus refractory proteins among mosquitoes.
- Studies on the identification of species complexes/ geographic variants of mosquitoes using modern technologies and their role in disease transmission.
- Molecular characterization of insecticide resistance among mosquito vector species for identification of genes responsible for resistance, their possible manipulation and development of screening methods.

Biological Control

- Field evaluation of a flowable formulation of *Pseudomonas fluorescence* against *Aedes aegypti*, *Culex quinquefasciatus* and *Culex tritaeniorhynchus*. Evaluation of the larvicidal potential and residual effectiveness of botanical insect growth regulators (IGRs) against mosquito vectors.
- Faunal diversity and distributional pattern of the vectors of malaria and cutaneous leishmaniasis in western parts of the country, with special reference to desert ecosystem.
- Insecticide Resistance: Monitoring of insecticide resistance for individual insecticides. Impact on resistance by using a combination of insecticides such as IRS/LLIN. Biochemical mechanisms of the new compounds for vector control.
- Development of Molecular Markers for the characterization of populations of *Phlebotomus argentipes* for the identification of three sibling species recognized morphologically in *Ph. argepentis* for their use in various field studies.

Clinical Research for Vector Borne Disease Control

- Host-parasite interaction: To understand the immunological and molecular basis of host parasite interaction for identifying novel targets towards development of insecticide for vector control and newer drugs for parasite control.

Epidemiological/Operational Research for Vector Borne Disease Control

- Population genetic studies to reveal the evolutionary trends in the species complexes and yield effective diagnostic tools towards characterization of different members of the species or strains.
- Studies on vector ecology to understand response of the vectors to the interventions in the National Programme, and to optimize control options.
- **Vector Surveillance** for monitoring insecticide resistance in vectors and the mechanisms involved.
- **Malaria:** Studies on vector bioecology in the entire country including north eastern states like Meghalaya, Mizoram, Arunachal Pradesh, Assam as well as other states like Chattisgarh, Jharkhand and Orissa. Studies are required on vector ecology and behaviour, vector bionomics, blood meal feeding preferences, resting habits (exophilic/endophilic), breeding habitats, impact of ecological changes on the vector populations, vector competence, vector population dynamics, cytotaxonomic studies, identifying major vectors as species complexes and laboratory and field studies to examine the same. Development of risk maps at district level for prediction of epidemics of Malaria.
- **Visceral Leishmaniasis:** Impact of environmental management, insecticide treated bed Nets and DDT spray in Kala-Azar control; introduction of new regimens into programme.

Translational Research

- **Vector Management:** Formulation of integrated strategies for control of VBDs for the National Programme and test them in different eco-epidemiological situations.

- Identification, development and evaluation of new bio-pesticides: in view of the challenge posed by vector resistance to insecticides and the environmental hazards due to insecticide use.
- Control of mosquitoes using environmental management methods through community participation and inter-sectoral co-ordination. The bio-efficacy trials of new insecticides, biolarvicides, bednets *etc.*
- Determination of appropriate contents of the new formulations, products, compounds for vector control.
- **Development of Kala azar risk maps:** As Kala azar endemicity is variable, remote sensing technology can be used to get landscape to have focussed and rational approach to plan situation specific intervention measures. Laboratory and field trials to evaluate new insecticides/ vector control tools, monitoring of DDT resistance in sand flies, evaluation of diagnostic kits/ assays for parasite detection. This would help to have focused and rational approach to plan situation specific intervention measures.
- **Filariasis:** Biodiversity updates of culicine mosquitoes, in view of rapid change in environment and water management, update fauna, development of filarial risk maps. Efforts have been initiated by VCRC Puducherry, which has developed mathematical models (Lyphasim and epilympho) for disease prediction. These models need to be further fine tuned and validated in Vector surveillance and Xenomonitoring.
- **Dengue & Chikungunya:** Mapping of all breeding sites of dengue and chikungunya vectors, development of district-wise risk maps for prediction of epidemics of dengue and chikungunya.
- Novel vector control measures using genetic manipulation and SiRNA technique.
- Role of *Aedes albopictus* in the transmission of dengue.
- Develop guidelines for promoting community-based interventions and behavioural change towards vector control.
- **Japanese Encephalitis:** Mapping of JE prone areas to estimate/predict risk of disease transmission, using satellite remote sensing, evaluation of biological control agents and insecticide treated mosquito curtains/nets for JE control, use of larvivorous fish and neem cake in rice fields to be evaluated in other areas and with improvisations to keep fish survive longer and spread through the entire rice fields.

Diarroheal Diseases

Basic research

- Development of molecular methods for the identification of emerging diarroheal pathogens including, detection and molecular characterization of diarrhaeogenic viruses.
- Molecular studies on rational drug targeting and designing in diarrheagenic parasites.
- Studies on molecular pathogenesis of cholera toxin gene negative *V.cholerae* O1 and *V.cholerae* non-O1, non-O139 strain.
- Enhancement of research on typhoid fever, *Helicobacter pylori* infection.

- Immunological, genetic and biochemical studies leading to better understanding of immune mechanisms of enteric infections and development of candidate vaccine(s).
- Development of new animal models for diarrheal diseases.
- Molecular typing of rotavirus infection in human and its molecular polymorphic dynamism in Orissa.
- Molecular and epidemiological characterization of opportunistic enteric pathogens especially by *Cryptosporidium* and *Giardia lamblia*.
- Molecular characterization of pathogenic *E. coli* and Shigella species related to acute diarrhoea among the children in Orissa.
- Role of Enteroaggregative *E. coli* in diarrhoea.
- Evaluation and monitoring of drugs for enteric pathogens.
- Development of new animal models for diarrheal diseases.
- Development of a candidate vaccine against shigellosis including development of vaccines against common serotypes.
- Studies to domestically develop novel, affordable and available rotavirus vaccine.

Translational Research

- Establishment of surveillance system for the identification of pathogens of emerging diarrhoeal diseases (bacterial pathogens *Vibrio cholerae*, *Vibrio parahaemolyticus*, Shigella, Salmonella and diarrhoeagenic *Escherichia coli*), and assess its usefulness in early warning of outbreaks and epidemics.
- Research towards the development of vaccines against i) *V. Cholerae* O1, O139, ii) *S. dysenteriae* type 1, iii) *S. flexneri* and iv) HIV, v) Rotavirus, vi) ETEC.

Evaluation of tools of Biostatistics in the area of disease surveillance, health education and health policy research, studies on unmet need of RCH care and facilities, studies on un-served and underserved populations, survey methodologies in medical and health research, health economics, health information system, statistical techniques in clinical trials and epidemiology, health and demographic transitions, multilevel modeling, studies on disease burden.

Tribal Health

Tribal health has been focused as one of the important areas for action in health research. Studies on tribal population and of special groups will be carried based on the recommendations made periodically by the Tribal Research forum and the Expert Group on North East through call for proposals.

- Burden of communicable Diseases in different tribes and vaccine preventable diseases along with correlation of **incidence** of communicable Diseases with morbidity and mortality rates.
- Stratification for malaria control in tribal dominated high malarious zones.
- **Tuberculosis:** clinical, social, behavioral and operational research to improve diagnosis and treatment interventions.

- Studies on prevalence pattern of filariasis and intervention studies.
- Epidemiology and impact of helminthes on the population: some tribal areas have exotic parasite infections *e.g.* Paragonimiasis in the North-east, infestation by flukes is prevalent in some areas.
- Studies on NCDs, MCH, nutrition, health services delivery and socio-behavioral issues.

Basic Medical Sciences

The division of Basic Medical Sciences will continue to support extramural research in basic biomedical sciences *viz.* Allergy, Anatomy, Anthropology, Biochemistry, Bioinformatics, Cell and Molecular Biology, Genomics, Haematology, Human Genetics, Immunology, Nano-medicine, Organ Transplantation, Pharmacology, Physiology, Traditional Medicine including medicinal plants, Stem Cell Research and Therapy, Toxicology *etc.* The research will be supported through open-ended flowship project, ad-hoc research schemes, Centres for Advanced Research and Task Force Projects in various research institutions, medical colleges and universities in the country. Following activities will be pursued :

- **Centre for Advanced Research**

Following Centres will be established :

- Network of new pre-clinical toxicology, clinical pharmacology and clinical trial centres for research and training.
- Centres for Molecular Medicine
- ‘Virtual Advanced Centres’ for molecular medicine
- Centres for Advanced Research in specific areas in Human Genetics
- Genetic study of Lysosomal storage disorders
- Other specialized centers on stem cells and other relevant aspects.
- Centre for Advanced Research in Congenital Defects.

National Centres :

- National Centre for Clinical Pharmacology
- National Centre for Allergy

- **Task-Force Activities**

- Translational programs for the leads from research carried out under Division of Basic Medical Sciences.
- National Task Force on Inborn Metabolic Disorders (IMD’s).
- Investigations into geo-ethnic clustering for genetic disorders.
- Task Force on Pharmacogenomics.
- Setting-up Task Force on ‘Developing Nanotechnology in Health’.
- Task Force on molecular pharmacology.

- Human resource development in new drug discovery process and development.
- National programme of training in different aspects of toxicology including genotoxicity, carcinogenicity, reproductive toxicity *etc.*
- Human resource development in Good Clinical Practices and ethics related to clinical trials.
- Basic Research: Stem cell biology of Human Embryonic Stem Cells (hESC) and Induced Pluripotent Stem Cells (iPSC).
- Establishing SOPs and standards for isolation, derivation, processing, expansion and storage, revival, transportation and viability check for stem cells.
- Training of scientists and physicians in GMP/GLP/GTP and clinical trials in Stem Cell Research and Therapy.
- Clinical trials for spinal cord injury and critical limb Ischemia using stem cells.
- Educating public about stem cell therapies.
- Task Force on heavy metal related diseases.
- Study on prescription trend of physicians across the country improving pharmacovigilance and pharmacoeconomics.
- Task force on sports medicine.
- National Task Force study on Lysosomal storage disorders.
- Pilot programme for setting up centers for community control of thalassemia and hemoglobinopathies at state level.
- MEGA PROJECT “Indian Normatives for Clinical Laboratory Parameters (INCLAP)” .
- **Open ended Adhoc Research Schemes and Fellowships :**
 - It is expected that about 400 adhoc research schemes and 500 fellowships will be sanctioned.
- **Other Activities :**
 - Guidelines /Policy Documents:
 - ◆ Revision of Stem Cell Research and Therapy Guidelines.
 - ◆ Revision of Ethical Guidelines for Biomedical Research involving human subjects.
 - ◆ Enactment of the Biomedical and Health Research involving Human Participants (Regulation of Ethical, Legal and social issues) Bill.
 - ◆ Ethical Guidelines for Conducting Research on Mental Illness or Cognitive Impairment and Research Involving Mentally Ill or Cognitively Impaired Individuals.
 - ◆ Guidelines for Compensation to Participants for Research Related Injury in India.
 - ◆ Guidelines on Data Sets and Bio-banking.
 - Biomedical Innovation Fund : Through this fund, support will be continued to be provided to the scientists to test and validate novel and highly creative ideas.

Reproductive Health & Nutrition

Supports research through various medical institutions, especially through number of HRRCs in clinical, epidemiological and operational research.

Basic Reproductive Biology

(i) Gamete biology (ii) Implantation (iii) Embryology (iv) Infertility (v) Genomics of male & female infertility (vi) Disorders of sex development (vii) Endometriosis (viii) Preeclampsia (ix) Polycystic ovarian syndrome (x) Development of biomarkers (xi) Reproductive cancer (xii) Environment & reproductive health.

Epidemiological/ Operational Studies

Infertility

- Phase-IV clinical trial with Letrozole for induction of ovulation in anovulatory infertility.
- Studies on identifying the major causes of infertility in India.
- Model projects of capacity building on fertility regulation, expanding contraceptive choices and Infertility.
- The effects of cell phones on reproductive health.
- Initiate new studies in the areas like emergency contraception, especially (i) research leading to development of new contraceptives both for male and female (ii) conducting pre-clinical toxicity studies with new contraceptives (iii) conducting various phases of clinical trials with new contraceptive (iv) evaluation of existing contraceptives for their safety and efficacy (v) conducting post marketing surveillance.
- Research towards expanding contraceptive choices to improve the acceptance of existing contraceptives and evaluating newer contraceptive implants for suitability for the women.
- Piloting the feasibility of introduction of subdermal contraceptive implant 'Implanon' at secondary level of care.
- Studies on tubal ligation at different levels of care.
- Evaluating contraceptive method-mix for expanding contraceptive choices with existing methods.
- Randomised comparative evaluation of newer emergency contraceptives to improve availability and acceptability.
- Health system research capacity building through mentoring of district hospital health providers and programme managers.
- Feasibility of introducing medical methods of safe abortion at district and sub-district level.
- Prevalence and sequelae of induced abortion at all levels of care.
- Prevalence of unsafe abortion at community settings.

- Acceptability of medical methods of abortion vis-à-vis other surgical methods in peripheral settings.
- Comparative evaluation of ethacridine lactate v/s medical methods for second trimester pregnancy termination.
- Feasibility of involving mid-level providers (graduate nurses) for provision of safe abortion services.
- Hospital (all levels of care) based surveillance of reproductive morbidity and mortality due to unsafe abortions.

Maternal Health

- Clinical, operational and implementation research for implementing best practices.
- National database on reproductive health with data on maternal, perinatal, child and adolescent health to evaluate programmes, identify gaps and improve health care and service delivery.
- Role of maternal age, nutrition including micronutrient status, maternal disease such as pre-eclampsia, gestational diabetes, anaemia *etc.*, environmental pollutants, toxins, maternal infections *etc* on health of the mother and the newborn.
- Epigenetic studies, studies on systems biology, congenital birth defects, epidemiology and pathophysiology of Intra Uterine Growth Restriction (IUGR), preterm birth and stillbirths.
- Studies on epidemiology and pathophysiology of Reproductive Tract Infections (RTI) / Sexually Transmitted Infections (STIs) including Female Genital Tuberculosis (FGTB), development of diagnostic technologies including algorithms for management of RTI/STI/FGTB.
- Facilitate the development of new, safe and accessible methods of preventing the transmission of HIV/AIDS and of other sexually transmitted diseases.
- Research on HIV complicating pregnancy and prevention of mother to child transmission.

Child Health

- Studies on infection especially hospital-based surveillance for neonatal, perinatal and childhood morbidity and mortality.
- Set up surveillance system for anti microbial susceptibility of organism causing pneumonia.
- Identify risk factors for developing severe Acute Lower Respiratory Tract Infections (ALRTIs) and mortality in children.
- Develop simple algorithms for identification and management of sepsis and its applications in the existing programme for use by health care provider.
- Studies on different regimens to treat neonatal sepsis.
- Using pro-biotics as a nasal drops/nasal spray /or nebulisation for combating pneumonia in children.

- Effects of probiotic supplementation in altering fetal, neonatal and infantile immune response during pregnancy and lactation.
- Role of probiotic bacteria in mucosal protection against HIV in breastfeeding infants.
- A follow up study to examine long term colonization patterns of probiotics.
- Use of topical probiotics for the inhibition of surface contamination by a pathogenic microorganism in newborns admitted to the NICU set up.
- Topical use of probiotics in the management of diabetic foot ulcer & other sepsis.
- Develop database on childhood and maternal morbidities and mortality from tertiary care hospital as well as from district hospital (secondary level).
- Retinoblastoma registry and feasibility of a screening card, timed with immunization card to spread awareness.
- Birth defect registry and studies on operationalization of exclusive breast feeding and improving young infant and child feeding.
- Studies on integrated community based care that includes some or all components of provision of maternal and newborn care.
- Home based management of young infants with testing of more home based newborn survival interventions at developed sites and in urban slums.
- Immunization studies to measure measles antibody level in children receiving only measles vaccine and those receiving MMR vaccine at 15 months.
- Surveillance of HIV infected cohort of infants for clinical, virological, immunological and therapeutical end points.
- Perinatal surveillance in India, identifying gaps, partnerships, and interventions need to be developed or enhanced, policy and practice.
- Research on fetal developmental biology and chronic childhood diseases (childhood anaemia, renal diseases, and obesity).
- Evaluation of impact of IMNCI programme, effectiveness of *Janani Suraksha Yojana* (JSY) programme /community based intervention in improving perinatal and neonatal outcomes.
- Feasibility studies on solar powered portable culture incubator and solar powered baby warmer in district hospitals.

New Centres for Advanced Research

- Centre for Advance research in community based maternal, new born & child health.
- ICMR Advanced centre for research in childhood & nutrition.
- Advanced centre for adolescent health and gender equality research.
- Advanced centre for policy research in maternal and child health.
- DHR and WHO Joint steering group for defining implementation research.

- Centre for advance research in molecular and cellular reproduction.
- Centre for gender related health issues.
- Centre for advance research on transgender issues.
- ICMR-ICAR centre on health foods & centre of excellence in nutrition.

Nutrition Research

- Nutritional status of elderly population.
- Food safety issues including food contaminants, adulterants and genetically modified food items.
- Micronutrient research to see the impact of ongoing national programmes on prevention and control of micronutrient deficiency disorders such as iron deficiency anaemia, vitamin A deficiency disorders and iodine deficiency disorders.
- Studies to generate database and role of diet and lifestyle in relation to non-communicable diseased disorders.
- Assessment of magnitude of problem of dental and skeletal fluorosis, specific intervention strategies and defluoridation.
- Studies on nutrition status of tribal population & to develop intervention strategies.
- Centre for promotion of nutrition research and training with special focus on North-East, tribal and inaccessible population would impart training, undertake collaborative research, carry out quality assurance programme and would develop infrastructure in terms of improving research capability specially in the field of food safety.
- To develop intervention strategies for nutrition in partnership with State Government.

Non-Communicable Diseases

ONCOLOGY

- **Studies on Human Papilloma Virus (HPV) and cancers**
Pathogenesis, HPV transmission dynamics, and availability of therapeutic and long-acting vaccines.
- **Biomarkers for prevention and early detection of cancers**
Biomarkers which may help in prevention or early detection of cancers.
- **Cancer of Gall Bladder**
Studies on understanding the aetiological factors of cancer of gall bladder, biological processes associated with pathogenesis and identification of better modalities for its early detection & treatment.
- **Biorepository for Tumour/ Blood samples**
For laboratory based studies on pathological aspects and also technology development.

- **Oesophagus Cancer**

Multi-disciplinary and multi-centric study to know the mechanism and etiology of this cancer.

- **Prostate Cancer**

Etiology, early diagnosis and management.

- **Paediatric Cancers**

Multicentric and multidisciplinary studies on aetiological aspects as well management practices.

- **Clinical Trials for management of common cancers**

Developing/ identifying leads for treatment of common Indian cancers and to test their efficacy through well planned clinical trials for common cancers of the country.

- **Chemoprevention**

Chemo-prevention of common cancers like that of oral cavity and cervix, using less expensive, indigenous Indian products in collaboration with AYUSH.

- **Quality of Life of Cancer Patients**

Quality of life with various management schedules in their totality under India scenario.

CARDIOVASCULAR DISEASES

- **Management of Hypertension- A Registry in Essential Hypertension**

A three step approach *viz* (i) the guidelines and recommendations taken as reference in the management of these patients will be identified; (ii) the variance between individual targets defined by physicians in their practice compared to guidelines and recommendations will be looked into and (iii) a prospective registry at multiple centres will be established to provide a platform where physicians will collect baseline data, determine individual target BP values according to risk factor profile and conduct several follow-up visits for monitoring achievements of these targets.

- **An epidemiological study of genetic and non-genetic determinants of coronary artery disease (CAD) in Indians**

To generate new genetic and non-genetic information and to utilize the new and currently available information to improve the diagnosis, risk stratification and application of therapies for patients with atherosclerotic CAD.

- **Developing Biomarkers for Coronary Heart Disease**

To identify and qualify new biological markers for detection, diagnosis and treatment of cardiovascular diseases.

- **Prevention and Control of CVDs**

Effects of diet and weight control on CVD risk factors across population subgroup

To evaluate the regional differences in dietary patterns and their effect on both lipid and non-lipid endpoints in combination with weight control and aerobic exercise.

- **Cardiac Intervention program using lifestyle changes**

To examine the effects of intensive lifestyle modification on symptom relief, this proposal will investigate changes in angina pectoris, coronary risk factors, quality of life, and lifestyle behaviors in patients with stable coronary artery disease enrolled in the cardiac lifestyle intervention program.

- **A Laboratory Network for Cholesterol using Reference Method: A Model for Standardization and Improvement of Clinical Laboratory Measurements**

A laboratory standardization panel is proposed to be established to assess the reliability of blood cholesterol measurements in the country and recommend analytical performance specifications for precision and accuracy. A reference method laboratory network will then be established.

- **Innovative new technologies to improve quality, efficiency and cost of care**

Integrating digital auscultation and hand-held echocardiography with mobile phone technology to screen for heart disease in remote locations:

Evaluation of various technologies for application in a variety of Indian settings.

- **Training of paramedical workers to screen for structural heart disease using a digital stethoscope:**

Exploring the application of digital stethoscope with a integrated phonocardiogram to screen for congenital and structural heart disease in rural and remote locations and transmission of information via internet or telemedicine.

MENTAL HEALTH

- **Centre for Advanced Research on Urban Health**

For studying complex interplay of various risk factors peculiar to urban areas and their role in health problems, to find out the various risk factors prevalent in urban areas that are amenable to intervention, and to evaluate the effectiveness of interventions aimed at improving the health of urban communities.

- **Common Mental Disorders (CMD)**

Epidemiological studies across different regions in the country study to assess the prevalence of common mental disorders in the community, associated disability, quality of life of patients and treatments taken by the patients and be followed up for a duration of 2 years to assess the course, outcome and response to specific treatments.

- **Adolescent Mental Health**

Profile of specific learning disabilities, Attention Deficit Hyperactivity Disorder (ADHD), mental retardation psychiatric co-morbidity and the comparative analysis of various management techniques of childhood psychiatric disorders including mental retardation.

- **Burden associated with severe mental illness**

A multi-site project for assessment of degree of disability associated with different mental disorders in target population, number of years spent in illness along with disability, extent of burden on caregivers, financial costs (both direct as well as indirect) and effect on life expectancy.

- **Alcohol and Drug Abuse**

Multi centric task force project to develop strategies for identification of alcohol and drug use disorders in community to develop intervention packages and service delivery models for various kinds of alcohol and drug use disorders.

- **Long term course and outcome of anxiety disorders and its determinants**

Study on patients with anxiety disorders and its determinants.

NEUROLOGY

- **Molecular and genetic studies in stroke for determining genetic risk factors contributing to high prevalence of stroke in Indians**

Multicentric, multidisciplinary study for understanding the molecular and genetic determinants of stroke.

- **Supporting research in genetic disorders, focusing on Duchenne muscular dystrophy, spinal muscular atrophy, and spinocerebellar degenerations**

Research for cost effective diagnostic tests for the neurogenetic disorders.

- **Studies on Neuro-metabolic disorders**

Epidemiology, clinical presentation and management of most neuro-metabolic and neuro-degenerative disorders.

DIABETES

- **Pathophysiology of Type 2 Diabetes -Genetic approaches to the molecular understanding of T2D**

Study understand the various cellular signaling pathways such as inositol pathway, determinants of fetal/neonatal phenotypes and metabolism, liver adiposity and hyperglycemia, pharmacokinetics of drug response, process involved in understanding complications of diabetes GLUT4 protein, protein kinase C and calcium signaling pathways in understanding the pathophysiology of diabetes.

- **Diabetes Cohort Study**

The study is proposed to be conducted among residents of Delhi (GTB Hospital, Delhi) and Puducherry (JIPMER, Puducherry), to begin with in rural and urban settings. A predesigned questionnaire would be administered to all recruited subjects with relevant items.

- **Development of Atlas on Prevalence and Pattern of Diabetes**

To evaluate differences in diabetes pattern across the country in a relatively cost effective way and make an attempt to estimate prevalence of diabetes.

- **Genome Wide Association Studies in Type 1 Diabetes**

The Task Force project on “Genomics of Type 1 Diabetes,” is ongoing at AIIMS, Delhi; MDRF, Chennai and SKIMS, Srinagar. Based on the findings, it is proposed to replicate 15-20 genes in DNA samples collected from three regions.

- **Bio Bank of People with Diabetes with Young Age at the Onset**

The Council has initiated a Task Force Project on “Registry of People with Diabetes with Young Age at the Onset.” The study is presently ongoing at nine centres and data has been collected at all centres. The Collaborating centres have already stored the serum samples of subjects enrolled under this Task Force project for future research on molecular and genetic studies, which is one of the main objectives of the ongoing study.

- **Revised Guidelines for Management of Type 2 Diabetes**

The Council brought out ‘Guidelines for the Management of Type 2 Diabetes ‘ in 2005. In view of recent changes in management of diabetics based on recent data available nationally and internationally, it is proposed to revise the Guidelines for better management of type 2 diabetes patients.

- **Task Force on Camel Milk and Diabetes**

Biochemical Analysis of Camel Milk

A concept note was formulated based on previous work done in the subject and published reports in the literature. The camel milk is also reported to constitute high levels of vitamin C, antioxidants, amino acids, *etc.* The camel milk will be analyzed for various biochemical properties and other investigations.

- **Islet Cell Transplantation and Pancreatic Transplantation**

Developing cost effective strategies to implement pancreatic and islet cell transplantation in India and also focusing on developing resources that may enhance increased cadaver pancreatic harvest and islet cell storage is an area of public interest.

- **Developing Cost Effective Tools for Diabetes Management and Care**

Developing affordable glucose monitoring systems, reagents and devices in management of glycemic control is important area of research. The Council would be developing task force projects addressing these issues and support the individual investigators in medical colleges and universities.

- **Capacity Building for Genomics Research, NCD Prevention, Laboratory Standardization and Quality Control**

The program is proposed to support the integrated medical and research opportunities in areas of basic genetics that would build on, and compliment, the trainee’s clinical background. For basic genetics, the research and training would be specifically designed to foster a career in human and medical genetics.

- **Gene-Environment Interactions**

Studies on gene environmental interactions would be initiated.

- **Translational /Operational Research**

To translate results of laboratory into widespread clinical practice. It is proposed to undertake cost effective programs to (i) identify individuals at high risk who could benefit from preventive programmes, and (ii) successfully promote lifestyle change.

- **Yoga and Treatment of Diabetes**

To undertake studies to see the beneficial effects of yoga in diabetic patients.

Other Researchable Areas

The research in the areas of fetal programming, stem cell therapy for treatment purposes, distribution and pattern of various types of diabetes in the young, setting up the biological specimen bank for the future studies especially susceptibility genes for predisposition to disease is proposed.

- **International Collaboration for Diabetes research:** with University of Minnesota, Australia and France is well established, being used as good platform for researchers to pursue their scientific interests, enhance scientific knowledge and capacity.

OPHTHAMOLOGY

- **Age Related Macular Degeneration (ARMD)**

A case control study to identify the risk factors.

- **Blindness survey**

Reassess the prevalence of blindness.

- **Cataract**

For better understanding of complete constituents of lens membrane chemistry, biophysical changes and factors responsible for varying incidence of cataract in different parts of the country, other researchable issues are dietary factors and the genetic susceptibility.

- **Childhood Blindness**

Multicentric project to study the various aspects of childhood blindness for supporting the National Programme.

- **Corneal Diseases and its Management**

Studies on up gradation of the formulation of preservation media and development of newer media suitable to country requirements.

ENVIRONMENTAL AND OCCUPATIONAL HEALTH

- **Study on biomarkers of environmental exposures**

To identify markers useful for biomonitoring and exposure to various environmental pollutants.

ASTHMA

- **Pathogenesis of Asthma**

Studies on immunological and genetic changes associated with development of the disease, and also to learn about different phenotype(s) which may be predisposed to asthma vis-à-vis different aetiological factors, like childhood infections. Microbes in GI tract and associated sensitization, effect of cold exposure, prevailing condition of lungs.

- **Diagnosis and Management of Asthma and COPD**

Clinical trials to test the role of carefully searched leads related to newer drugs, including herbal and homeopathic drugs, probiotics, power breath inspiratory muscle training, pranayama and exercise, *etc.*

- **Multicentric study on time trends of asthma**

Repeat the survey after a period of 5 years to show any changes in the occurrence of asthma.

NON-COMMUNICABLE DISEASE SURVEILLANCE

- **Assessment of Non-Communicable Diseases and their risk factors in Tribal areas:**

To generate data on NCDs, determinants for prevention and intervention.

- **Healthy Public Policies: An Inter-sectoral platform for Integrated Prevention and Control of Non-communicable Diseases**

To generate data to a supportive environment to enable people to lead healthy lives, NCDs have gained enormous importance as public health problem in the country, and studies have shown a high burden of risk factors which have the potential for modification using well defined interventions. In the pursuit of a healthy public policy, government sectors concerned with agriculture, trade, education, industry, transport, finance, food processing *etc.*, need to take into account health as an essential factor. These sectors should be accountable for health consequences of their policy decisions and should pay attention to health as to economic considerations.

- **Translational Research for Prevention and Control of Non-Communicable Diseases**

Implement leads to facilitate translation of research products for utilization of providing and improving health care towards the prevention and control of NCDs.

NCD DATABASE

- **Comparison of the physician review and the computer based probabilistic model in determining adult causes of death**

To explore how a computer-based probabilistic model performs in comparison with PR in interpreting VA data on mortality due to NCDs.

NON-COMMUNICABLE DISEASE BURDEN

- **Health state valuation studies**

A multi-centric measurement exercise is to be planned in a range of domains, using a larger array of conditions, to gauge differences in disability severity related to social, cultural or economic contexts.

- **NCD burden estimates and projection**

The study proposes to take stock of newer studies as well as review older studies, review the data coming from ICMR studies and determine updated statewise estimates of NCD burden and projection for 2015, 2020.

ORTHOPEDICS, DISABILITY & REHABILITATION

- **Osteoporosis**

Study to measure early detection of osteoporosis and genetic predisposition.

- **Spinal Cord Injury**

To initiate and standardize therapeutic evaluation of the technique of schwann cells implants in humans in order to help repair damaged spinal cord axons, thereby enabling axons capable of transmitting nerve impulses to accomplish their normal functions and explore the embryonic cell transplant therapy for spinal cord regeneration.

- **Research on Arthritis**

Interdisciplinary research to undertake the mechanism and regulation of cartilage repair and regeneration for finding out the pathways of progression of joint diseases such as osteoarthritis and look for early intervention for retarding the progression of joint diseases.

- **Role of vitamin D in musculo-skeletal disorders**

Disease modifying capacity of vitamin D and pathways for early intervention of osteoporosis and osteoarthritis.

- **Over use injury**

Studies on alignment abnormalities and overuse injuries.

GERIATRICS

- **Research on Frailty in the aged**

Relationship of ageing with coexisting diseases, nutrition and muscle training, better diagnostic criteria, identification of biomarkers, interventions on muscle metabolism and animal model development to understand the mechanism of syndrome.

- **Research to understand mechanisms of ageing and longevity**

To identify the pharmacologic interventions that increase the functional lifespan, to quantify the extent of calorific restriction and its effect on the resistance to different stresses, age-related diseases and longevity, the impact of stress and physical activity on ageing, genetic studies. To study different model systems and bone marrow stem cell research and signaling cascades in inflammatory conditions.

- **Impact of Nutrition on Ageing**

Nutrition is an important component on the quality of life of the elderly. Nutrients interact and modulate genetic, cellular and molecular mechanisms in the body. Research is needed in nutrigenomics and nutrigenetics to unravel the complex relationships between nutritional molecules, genetic polymorphisms and the biological system.

- **Brain ageing and neuro-degeneration**

To understand the genetic mechanisms of brain ageing and neurodegeneration, epidemiology of neurodegenerative disorders, effect of nutrition as a neuroprotective agent, factors which promote recovery of functions after ageing.

GASTROENTEROLOGY

- **Inflammatory Bowel Diseases**

Epidemiology, establishing diagnostic criterion, developing capacities of peripheral health care systems for early diagnosis and prompt referral, study the pathogenetic mechanisms of the diseases and conduct trials on efficient pharmaco-therapeutic options.

- **Pediatric Gastroenterology Research Program**

Multi-disciplinary research, partnerships and collaborations, alignment with other national relevant public health strategies and programs, multi-centric studies to be initiated in the areas of neonatal cholestasis, extrahepatic portal venous obstruction, acute hepatitis, acute liver failure, chronic hepatitis B, quality of life instruments, celiac disease, acute diarrhea, recurrent diarrhea, pancreatitis and inflammatory bowel diseases.

- **Burden of Gastroenterology Related Disorders**

Assessment of burden through analysis of available data and reports, ongoing collection through registries, special surveys, and statistics from the national databases and the application of data for prevention/cure.

- **Microbial Flora and Immunity**

Characteristics of gut microflora in normal healthy population across the age groups, determine its evolution and impact of health, study the flora related immune status in ill health conditions and evaluate the role of supplementation of microflora in maintaining health and managing diseases.

- **Chronic Liver Diseases**

Epidemiology, burden, diagnostic workup, early screening, follow up and monitoring strategies, managing etiology/morbidity, quality of life and complications and economic consequences.

OBESITY AND METABOLIC SYNDROME

- **Physical Activity**

Studies on physical activity (inactivity) would be aimed on the mechanisms for energy expenditure including non-exercise activity thermogenesis, epidemiology, measurement tools, determinants, health consequences, interventions for promoting activity and developing a sound public health policy for its effective implementation.

- **Nutrition Transition**

To document the nutrition transition scientifically, determine its impact on health, identify factors and reasons for the rapid shifts, evolve intervention packages to reduce its impact, and undertake ethnographic studies to propose a mechanism and suitable policy imperatives.

- **Metabolic Syndrome**

For understanding the factors contributing to these conditions would help in formulating strategies to curb T2DM and CHD and improve health outcomes and childhood metabolic syndrome.

- **Mechanisms of Obesity and Metabolic syndrome**

Mechanisms running these two outcome parameters resulting in inappropriate fat accumulation in the body include infectious insults, immune mediation, inflammatory stress, nutrition impacts including micronutrients and vitamins, the brain-gut axis for its mechanistic role by involving neurohormones, gut hormones, study of bariatric surgery as a tool for studying pathophysiology *etc.* The studies would involve genetic, molecular, metabolic, animal model and other relevant systems to determine the pathophysiology of obesity and metabolic syndrome.

ORAL HEALTH

- **Caries and diseases of dental hard tissues**
- **Periodontitis .**
 - **Malocclusion and dentofacial anomalies**
 - Biological basis of orthodontic treatment, stem cell, fundamental research, genes and environment in the causation/prevention of malocclusion.
- **Edentulism: Research for optimum rehabilitation of such cases**
- **Patients with special care needs:** It is proposed to research into prevention of occurrence of dental problems in patients with special care like dental vaccines, enzymatic caries control, immune modulation and gene therapy.
- **Cleft Lip and Palate anomaly in India: Clinical profile Risk factors and current status of treatment (pilot phase and main study)**

As proposed, the pilot and main phases of the study will be carried out during the XII five year plan. The pilot study will be done to standardize the mechanism of data collection and testing the study tools, understanding the coordination mechanism across the different centres, as this will be a multidisciplinary study. The main study will be carried out at different centres across the nation and will last for five years.

TRAUMA, ACCIDENTS AND INJURIES

- **Development of a hospital based Trauma, Accidents and injuries database**

For studying trends in type of injury, demographic profile of injured individuals, geographic distribution of traumatic injuries, economic impact of traumatic injury, outcome of traumatic injuries.

NEPHROLOGY

- **Acute Renal Failure**

A hospital based study to find out the picture of commonly reporting acquired ARF in India with special reference to finding out urinary markers for the same and to evolve preventive strategies.

- **Centre for Advanced Research (CAR) - Paediatric Uropathies & CKD**

To aim for studying pathways for finding out pathophysiology and pathogenesis of various uropathies and kidney diseases among children at its inception.

- **To identify genetic basis of renal morbidity in congenital uropathies**
To study candidate genes.
- **Gene environment interaction in Congenital Uropathies**
To validate the 'two-hit' hypothesis for renal damage in congenital uropathies as a sequelae of gene-gene interaction between i) pathogenesis of aberrant renal development & ii) ACE I/D induced renal parenchymal injury., besides studying the effect of Nitric Oxide on renal function recovery as a baseline study for a future role of 'iNOS gene transfer studies' for renal recovery.
- **Genetics and Etiopathogenesis of Nephrotic Syndrome**
Genetic and genomic studies to understand etiopathology of nephrotic syndrome.
- **Management of various Primary Glomerular Diseases**
To standardize the treatment schedule and method for such patients.

OTOLARYNGOLOGY

- **Prevalence of Hearing Impairment**
Studies on defining the role of infectious agents in causation, its occurrence in special high risk groups (*e.g.* immunocompromised), role of bio-films and genetics in its development and development of non-invasive diagnostic tools in hearing impairment, identification of candidate vaccines for prevention of Otitis Media and multicentric epidemiological survey to estimate hearing impairment across six regions of the country.
- **Modifier Gene contributing to severity of hearing Loss**
Studies on the epidemiology of Otosclerosis to describe regional variation and risk factors.
- **Cochlear implants**
Epidemiology and pathogenesis studies and research in the evaluation of indigenous implant devices.

Health Systems Research

- Assess and promote public, public-private and NGO partnership for improving RCH services.
- Studies on the role of health insurance scheme in improving health care access and utilization in rural India for policy implications.
- Strengthening research capacity and effective knowledge utilization reducing gender discrimination & improving adolescent health.
- Access and delivery of healthcare services among rural-urban migrants.
- Health Economics.
- Delivery of services in selected population group – Tribal population, paramilitary/ police/security forces; marginalized groups.

- Studies on role of different indigenous management strategies in improving the health service delivery and research.

Social & Behavioral Research

- Study the various issues involved with the acceptability of new microbicides to enable quick introduction once they become available.
- To understand the awareness and other social and psychological dynamics of increasing social problems like substance use, accidents and injuries, sexual abuse *etc.*
- Understand decentralized governance and organizational behavioural issues for their potential impact on the service delivery in the new health services scenario post-liberalization.
- Studies on social determinants of health in the new socio-economic and political environment.
- Behaviour change communication & IEC and promoting newer technologies & products to plan effective translational programmes.

Medicinal Plants Unit

- Establish a Centre for Advanced Research on quality standards of Indian medicinal plants.
- Phytochemical Reference Standards of selected Indian Medicinal plants.
- Develop a Compendium of information as available in ancient texts on plant drugs with focus on toxicity, adverse drug reaction interaction *etc.*
- Development of databases on country's ethno medicinal and biological wealth.
- To develop database on Ethnobotanical Studies/Folklores.
- Create a database on medicinal plants of their use as food, condiments, spices and nutraceuticals *etc.*
- Atlases on pharmacognostical, phytochemical profile of medicinal plants and all single drugs.
- Human resource development/strengthening of existing infrastructure and facilities.

CENTRES TO BE SET UP IN EXTRAMURAL MODE

During XI plan, extramural activities of the ICMR were augmented through setting up of many centres of Excellence, Centres for Advanced Research and Task Forces, besides funding to Adhoc projects and fellowships. To accelerate these activities further and increase outreach to cover many more new areas it is proposed to establish following new centres in extramural mode depending upon experience and feed back. These could be then considered for conversion in intramural mode later. Besides, activities which could not be completed during last plan will also be taken up during XII plan.

Centres for Pre-clinical Toxicology, Clinical Pharmacology and Clinical Trials

Many therapeutic important synthetic chemicals, recombinant products, biological products are being developed in the country. For developing these in to drugs there is need to test the pre-clinical toxicology in animals, clinical pharmacology in human subjects and ultimately clinical trials. Accordingly, there is need to set up these facilities in the country. ICMR under its thrust on drug development initiatives has planned to set up these centres in selected institutions in the form of Centres for Advanced Research.

Centres for Molecular Medicine

Establishment of Centres for Molecular Medicine has been one of the goals of ICMR since the XI five year plan. This effort will be accelerated during the XII Plan so as to modernize the medical research in the Country.

Virtual Advanced Centres for Molecular Medicine

Under this scheme, ICMR plans to identify the Departments/Laboratories who have established their expertise in a particular aspect of molecular medicine for further support. This will be done with a view to achieve faster progress and encourage these centres to stimulate others to join and mentor their activities.

Centres for Advanced Research in specific areas of Human Genetics

The application of various developments in human genetics requires synergy, quality assurance, training and operational research aimed at testing of different technologies, counseling and other interventions. Various expert groups at ICMR have felt the need of creating: 1. An apex centre in human genetics which will provide the leadership and will have coordination role of not only research laboratories involved in evolution of methods but also implementational research for application in clinical practice and public health, and 2. in other areas including ocular genetics and epidemiology of genetic disorders in rural areas. For this purpose, ICMR has planned to develop such an advanced centres in the XII plan.

Centre for Advanced Research on Genetic Study of Lysosomal Storage Disorders in India

It is proposed to set up a centre for advanced research on Lysosomal Storage Disorders in India. There are about 50 different types of storage disorders sharing common pathogenesis: a genetic defect in a specific lysosomal enzyme, receptor target, activator protein, membrane protein or transporter that causes accumulation of specific substrates. Though individually rare, the combined incidences are 1:5000 to 1:7000 and are likely to be higher for India due to high population rate and consanguineous marriages in many ethnic groups. Missed or delayed and erroneous diagnosis of storage disorders exert an enormous toll on affected patients, families and healthcare providers. Therefore early and accurate diagnosis is essential to provide specific therapy before the development of irreversible injury. Enzyme replacement therapy (ERT) once thought as incurable can now be treated with success like Gaucher, Pompe, Fabry and Niemann Pick B. However, it is very important to identify the disease at an early stage before it progresses to neurological impairment. It is thus proposed to set up a advanced centre which will cater to the needs of the patients from various parts of the country and carry out research, provide service including prenatal diagnosis and training opportunities to researchers interested in carrying out biochemical or molecular investigations in LSDs"

Centres on Stem Cell Research

ICMR and various other science agencies are contributing to research and application of stem cell as well as other cell based therapies. Several such centres have been established during XI Plan. In order to strengthen the research and implementation of infrastructure in the medical colleges, such centres need to be opened in different parts of the Country. ICMR proposes to approve at least a dozen such centres in the coming years.

Centre for Advanced Research on Congenital Defects & Disorders of Sex Development

ICMR plans to establish advanced centre(s) to accelerate and coordinate research on congenital birth defects and related problems during XII plan.

Centre for Advanced Research in Diabetes, CVD and Stroke (CARDiCS) at PGI, Chandigarh

The centre is proposed to generate new knowledge in the area of cardio vascular disease, diabetes, stroke by adopting a inter disciplinary approach for prevention, management and control. The centre will also support research efforts for new discoveries and cutting edge research in the basic, clinical as well as carry translational research. This will also be a reference centre for these diseases.

Centres for Advanced Research on Muscular Dystrophy at Coimbatore & Mumbai

Muscular Dystrophy is an important health problem which needs to be focused from the point of view of management of the affected individuals and also research on the genetics for developing appropriate counseling procedures. A Centre(s) for Advanced Research on

Muscular Dystrophy is/are proposed to be set up at Coimbatore, Mumbai and other appropriate locations.

Centre for Neuro Muscular Disorders at NIMHANS, Bangalore

Neuro muscular disorders are important disorders affecting larger section of the society, which need to be addressed as per the conditions of the affected individuals and also research on the genetics aspects of the disease so that appropriate counseling can be given. A Centre for Advanced Research on Neuro Muscular Disorder is proposed to be established at NIMHANS, Bangalore.

Centre for Advanced Research on Urban Mental Health at IHBAS, Delhi

In the changing scenario of urban life and social disintegration of family life, mental disorders are becoming important. In order to manage these problems more effectively, knowledge needs to be generated from the urban populations in Indian settings. A Centre for Advanced Research on Urban Mental Health is proposed to be established by the ICMR at Institute of Human Behaviour and Allied Sciences(IHBAS), Delhi to undertake multidimensional studies.

Centres for Uropathies and Chronic Kidney Disease at AIIMS, New Delhi & PGIMER, Chandigarh

In order to give special attention to the development of renal problems in children as well as adult population, ICMR proposes to establish Centres for Advance Research on Uropathies and Chronic Kidney Disease at AIIMS, New Delhi, PGIMER, Chandigarh and other appropriate institutons.

Centres on Mental Health & Ageing

India has a increasingly number of ageing population. This population has many problems of which mental health is the most important component. While mental health as such needs to be strengthened in the country by appropriate research, adequate manpower to implement and coordination among various health and research agencies. The Geriatric mental health needs special attention and important departments have been established at CSMU, Lucknow, which could be considered to serve as National centre. For this purpose, ICMR proposes to approve/ establish advanced centres/national centres in institutions such as CSMU, Lucknow and others across the country.

Centre for Research on Oral Health

ICMR has been trying to encourage research on oral health by funding different adhoc projects. While there is an improvement in terms of more clinicians and epidemiologists joining the mainstream of research for epidemiological investigations as well as improved methods for diagnosis and management of indigenous efforts can be described as just as the beginning. The apex centre will undertake research and training on important oral health issues, will coordinate multicentric studies on epidemiology, interventions and implementation of different preventive and curative methods for improving the oral health. Research in to areas of key interest which can bring dental treatment to affordable cost and easily available to all sections of society will be the major objective of these research efforts. Organization of research methodology

workshop, development of projects on key issues including congenital birth defects will also be included. This centre should ultimately lead to the development of a National Institute for Dental and Oral Health Research.

Centre for Research on Trauma

Due to rapid increase in the road traffic and several inherent contributing factors, the accidents have increased in numbers. Similarly, the injuries due to various other occupations have also undergone qualitative and quantitative change. Govt. of India has made special efforts to enhance the capability in the hospitals to deal with trauma. Many trauma centres are coming up in the major hospitals in different cities. While legislative and other preventive measures about the road conditions *etc* are to be dealt with by other agencies, there is a need to launch a focused programme on scientific/medical issues of management of injuries. Such research, will be in terms of only modifying the surgical procedures, appliances and rehabilitation measures. ICMR plans to have a dedicated scientific research programme on trauma related issues and opening of research centres/units will be among those measures.

Centres on Bone Health

Bone health has not received adequate attention from the research perspective. While our orthopedic departments and surgeons have been doing a good job in bringing latest surgical methods to the people, the issues pertaining to effect of nutrition, hormones, genetics on bone formation and healthy bone deserve greater attention as many of the conditions could be prevented. ICMR plans to augment research on various aspects of bone health by creating task forces, opening specialized centres in medical institutions to address these problems.

Centre for studies on Fluorosis

Fluorosis has been a significant health problem in several parts of the country for many decades. Not only this leads to bony changes and disability, this may damage also the kidneys and produce other systemic defects. Government of India as a special programme to address the problem of high fluoride content in the deep tube well water has recommended the use of several methods which have been developed in India. ICMR has reviewed the current status of the problem and created a special task force to deal with the issue. Studies are being funded/will be funded to assess the current public health impact of use of such water with high fluoride content and impact of different intervention measures. In addition, the studies will be expanded to investigate other harmful elements like arsenic in the same water sources. Feedback will be made available to the programmes on health as well as safe water supply.

Advanced Centre on Zoonosis

Various zoonotic diseases are important public health problems in India. Because of the proximity of the animals and humans, the country requires a well focused research programme to generate knowledge for public health interventions. This requires coordinated efforts between medical and agriculture scientists working on veterinary medicine. ICMR and ICAR have launched a joint programme to strengthen the research programme on zoonosis. It is felt that a Joint Advanced Centre on Zoonosis is required

for constantly reviewing the priorities, dynamics of transmission of such diseases and suggest implementation measures for control of these infections. During the XII Plan, it is proposed to establish such a Centre(s).

Centre for Studies on Climate Change and Health

There is a growing concern on the effects of climate change on health. While the issue has many dimensions such as, the changes in the character or radiations, pollution, vector borne diseases, nutrition *etc*, concerted efforts on individual target areas will have to be made for in depth analysis of any such effects and then to develop appropriate methods to deal with them. ICMR is funding several studies on different aspects related to climate change. However, these efforts are just the beginning and there is a need to scale up these activities to involve many other stakeholders such as medical colleges, states in the research efforts. ICMR plans to give special attention to this issue by creating networks for joint projects, in depth reviews and opening of centres of excellence/advance centres to stimulate research in different parts of the Country. These centres will be inter-disciplinary and work on different areas of human health (communicable-vector borne/water borne and non-communicable diseases) linked with the climate change.

Centre on Influenza

Influenza is an acute viral infection that spreads easily from person to person and circulates worldwide quickly due to increased air travel and can affect anybody in any age group. It is a serious public health problem that causes severe illnesses and deaths for higher risk populations. Influenza is very important as outbreaks/epidemics and pandemics are quite common as virus keeps on changing constantly. An epidemic can take an economic toll through lost workforce, productivity, and strain health services. National Institute of Virology (NIV), Pune of ICMR is the apex organization dealing with the viral diseases in addition to National Centre for Diseases Control (NCDC), Delhi. An expert group of the Planning commission for XII plan suggested that a dedicated centre on Influenza should be set up that can work, co-ordinate and implement national research plans in to action. Hence, it is proposed to set up an exclusive centre on Influenza during XII plan. This centre may be established either at National Institute of Virology (NIV), Pune or elsewhere, where logistics are available.

Centre for Advanced Research in Community based Maternal, New born and Child Health

This Advanced Centre would carry out research on issues related to maternal, new born and child health in the community. The Centre would address research on identifying community-based solutions on these priority areas and would suggest appropriate intervention strategies.

Centre for Advanced Research in Childhood and Nutrition

Nutrition is important component of the well being of a growing child. The Centre aims to carry out basic, clinical and operational research on the problem of malnutrition and under-nutrition and suggest interventions.

Centre for Advanced Research for Adolescent Health and Gender Equality Research

Several issues on Adolescent health, especially in semi-urban and rural areas are still not completely understood. Such data/information is required for addressing the emerging problem of drug addiction, alcohol consumption *etc.* The area of gender equity is necessary to understand and bridge the gender gap in access to health care.

Centre for Advanced Research on Policy Research in Maternal and Child Health

The proposed centre will carry out research on identifying the priorities on studies related to the health of the mother and child. The priorities identified will find policy applications.

Centre for Advanced Research on Molecular and Cellular Reproduction

It is proposed to start a Centre for Advanced Research in Molecular and Cellular Reproduction to carry out basic research towards developing new safe, effective, reversible and user- friendly contraceptives.

Centre on the Gender Related Health Issues

It is well known that gender issues are important not only in reproductive health related aspects but in many other facets related to delivery of services according to the needs. ICMR and DHR plans to give special impetus to research related to women health, adolescent health in the context of biological as well as socio-behavioural issues pertaining to health. This would be attempted again by establishing a national centre/centre for advanced research after defining the core deliverables for each of such centres.

Centre for Advanced Research on Transgender Issues

It is proposed to set up a Centre for Advanced Research on transgender issues to deal with the problems related to this area and find out appropriate solutions through the research in this area.

ICMR-ICAR Centre on Health Foods

Health foods are increasingly being consumed for specific health benefits such as promoting health by maintaining the functions of the body, lowering risks of diseases and reviving vitality after sickness. It is an umbrella term comprising of functional foods/ nutraceuticals, organic foods, novel foods and sometimes nutritional supplements. During the last decade, there has been increased influx of health foods in the market. However, there is no systematic approach for evaluation of health foods to ensure efficacy & safety. It is, therefore, proposed to have a joint venture of ICMR & ICAR on health foods during XII Five Year Plan with the following objective: interdisciplinary research leading to development of nutritionally-enhanced and value-added food/food products for improving the health and brings about benefits to the consumers, ensuring safety without sacrificing specific functional or sensory aspects of food/ food products. Acceptability studies of health foods, market surveillance, impact evaluation, capacity building & development of regulatory guidelines for research purpose could be other aspects which will be covered under the joint venture.

Centre of Excellence in Nutrition at Government Medical College, Jammu

It is proposed to establish a “Centre of Excellence” in the field of nutrition at Government Medical College, Jammu with the objectives to conduct basic, clinical and epidemiological research in the field of nutrition; facilitate regional Institutes, Medical colleges *etc* by providing technical support; capacity building and manpower development by imparting training to State personnel and researchers; development of training modules for training of paramedicals and evaluation of national programmes in the field of nutrition.

Centre for Advanced Research on Quality Standards of Indian Medicinal Plants

ICMR has a medicinal plant unit, it is also involved in the research on plant based medicines by collaborating with Department of Ayush and CSIR. It has now got an institute at Belgaum which has a main focus on herbal medicines for encouraging the research on this aspect. The establishment of a centre for Advanced Research on quality standards of Indian medicinal plants by ICMR will be very important and is being planned to create such a centre in the XII Plan.

TRANS-DISCIPLINARY AND INTEGRATIVE RESEARCH

(Rs. 500 Crores)

Achievement of national health goals requires an integrated delivery of health services utilizing the mutual strengths of bio-medical and Indian Systems of Medicine. The National Health Policy (2002) noted that ‘Under the overarching umbrella of the national health frame work, the alternative systems of Medicine – Ayurveda, Unani, Siddha and Homoeopathy – have a substantial role. Because of inherent advantages, such as diversity, modest cost, low level of technological input and the growing popularity of natural plant-based products, these systems are attractive, particularly in the under-served, remote and tribal areas.’ Similarly, the National Policy on Indian Systems of Medicine & Homoeopathy (2002) declares as its basic objective, inter alia, the “integration of ISM&H in healthcare delivery system and National Programmes and ensure optimal use of the vast infrastructure of hospitals, dispensaries and physicians”.

Trans-disciplinary research and practice requires standardization of terminologies and of classical therapies, and development of Standard Treatment Guidelines, which must be taken up as a priority. Also, classical drugs listed in formularies and therapies should be validated for their safety and efficacy, as recommended in the National Health Policy of 2002. A joint ICMR-AYUSH decision making body with representation of all Research Councils may also be constituted for promoting interdisciplinary research in areas of national interest.

TRANS-DISCIPLINARY AND INTEGRATIVE RESEARCH

HUMAN RESOURCES REQUIREMENT FOR THE XII PLAN

Creation of 500 Scientists posts as per the recommendation of Performance Appraisal Board

As per the recommendation of Performance Appraisal Board, a proposal has also been submitted to the Government for creation of 512 new regular posts of scientists (B-E) for different institutes of the Council to carry out their research programmes. Out of this 136 posts have been recommended for creation in the year 2011-12 and the balance 376 posts may be sanctioned in the first two years of the XII Plan so that action for filling of these posts can be taken and the work starts at the earliest. The 48th Standing Committee of Rajya Sabha has strongly recommended for creation of these posts.

Matching manpower for 500 scientists posts

In addition the 48th Standing Committee of Rajya Sabha has recommended creating matching 500 Junior Research Fellows and 500 Technical Officers posts (250 each) in PB-2, Grade Pay of ₹ 4600 and PB-3, Grade Pay of ₹ 5400.

Engineering, Technical and other Staff to Support High Technology and other Facilities of ICMR

Engineering cell in ICMR is looking after the design, drawing, planning, estimation, tendering, approvals, monitoring of progress, co-ordination with various agencies & all other activities regarding engineering works in its thirty one Institutes & Head Quarters. Various engineering works involved design and construction of laboratories, animal houses, administrative buildings, hostel, guest houses, staff quarters, water tanks, electrical and water supply, sanitation, roads & substation *etc.* Construction of highly sophisticated laboratories like BSL-3 & BSL -4 is also being established in various ICMR Institutes. All these facilities do not have proper engineering support to run and maintain them. It is therefore proposed to establish an engineering and technical core group for Biosafety laboratories in ICMR. Many new Institutes are coming up for which buildings are to be constructed. Laboratories and animal house of old Institutes are to be renovated & to be brought up to the international standards. The repair & maintenance of existing infrastructure is also taken care by the engineering cell.

Large numbers of engineering works of different magnitudes are sanctioned every year. In 2000-01, the total capital outlay was hardly ₹ 7- 8 crores, which has increased to ₹ 80-90 crores in 2011-12 & likely to increase further. The existing positions in engineering cell are one Ex. Engineer (civil), one JE(civil), one JE(electrical) and one Maintenance officer (JE civil).

Due to the shortage of engineering staff, there is delay in implementation of the projects which affects the Health research in the country adversely. The maintenance and upkeep of records

regarding all the projects is also not possible, and monitoring of progress of works is delayed. This has also been commented upon through audit by the Principal Directorate of Audit for Scientific Department, Govt of India.

In order to manage the existing and future works of ICMR properly, 10 posts of engineers and supporting staff are required.

Research Group on highly infectious potentially epidemic/ bioterrorism agents

Keeping in view the current scenario and our growing capabilities we should be able to detect pathogens with capacity to spread fast. Infectious disease laboratories of network of DHR will provide infrastructural base. However, a dedicated research human resource will be essential to carry out research on such agents, develop/ evaluate reagents and assist MOHFW and NDMA whenever required. For this purpose 105 scientists (3 per state) and 315 technical assistants/ officers will be required to carry out research on a **regular basis** on infectious pathogens and to prevent and manage epidemics/ outbreaks/ disasters. These personnel will be posted at nearby ICMR/ other Central Government Institutions, This will empower the country to be self-reliant and leader in this aspect which will be threat from public health point of view.

Human resource for research studies on flagship programme on Control of Vector Borne Diseases, Nutrition & Reproductive Health

Based on dire need of creation and sustenance of dedicated manpower and infrastructure to work on translational, operational and implementation of research on vector control, viral infections like JE, human reproduction specially fertility control and malaria, ICMR is working through extramural mode for the last 5-30 years. These projects cannot be terminated till regular posts are approved as all of these programmes will have to be internally sustained. 580 personnel in different categories will be required. Further there is large number of litigations as ICMR do not have any regular post to regularize their services and MOF has been sanctioning posts whenever courts have been forcing. In such a situation even efficiency of these intramural projects (run in the name of extramural long term projects) is getting affected. It is proposed to create these 580 posts. The financial implication for these posts would not be there as they are already drawing salary from the funds of the council.

Manpower requirement for National Institute for Research in Environmental Health (NIREH)

National Institute for Research in Environmental Health (NIREH) has been established at Bhopal with the approval of Group of Ministers and Standing Committee has to be constituted for this institute to see the construction of building and requirement of personnel for managing the institute. The Standing Committee has recommended a total of 201 posts in different categories In addition 18 consultants in different disciplines would be required to manage OPDs set-up recently established at Kamla Nehru Gas Rahat Hospital which will be required even after the proposed takeover of Bhopal Memorial Hospital and Research centre.

Restructuring of technical as well as administrative cadre

In the last two decades, neither any additional regular post was sanctioned nor was any restructuring of the cadres carried out. The Performance Appraisal Board (PAB) has

recommended restructuring of the cadres to make it more effective and provide motivation to the staff with a view to increase their efficiency and induct more qualified and skilled staff. The financial implication of this proposal would not be very high and would be adjusted within the sanctioned budget of ICMR.

Deemed University

A total of 16 posts in different categories will be required for the Deemed University.

Directorate of Recruitment and Assessment (DRA)

A total of 10 posts will be required for Directorate of Recruitment and Assessment.

Manpower for New Institutes/Centers

The new institutes and centers, if approved, will be created through EFC/SFC and manpower will be projected in the respective documents to be submitted for approval of the Government.

The total budgetary requirement for the above post would be ₹ 150 crore for the XII Plan period.

BUDGET

For the XII Plan, an outlay of ₹ 16000 crores is proposed. Main budgetary items are:

DHR other than ICMR: (₹ 7500 crores)

- **Infrastructure Development** (₹ 3000 crores; 250 multidisciplinary units in medical colleges; 50 MRHRU units; specialized centres/units)
- **Human Resource Development** (₹ 1000 crores; 1000 midcareer and 2500 young investigators; 2/3 from medical colleges)
- **Laboratory network for research on viral and other infectious diseases** (₹ 900 crores; 6 regional BSL III; 50 cat. I state level labs and 200 Cat. II district level labs in medical colleges)
- **Grant in Aid scheme for projects requiring inter-sectoral coordination, translation specially in PPP mode and IT enabled governance, implementation research** (₹ 2000 crores)
- **Transdisciplinary and Integrative Research** (₹ 500 Crores)
- **Governance and Departmental Expenses** (₹ 100 crores)

ICMR: (₹ 8500 crores)

- **Funding of Extramural Projects** (₹ 2500 crores including the ongoing projects);
- **Funding of Intramural Programmes through ICMR Institutes/ Centres** (₹ 2500 crores including the ongoing studies)
- **New Institutes/Centres/upgradation of existing ones** (₹ 3150 Crores – Non communicable diseases - Cardiovascular, neurological, mental health, ageing ; Primates and other animal models; Health Systems Research, Health Economics, Policy Research on Drug resistance, Vaccine Preventable Diseases, Clinical Pharmacology, Molecular and Transplant Immunology *etc.*)
- **Outbreak /Disaster Response Fund- ₹ 50 crores**
- **New Positions – (₹ 300 crores)** – Mostly scientific for creating essential structure in DHR, its outreach units/ labs; ICMR Institutes/ Centres in deficient areas as well as new Institute and Hospital at Bhopal.

ANNEXURES

ICMR PERMANENT INSTITUTES / CENTRES

ICMR PERMANENT INSTITUTES / CENTRES

1. National JALMA Institute for Leprosy and Other Mycobacterial Diseases
P.B.No.101, Dr. M. Miyazaki Marg
Taj Ganj
Agra 282001
2. National Institute of Occupational Health
Meghani Nagar
Ahmedabad 380016
3. National Institute of Epidemiology
R-127, 3rd Avenue
Tamil Nadu Housing Board
Ayapakkam
Chennai 600077
4. National Institute for Research in Tuberculosis
No. 1 Sathiyamoorthy Road
Chetput
Chennai 600031
5. National Institute of Malaria Research
Sector 8, Dwarka
New Delhi 110077
6. National Institute of Nutrition
Jamai Osmania, Tarnaka
Hyderabad 500007
7. Food and Drug Toxicology Research Centre
National Institute of Nutrition
Jamai-Osmania
Hyderabad 500007
8. National Centre for Laboratory Animal Science
National Institute of Nutrition
Jamai Osmania
Hyderabad 500007

9. National Institute of Cholera and Enteric Diseases
P-33, CIT Road Scheme XM
Beliaghata
Kolkata 700010
10. Centre for Research in Medical Entomology
4, Sarojini Street
Chinna Chokkikulam
Madurai 625002
11. Enterovirus Research Centre
Haffkine Institute Campus
Acharya Donde Marg
Parel
Mumbai 400012
12. Genetic Research Centre
National Institute for
Research in Reproductive Health
Jehangir Merwanji Street
Parel
Mumbai 400012
13. National Institute for Research in
Reproductive Health
Jehangir Merwanji Street
Parel
Mumbai 400012
14. National Institute of Immunohaematology
13th Floor, New Multistoreyed Building
K.E.M. Hospital Campus
Parel
Mumbai 400012
15. National Institute of Medical Statistics
ICMR Head Quarters Campus
Ansari Nagar
New Delhi 110029
16. Institute of Cytology and Preventive Oncology
I-7, Sector-39, P.O.Box.No.544
Near Government Degree College
Opposite City Centre
NOIDA 201301

17. National Institute of Pathology
Safdarjang Hospital Campus
Post Box No. 4909
New Delhi 110029
18. Rajendra Memorial Research
Institute of Medical Sciences
Agamkuan
Patna 800007
19. Vector Control Research Centre
Medical Complex
Indira Nagar
Puducherry 605006
20. Microbial Containment Complex
Sus Road
Pashan
Pune 411021
21. National AIDS Research Institute
G-73
MICD Complex, Bhosari
Pune 411026
22. National Institute of Virology
20-A, Dr.Ambedkar Road
P.B. No.11
Pune 411001
23. ICMR Virus Unit (Regional Infectious Disease Laboratory)
GB4, Ist Floor , ID & BG Hospital Campus
57, Dr. S.C. Banerjee Road, Beliaghata
Kolkata 700010
24. National Institute for Research in Environmental Health
Kamla Nehru Hospital Building
Gandhi Medical College Campus
Bhopal 462001
25. National Centre for Disease Informatics and Research
Nirmal Bhawan-ICMR Complex (II Floor)
Poojanhalli Road, Off NH-7
Adjacent to Trumpet Flyover of BIAL
Kannamangla Post
Bangalore 562110

26. Bhopal Memorial Hospital & Research Centre
Raisen Bye Pass Road
Karond
Bhopal 462 038
27. Regional Medical Research Centre
Nehru Nagar
National Highway No. 4
Belgaum 590010
28. Regional Medical Research Centre
Nandankanan Road
P.O. Chandrasekharapur
Bhubaneswar 751023
29. Regional Medical Research Centre
N.E.Region, East-Chowkidinghee
Post Box No. 105
Dibrugarh 786001
30. Regional Medical Research Centre for Tribals
Medical College Campus
Nagpur Road
P.O.Garha
Jabalpur 482003
31. Desert Medicine Research Centre
P.O.Box No. 122
New Pali Road
Jodhpur 342005
32. Regional Medical Research Centre
Post Bag No.13
Dollygunj
Port Blair 744101

REPORT OF THE WORKING GROUP ON HEALTH RESEARCH FOR THE XII PLAN

Health research is the key to a well functioning and effective health sector in the country. Major scientific breakthroughs hold the promise for more effective prevention, management and treatment for an array of critical health problems. The research to be undertaken should be on country specific health problems essential for the formulation of sound policies and plans for field action. But new interventions and development of new health products (drugs, diagnostics and vaccines) are possible only when there is well defined funding, infrastructure and priority for health research. Medical research in the country needs to be focused on new therapeutic drugs/vaccines for tropical diseases, normally neglected by multinational pharmaceutical companies on account of their limited profitability potential. In addition, India is also witnessing the ‘dual disease burden’ with the non-communicable diseases like cardiovascular diseases, diabetes, cancers *etc.* threatening to overtake infections. The thrust and focus of our medical research therefore needs to be on both the infections as also the newly emerging NCDs using cutting-edge science and technology based on genetics, molecular biology, genomics *etc.* It would be reasonable to infer that with the current low budget allocation to health research, it is difficult to make any dramatic break-through within the country, by way of new molecules and vaccines and other health products.

The National Health Policy 2002 defined the goal for Health Research as follows:

“Over the years, health research activity in the country has been very limited. In the Government sector, such research has been confined to the research institutions under the Indian Council of Medical Research, and other institutions funded by the Central/ State Governments. Research in the private sector has assumed some significance only in the last decade. In our country, where the aggregate annual health expenditure is of the order of Rs. 80,000 crores, the expenditure in 1998-99 on research, both public and private sectors, was only of the order of Rs. 1150 crores. It would be reasonable to infer that with such low research expenditure, it is virtually impossible to make any dramatic break-through within the country, by way of new molecules and vaccines; also, without a minimal back-up of applied and operational research, it would be difficult to assess whether the health expenditure in the country is being incurred through optimal applications and appropriate public health strategies. Medical Research in the country needs to be focused on therapeutic drugs/vaccines for tropical diseases, which are normally neglected by international pharmaceutical companies on account of their limited profitability potential. The thrust will need to be in the newly-emerging frontier areas of research based on genetics, genome-based drugs and therapies, vaccine development and molecular biology *etc.*”

Since its establishment, the ICMR has been making concerted efforts to address the health needs of the nation. Given its limited resources – human, financial and infrastructural the Council has discharged its national obligations through its network of 32 national institutes including 6 regional medical research centres, over 100 field stations and a strong and vibrant

extramural research in medical colleges and other institutes. The rapidly growing economy with an average annual growth rate of almost 9.0% has thrown up new challenges in the health sector: a population that is divided into an increasing number of middle and upper middle class and the marginalized segment of society. The health challenges continue to be huge, and complex. We have at the same time serious problems of malnutrition, both under-nutrition among children and growing problem of obesity in school going and adolescents, continued infectious disease burden among the poor to rising cardiovascular disease and diabetes disease load among the rich. What is more, 'development' – rapid industrialization of India, use of pesticides and fertilizers for improving crop yields are rapidly degrading the environment, causing air and water pollution resulting in several health problems from chemicals in breast milk to increasing cancers in different communities.

Due to improved health care, there is a growing and greying middle class adding to older citizens which is demanding specialized geriatric care. To address these unique 'double burden', the national research agenda needs to be constantly updated to cope with these new challenges. Finally, the global trade and new intellectual property rights regimes have added another dimension of the rise in cost of medicines and the limited possibility of producing affordable generics in the future. We need to create our own products and processes, if we have to ensure affordable health care for our population; even to address the infections like TB, malaria, HIV/AIDS *etc.* that largely come under the public health system.

Clearly, Medical Research in the country needs to be focused on creating our own therapeutic drugs/vaccines and other interventions especially for tropical diseases for which there have been few inventions in the last decades. However, the development of new health products (diagnostics, drugs and vaccines) is a long and complex process and we need to have systems in place to encourage innovation and appropriate ethical and regulatory frame-work for pre-clinical work and clinical trials for bringing our health products to market.

The thrust and focus therefore needs to be to create new directed knowledge generated in frontier areas of research based on genetics, molecular biology, *etc.* and conventional means to develop affordable genome-based drugs and vaccines, which is the strength of the resurgent India. Over the years, the Council has been doing its best in all these areas, despite limited resources.

NEW SCENARIO

During the last 10 years, the overall situation has somewhat changed with more resources being provided for biomedical research to and through the ICMR, and to other science agencies. But unlike biomedical research, health research is much more encompassing covering a wider horizon for the creation of new knowledge and tools for application in human populations. To address this challenging task and to give a greater thrust and focus to Health Research, a new Department of Health Research (DHR) under the Ministry of Health & Family Welfare was created on the 17th September, 2007. The Department was formally launched on 5th October, 2007.

The mandate of DHR is as follows:

1. Promotion and co-ordination of basic, applied and clinical research including clinical trials and operational research in areas related to medical, health, biomedical and medical profession and education through development of infrastructure, manpower and skills in cutting edge areas and management of related information thereto.

2. Promote and provide guidance on research governance issues, including ethical issues in medical and health research.
3. Inter-sectoral coordination and promotion of public-private partnership in medical, bio-medical and health research related areas.
4. Advanced training in research areas concerning medicine and health including grant of fellowships for such training in India and abroad.
5. International cooperation in medical and health research including work related to international conferences in related areas in India and abroad.
6. Technical support for dealing with epidemics and natural calamities.
7. Investigation of outbreaks due to new and exotic agents and development of tools for prevention.
8. Matters relating to scientific societies and associations, charitable and religious endowments in medicine and health research areas.
9. Coordination between organizations and institutes under the Central and State Governments in areas related to the subjects entrusted to the Department and for the promotion of special studies in medicine and health.
10. Administering and monitoring of Indian Council of Medical Research.

With the creation of Department of Health Research, a paradigm shift in pursuing the national health research agenda is expected. Since independence, India has spent most of its resources and energy on the development and deployment of new knowledge about various diseases (especially infectious diseases which account for most deaths) in a concerted attempt to control, treat or eradicate them. While tools used were mostly global, the strategies developed were local. The new disease control/treatment regimens and methods of their usage in public health were the original concepts from India, especially for diseases like tuberculosis and leprosy. These strategies have been widely acclaimed and recognized and have found their way into international programmes operated through agencies like the WHO. India has thus spent considerable efforts in successfully putting various ideas into action. As a result, we have achieved great successes in the area of infectious diseases like elimination of guinea worm disease, eradication of smallpox, elimination of leprosy and polio as public health problems. During the recent times, the country showed remarkable and globally acclaimed successes in controlling the speed of spread of H1N1 epidemic. In addition, there have been emerging and re-emerging infections like H1N1, exotic viral infections that have been continuously challenging the health system. As the infectious diseases have no respect for borders, we may well have prevented a disaster of spread of these epidemics in the Indian sub-continent. While we count these successes with legitimate pride, there have been failures in some sectors. We have also not been able to successfully address issues like the huge maternal and child mortality and have been way behind in the achievement of MDGs 4 and 5. We have also not been very successful in providing access to even minimal health care to our large tribal and marginalized communities. All these remind us of the need for constant vigilance and a nation-wide targeted, concerted and committed time-bound action plan. Such efforts need to be on a mission-mode with defined deliverables keeping in mind available human resources, infrastructure, and unique socio-economic as well as geographical realities while setting achievable and realistic targets for the XII Plan.

The XII Plan approach paper for S&T lays emphasis on

- (a) An in depth review of our existing institutions, structures and mechanisms so that the much needed resources, financial and human, are deployed in an optimal fashion. There is no alternative but to focus on innovations to develop and deploy affordable tools for the management of various diseases guided by equity as the core value.
- (b) Building of alliances and partnership as another key element for a vibrant innovation ecosystem for translating research outputs to measurable social and national outcomes.

This is especially important as in the post-TRIPS era, there is little chance of using products and processes developed outside for use in India in view of protection of intellectual property rights. Discovery and development of indigenous health products is imperative to achieve equity with access to our large populations. India has often been found wanting on converting ideas and leads into products and processes for various reasons. Building of alliances and partnership for a vibrant innovation ecosystem for translating research outputs to measurable social and national outcomes therefore has been emphasised as one of the key elements in the approach paper of the XII Five Year plan.

Considering that health is a major driver of economic development and social contentment in any country, India has unique challenges due to its large population and demographic transition. We have the largest young population and a significant spurt of the people who are living longer and need specialized geriatric health care. To address these existing and new challenges, Department of Health Research has been assigned 10 business of which 9 are new and their evolution is vital for developing the health research agenda of the country for achieving the targets in a time bound manner.

The only ongoing activity of Department of Health Research pertains to administering and monitoring Indian Council of Medical Research (ICMR) which is in its 100th year of existence. Today, the ICMR stands out as a formidable and strong structure having 32 national and regional institutes and more than 100 field stations under its fold. More significantly, the Council has been able successfully access the strong medical college system across the country and support/collaborate with other national research institutions. It is, therefore, imperative that ICMR be further strengthened by continuous modernization of its own institutions as well as by opening of new centres focussed on the new emerging communicable and non-communicable diseases, cutting-edge basic science like transplant immunology, genomics, proteomics *etc.*, strengthen infrastructure for animal experiments, clinical pharmacology, critical health policy issues, health systems research, socio-behavioural science research *etc.* The human resource within the ICMR is very small in terms of the numbers with many institutes/centres functioning with sub-critical scientific pool. **It is absolutely essential to enhance the number of researchers and supportive workforce in the ICMR. There is no gain saying the fact that ICMR will continue to be the fulcrum of the new Department of Health Research, dedicated to taking the modern health technology to the people.**

The DHR has already embarked upon path of improving research governance by developing appropriate policies; establishing authorities to implement the policies; initiating the process of creation of suitable infrastructure in a medical colleges and other institutions; developing a special scheme to strengthen human resources in medical colleges and state structures; initiating the establishment of an extensive infrastructure encompassing all regions of the country to carry out research on various infectious diseases aimed at containing all future outbreaks or

epidemics. Lastly, DHR has also planned a major initiative in respect of establishing a vibrant and effective inter-sectoral co-ordination amongst science agencies in the country having the strength and mission of developing new products and processes or have overlapping areas of activity. These include agencies of Government of India involved in basic science and/or innovation on one hand (DST/DBT/CSIR/DSIR/DRDO *etc.*), or with a major emphasis on epidemiology and public health (ICMR/DHR/ICAR/DARE), agencies like DIT, DAE having a strong technology platform, Rural Development & Water Supply, Alternate Energy Sources, Women & Child Development, Environment and Forests, having complimentary areas of activity. Towards this end DHR plans to establish during the XII Plan well defined mechanisms to create synergies, structures for technology generation and its introduction, and implementation of the knowledge locally or internationally which suits our needs.

Before undertaking an assessment of the current situation it is necessary to recap the vision and tasks identified for the new department, after wide consultations with the stakeholders, at the time of its creation in 2007. These have been further fine tuned during the process of preparation of Results Framework Document (RFD). Most of these, as pointed out at the beginning were completely new areas of activity.

The Department has a vision “To bring modern health technology to the people through innovations related to diagnostic, treatment methods and vaccines for prevention; to translate them into products and processes and, in synergy with concerned organizations, introduce these innovations into public health systems”.

Objectives

1. To provide research leadership for resolving existing and emerging health challenges by promotion, co-ordination & development of basic, applied, clinical and operational research.
2. To address matters related to major health problems pertaining to epidemics, natural calamities and other emerging causes of morbidity and mortality.
3. To improve research governance.
4. To accelerate translational programmes specially by facilitating joint projects with other stake holders like DSIR, DARE, DRDO., DBT, DAE.
5. To promote public-private partnership for translating research leads into development of affordable diagnostic technologies and pharma products including vaccines to achieve broader objectives of providing better healthcare for the people.
6. To accelerate international co-operation in medical and health research.

ASSESSMENT OF CURRENT SITUATION

The current situation has been analyzed so as to prepare a strategy for XII Plan. The important points emerging from this analysis are described below –

- a) Strengths-** Currently health research in the country is primarily being supported by 32 ICMR institutions and nearly 100 Field Stations/Units funded by ICMR. In addition, other science agencies like DBT, DST, DRDO, Department of Information Technology, DARE, DSIR/CSIR, Department of Environment and Forests, Department of Atomic Energy, Ministry of Women and Child Development, *etc.* are funding certain sectors

of health research mostly through extramural funding and to some extent through their specialized institutions.

- b) **Challenges** – Notwithstanding many strengths enumerated above, the health research in India faces several challenges/hurdles which include emerging and newly emerging infectious diseases; increasing burden of chronic non-communicable diseases; decline in mortality and fertility rates; ageing population; lack of adequate infrastructure and human resources; poor funding and priority setting in comparison with developed nations; inadequate regulatory structure for such governance; health inequities between rich and the poor, including marginalized community/sections *etc.* Lack of coordination and translation mechanism in terms of testing institutions and ill-defined regulatory pathways, is another pressing challenge. Collectively, all of these have retarded the pace of progress in health research field as also translation and implementation.

The XI Five Year Plan of the ICMR had identified certain challenges based on the report of National Commission on Macro Economics and Health. The challenges identified included demographic changes, disease burden due to communicable diseases (HIV, TB, Malaria and emerging and re-emerging infections); non-communicable diseases (cardio-vascular diseases, diabetes, cancer, mental health, chronic and pulmonary diseases, asthma, accidents and injuries, oral health, suicides and stroke and neurological disorders; urban health; nutritional problems; reproductive & child health; quality of drugs and devices; narrow research base; limited human resource and neglect of translational research. The XI Plan had also mentioned of a shift from medical to health research and the need for strengthening the governance structure for medical research. Creation of a dedicated Department of Health Research is a step in that direction. Significantly, even at the beginning of XI Plan, the challenges were mostly the same. Yet, despite the earlier disadvantages, there has been significant progress during the last 5 years. The ICMR launched several research initiatives for containing the transmission of HIV, treatment of the drug resistant TB and malaria as well as other emerging and re-emerging infections. New programmes have also been launched to carry out research on various non-communicable diseases in a much more focused and accelerated way than before. Nevertheless, several new challenges have emerged during this period that include:

- i) increase in the drug resistance among various infectious agents due to misuse of drugs as well as laxity in the safety precautions in the hospitals;
- ii) genetic disorders, that are becoming more evident due to availability of new diagnostic tools but are largely preventable due to improvement in the technology;
- iii) increase in injuries due to accidents/trauma due to high urbanization;
- iv) significant neonatal mortality despite increase in the hospital deliveries;
- v) deaths due to childhood pneumonia, diarrhoea;
- vi) morbidity and mortality due to pyrexia of unknown origin;
- vii) lack of adequate progress on gender related issues in health care;
- viii) inadequate delivery of adequate healthcare to marginalized sections including tribes;

- ix) increase in the diseases due to unsafe water (communicable as well as non-communicable);
- x) slow progress in the developing of the areas like disease burden studies specially vaccine preventable diseases; and
- xi) health systems research, health economics and socio-behavioural aspects.
- xii) sub-critical qualified/trained human resource despite reasonably high inputs into various aspects of the health research by nearly ten departments of Govt. of India. Some of the major challenges are elaborated below :

Epidemiological and demographic transition: India continues to grow both in terms of young population as well as increasing proportion of elderly population. The health services thus need to be geared to face the burden of all the chronic diseases faced by this growing elderly population. Thus, the research efforts need to be geared towards identifying the health problems in the context of changing social norms and the care of elderly population.

Emerging and re-emerging infectious diseases: Due to the vastness of our country, the assessment of prevailing diseases is very challenging. Further, new diseases are emerging and old and extinct diseases are re-emerging. Pandemic H1N1, first time reports of human cases of Crimean Congo hemorrhagic fever and a major proportion of encephalitis-like disease with the causative agent as yet unidentified underscore the enormity of challenge of new and emerging diseases. The distribution and epidemiological significance of several drug resistant organisms also remains inadequately understood. Further, the cause of death due to fevers (acute as well as chronic) also remains undetermined in a significant proportion of these cases. Newer vaccines are being developed and a major decision would need to be made as to whether they should be introduced into the immunization programme. Such decisions require research on the cost effectiveness of vaccines versus the current methods of sanitation, mosquito control, clean water *etc.* There is as yet no concerted effort to study these aspects specially in case of available/ likely to be available vaccines against rota virus, influenza, papilloma virus *etc.* Research is needed on policy issues as how such interventions could be introduced vis-a-vis their acceptability by people, cost-benefit analysis *etc.*

Reproductive and child health: During the XI Five year plan, there has been gradual improvement in the percentage of under 5 mortality rates, maternal mortality rates as well as birth rate. However, the progress has not been as targeted and intense operational research is required to accelerate the pace for achieving the desired results. Low birth babies are a major public health issue which need social as well as health interventions.

Nutritional problems: The problems of under nutrition and increasing childhood obesity continue to be worrying. Micronutrient deficiencies, toxicity due to arsenic and fluoride, pesticides and other harmful materials (additives) other important problems which need to be addressed.

Urban Health: Urban health has emerged as a major health issue in the recent times, especially migration from rural and tribal areas is on the rise. Accidents and injuries now constitute a major cause of concern as over 2.0 lakh people die in India due to

accidents. This ‘triple burden’ of communicable, non-communicable and injuries need to be considered for both research and health care. Most rural folk are forced to come to cities for treatment where they find difficult to get admission/ stay . It is predicted by the Mckinsey Global Institute that in the next 20 years, India will have 68 cities with more than one million population. Currently, we have 42 such cities. Thus by 2030 India would have twice as many cities as the whole of Europe. Urban population would increase from 340 to 590 million which means that 10% of the India’s population will reside in cities. We need to start planning for urban health now. If urban health care system is improved, the rural population would also benefit by the improved health infrastructure and manpower. But this requires multi level and multi-sectoral planning. Fresh thinking on research approaches for policy making would be required rather than the current vertical decision making. A trans-disciplinary approaches involving not merely medical personnel but also engineers, economists, social scientists and the civil society would be needed. The experience of developed countries like Japan and Korea where overcrowding has broken up extended families putting pressure on the nuclear family with resultant is but a pointer to the impending mental health challenges in our country. Rising suicides amongst children and lack of care for aged have become worrisome.

Non-communicable diseases: With increasing life span, the number of ageing population is on the rise with resultant rise in non-communicable diseases like cardiovascular and neurological problems are becoming more and more pronounced. The recent study conducted by ICMR has shown the prevalence of diabetes ranging from 2.5% in Jharkhand to 10% in Chandigarh and other urban areas of the country. While the percentage of population having cancers has remained static, the profiles are changing and burden due to absolute numbers is showing a marked increase.

Trauma: The number of injury cases mainly due to road side accidents has been rapidly increasing in India. The nature of services to cope with such emergencies is grossly inadequate. Intense research efforts are required to understand the profile of these injuries for their appropriate management strategies which include preventive, curative and rehabilitation services.

Drugs and devices: Adequate availability of drugs as well as devices at affordable prices has been the cause of concern. Despite the stated goals of tackling this problem, the progress remains to be slow and the impact is not visible.

Increasing health inequities: During the XI Plan, health care facilities in urban areas have undergone major changes. While the number of specialized/super speciality hospitals in the private sector has seen a rapid increase which have also been reflected by medical tourism, this has also led to a greater divide in the capability of all Indians getting appropriate medical care in a cost effective way. The gap between rich and poor specially marginalized communities/sections has shown an increase resulting in heavy economic burden on populations pushing them down the economic ladder.

Inadequate infrastructure and human resources: At macro level, the facilities for different disease investigations and patient management continue to be grossly inadequate despite attempts of the government to open AIIMS-like institutions and granting permission to open a large number of medical colleges, the number of health personnel remains far below the norms and is also not equitably distributed. These

personnel are either not adequately trained in research methodology or have poor motivation due to various reasons in most parts of the country. Though a lot of initiatives have been taken to improve the situation, it will take quite some time to reach desirable standards.

CREATING A PROMOTIVE ENVIRONMENT FOR HEALTH RESEARCH

Several changes in the national and international health research environment during XI Plan period can be used as strong positive inputs to drive the new health research.

1. The Prime Minister of India has declared innovation as the main pathway for development of the country. The Hon'ble Prime Minister has also expressed the commitment of the government to double the spending on Research and Development sector.
2. The DBT has created a translational health research institute and similar infrastructure.
3. The ICMR has created a dedicated structure for translational research.
4. There is a felt need and initiative for the indigenous production of medical devices and health equipments for affordable health care.
5. India continues to be a globally accepted leader in the production of high quality low-priced pharmaceuticals and vaccines.
6. Indian industry is investing more in R&D aimed to create new IPR and is partnering with Indian institutions to produce globally competitive products.
7. A large number of leads potentially useful for development of diagnostics, therapeutics and vaccines are available from the publicly funded Indian institutions.
8. Ten science and other departments of the Govt. of India are contributing towards the development of better/improved diagnostics/therapeutics and vaccines and also contributing to implementation research.
9. Translational research, implementation research, health systems research, policy research, health economics and other vital areas important for harnessing the fruit of advances in the knowledge have made their presence felt in the Indian scenario.
10. Non-governmental agencies like the Public Health Foundation of India are partnering with the governmental institutions to strengthen public health research in India.
11. The regulatory mechanisms are rapidly improving and becoming more user- friendly which is conducive to the growth of thinking and innovative environment in the academic institutions as well as the industry.
12. A massive national effort is underway for the development of human resources at all levels – school, college, university and new schemes to retain and attract the right kind of qualified scientists and physicians from overseas.
13. There is positive resonance to the initiatives to enlarge the health research base of the country by increasing funding to medical colleges and institutions in the periphery, strengthening the infrastructure base in the medical colleges and intersectoral coordination by creating synergy amongst science and user departments.

During the XII Plan period, the strategy of Health Research would be:

- Nation-wide strengthening of infrastructure and developing human resource to ensure availability of geographically equitable resources and environment for enabling health research.
- Strengthening human resources and creating enabling environment for the pursuit of health research.
- Establishment of surveillance and diagnostic facilities for service and research on infectious diseases.
- Inter-sectoral coordination for ensuring optimization of resources.

To sum up

Health Research efforts would be directed towards bringing modern health technology to community by:

- Encouraging innovations related to diagnostics, vaccines and treatment methods .
- Translating the innovations into products/ processes by facilitating evaluation/ testing in synergy with other Departments like MOH&FW and other science departments and introducing these innovations into the public health system through health systems research as the main pathway to achieve the goals.
- Strengthening the ICMR so that it serves as fulcrum of this Department in generating scientific knowledge for translation and implementation through DHR mechanisms and in partnerships with other science and health departments.

BROAD FRAME WORK OF HEALTH RESEARCH ACTIVITIES

In the current scenario, the ICMR focuses on active research programmes for generation of new knowledge whereas DHR concentrates on

- Governance
- Development of infrastructure and manpower in medical colleges, state health systems, universities *etc*;
- Promoting the translation and implementation research through Central & State Govt Institutions through optimum use of knowledge management & NKN and by partnering with professional bodies, NGOs/ private sector and other stake holders
- Strengthen and augment international collaborations in health and
- Creation of mechanisms for management of epidemics/ pandemics *etc*.

The above-mentioned strategy proposed for the XII Plan was discussed by the experts of the Working Group on Health Research notified by the Planning Commission. The Working Group held its meetings on July 13, 2011 and July 25, 2011 to prepare the report. The individual proposals and the observations of the Working Group in respect of each are discussed below:

Special support to medical colleges:

India has currently nearly 300 medical colleges, about 150 in the government sector. Various medical institutions have served well and continue to contribute in terms of specialized health

care, education and to some extent research. While research should have been an integral activity, it has not happened in that way and the research activity has been mostly confined to about 20-25 medical colleges who garner most of funding for biomedical and health research. This has created a heavy responsibility and work load on these national institutions which is affecting the growth of quality health care, health education and health research in the country. The DHR has plans for establishing multi-disciplinary research units (around 250 units) at least in all the government medical colleges. These units will provide the modern technology infrastructure which will improve the quality of the specialized care, training of doctors and other health care professionals and then research as per the needs of the population.

Experts of Working Group on XII Plan emphasized that the DHR should focus on schemes aimed at modernizing the infrastructure for research in medical colleges and consider working with MCI and NAMS to find ways to improve the environment / facilities for research in medical colleges. Strengthening should be for research laboratories as well as auxiliary support systems like bioinformatics/biostatistics/nation-wide e-library network etc. A FIST-like programme of the Department of Science & Technology can be used as a model by the DHR to augment and complement facilities and infrastructure provided to medical colleges.

This special programme for medical colleges which is not so far in mainstream of healthcare and academic system, is expected to bring a qualitative change in the working of these colleges especially those in the public sector. The outcome of the support system in these medical colleges will be reflected by quality medical education which would lead to more patients being provided with advanced medical care across the country, larger number of researchers generating good quality research projects in the areas of national priority and thus contributing to a strong knowledge base of the country.

Establishment of model rural health research units:

There is a wide gap between the available specialized health care technology and the technology being developed vis-a-vis their utilization in the State health systems. This is particularly true for rural health settings. It is generally felt that technology application needs specialized infrastructure and can be done only in urban settings. In order to develop models for transfer of such technology to the end care users, the Department has planned to establish model rural health research units in all the States (about 50); more than one in larger states) where technology transfer and the research targeting health interventions will be done in partnership with the States.

During the consultations, the Working Group suggested that public-private partnership (PPP) model may be pursued for laboratory strengthening at the village / district levels through a system of empanelment.

This special programme for rural areas will lead to continuous transfer of technology for handling infectious and non-infectious diseases by the state health services resulting in reduction in morbidity and mortality. This will also be measurable by active joint projects by Unit, local medical colleges and state health services addressing local problems. These changes will be continuously monitored to ensure sustenance.

i. Establishment of a National Network for Viral Diagnostic/Infectious Disease Laboratories

India continues to have outbreaks/ epidemics due to various infectious pathogens. Currently national apex institutes like NCDC, New Delhi and NIV, Pune are mandated

to undertake the investigations that results in heavy burden affecting their real referral role. The resultant delay in diagnosis/detection and adequate/incomplete data about these outbreaks significantly impact the response time for interventions. Significantly, avoidable delays in both short and long terms strategies for prevention, treatment through vaccine production/introduction and up-gradation of infra-structure *etc.* The Department is planning to establish about 250 laboratories of three grades on infectious pathogens which will work under the overall guidance of apex institutions like NIV, NCDC through appropriate linkages and networking.

As suggested by Experts of the Working Group, a separate dedicated centre for Influenza research is being proposed in the schemes of DHR for prompt investigation of epidemics/ outbreaks.

Impact of this major empowerment will be visible by prompt and accurate diagnosis and management of various infections; identification of causative agents for the outbreaks/ epidemics and smooth data flow from across the sites of epidemics by efficient knowledge management using NKN for policy interventions like quick deployment of resources and measures like introduction of preventive strategies like new vaccines etc.

ii. Establishment of other specialized research units including labs

As a emerging developing country, India has plans and ambitions to be in the fore front in the creation of new knowledge/technology and making the technology available to our population through appropriate interventions. For this purpose, modern clinical / public health oriented set-ups are needed to work on cutting edge science like stem cells, molecular medicine, nano medicine *etc.*, and specialized centres/Institutes for mental health, oral health, health systems, health economics, policy related to research on implementation, molecular & transplant immunology *etc.* The Department plans to establish/ develop such centres for service, education and research.

During the consultations, Working Group also emphasized that the DHR should have a well developed Division/ Centre(s) on Food & Nutrition to study the potential harmful effects of additives present in food as well as other safety issues (imported/ local). Health effects of pesticides and other environmental factors may be given special attention. The DHR should help in the development of 4-6 apex laboratories and empanelment of specialized labs/ set ups in the country for testing of pharmaceutical/biological products which is vital for the growth of pharmaceutical/biotech industry: Establishment of a Special division/ centre on research on “Disaster management and Bioterrorism” should be explored. The DHR should have a dedicated cells/ divisions/ units for studying critical aspects related to National Programmes; responses required to deal with health issues gaining importance in media *etc.*; There should be a cell/ centre within the DHR to advise on various aspects of newly developed / introduced vaccines or any other intervention.

As suggested by working Group, all of these specialized laboratories, cells/ divisions have been proposed in the XII Plan.

Impact of these initiatives will be reflected by increase in number of research studies in cutting edge areas, development of more affordable reagents/ technologies/ tools

for public health use and also global leadership in diagnostics and pharmaceutical products. This will also result in affordable advanced health care thus saving costs on public health expenditure.

iii. Human Resources Development for Health Research

A major constraint in the current scenario is the lack of adequate and properly trained human resources for the health research. As a result, the output does not match the input we make as the investment is concentrated in few places only. The Department plans to strengthen human resource base of the country by organizing focused training programs within and outside India, for mid-career professionals in medical colleges and other academic establishments. Over 3000 personnel are proposed to be covered in various programmes mentioned below. Improving the career path for young researchers, expanding the number of specialized researchers and then providing good initial support in the form of start up grants are planned as a part of this programme. Activities proposed in this regard are:-

- (a) Fellowships for training: Researchers in identified advanced fields
- (b) Scholarships at PG level: Support for producing human resources in newer areas
- (c) Young researcher program: To encourage young students for research
- (d) Special training programs: In specified areas, this also includes support to selected institutions for training
- (e) Mid-career research fellowships: Faculty development for medical colleges

During the consultations, the Working Group emphasized on the need for a strong career development & advancement schemes for research students, medical faculty and other researchers, creation of a dedicated Research Cadre, innovative fellowship systems trainings (that address issues as not losing seniority in the Govt system), schemes for women scientists (who leave research on domestic and other grounds) to rejoin research career with other career incentives and establishment of Research Chairs/ special research positions in medical colleges in partnership with State/ Central Govt. Building of a strong and vibrant partnership with academic bodies, Health Universities as well as other universities were also emphasized.

All these have been included in the proposed activities of XII Plan.

All these activities will create a strong human resource development mechanism for providing mentorship and creating conducive environment for needs of different categories of aspiring researchers. Outcome will be measurable by the numbers of persons trained; projects generated by them and development and/or introduction of new technologies into the health care system at all levels.

iv. Inter-sectoral coordination & national and/ international collaboration

While several science departments are significantly contributing to innovation related to different aspects of biomedical research, it is felt that translation process and further implementation research is not as strong as is needed. In order to strengthen research effort in which the partnership of different government agencies, NGOs and Industry

is required, the Department has planned to provide support in the form of grant-in-aid to selected projects; create awards, dedicated funding for translation of innovations and their implementation and support to professional associations *etc.* for developing guidelines and priority setting. Thus there will be special focus on encouraging innovation, their translation and implementation by collaboration and cooperation with other agencies by laying special stress on implementation research so that there is a better utilization of available knowledge. In the XII Plan it is proposed to focus on such areas and fund projects where synergy is expected to bring better results.

The Working Group agreed that an Inter-departmental mission of biomedical and health research may be launched around medical / health priorities such as:

- i) Tuberculosis.
- ii) Viral infections with potential for outbreaks.
- iii) Zoonotic diseases.
- iv) Maternal and Child health including gender issues in health.
- v) Nutrition and Food safety.
- vi) Diseases preventable through measures like vaccines, environmental interventions, public health education *etc.*
- vii) Diabetes, cardiovascular, mental and chronic neurological disorders.
- viii) Affordable health care technologies (diagnostics, therapeutics, devices *etc.*).
- ix) Innovation in health care delivery.
- x) Rural healthcare.

In addition to above areas, The Working Group emphasized that priority be given to emerging infections; mental health and ageing-related diseases such as dementia, Parkinson's Disease, *etc.*; Urban health; especially the emerging triple disease burden due to communicable and non-communicable diseases and trauma; mechanisms to provide information / guidance on healthy life style; Gender issues in the provision of health services, setting up of district research stations, *etc.*

All of these suggestions have been incorporated in XII Plan.

As discussed above, it is of paramount importance to create synergy among various science agencies/ departments – those mainly involved in basic science and or innovation on one hand (*e.g.*, DST, DBT, CSIR/DSIR, DRDO *etc.*) to those with major application on epidemiology, public health (*e.g.*, ICMR). Thus, the effort should be on i) establishing mechanisms to evaluate technologies for improving health care at individual & public health level; ii) fostering academia-Industry link: creating processes and cell to link developers with industry for translation of leads into products/processes; and iii) establishment of a rapid clearing house mechanism for evaluation of health research technologies including the commercial applications. In addition agencies/ departments having complementary activities with DHR such as, DIT, ICAR/ DARE, Social Justice, Environment and Forests, Women and Children; Water resources; other user departments of MOH&FW *etc.* are proposed to be engaged in the process. Strengthening of international collaborations of scientific and strategic mutual interest will be a priority.

During the consultations the Working Group emphasized that DHR should focus on development of mechanisms (regulatory/promotional) to accelerate the indigenous production of instruments/ medical devices that are vital for affordable health care; DHR should focus on schemes aimed at making health care affordable for the poor / marginalized groups/ communities; The Group further recommended that the DHR should set up Technology Assessment Board/ Department consisting of economists, social scientists, public health professionals and other specialists (similar to the Offices of Technology Assessment in some countries) whereby new technologies can be scientifically assessed for promotion and also before introduction / procurement. Schemes to promote development of indigenous products by the Indian pharma industry should be established on the lines of DST/CSIR model. With over US \$85 billion of pharma products going to be off patent during the coming 5 years, the domestic industry would have a good opportunity for growth. But there is also need to set up strict regulatory mechanisms systems and mechanisms for quality control of drugs and other health products. To address this need, the Group also recommended that the DHR should set up apex drug testing laboratories and related regulatory infrastructure in every state in synergy/ coordination with DCGI and other appropriate mechanisms. The expert group also suggested setting of a Medical Technology Development Board to promote development of indigenous medical technologies.

All of these suggestions have been included in XII Plan.

These new initiatives will help in the creation of an efficient, promotive and regulatory structure involving different agencies in the Govt as well as outside to develop integrated solutions for the promotion of health. Outcome of these initiatives will be reflected in the generation of joint inter-departmental/ inter-agency projects on health problems (some already identified above); more affordable technologies for public health use; lesser dependence and expenditure of imports/ technologies for advanced health care and stronger indigenous health care globally competitive industry.

v. **Establishment of regulatory framework for research governance**

Research governance is one of the major tasks allocated to the DHR. The Working Group noted that, the Department has already developed a National Health Research Policy, Knowledge Management Policy and also prepared a draft Bill on Ethical Issues pertaining to Biomedical Research. Department is also pursuing Assisted Reproductive Technology Bill as well as a Bill on Alternate System of Medicine. During the XII Plan, all these policies are to be implemented. Department proposes to establish an authority (ies), systems and extracting evidence generation through model projects for improving the research governance in health in India. Further mechanisms are being built to create systems/ administrative structures for recognition of health research institutions and for identification & promotion of affordable technologies for improved diagnosis, treatment and prevention of various relevant diseases.

The Working Group endorsed the plans to improve governance by -

- Putting in place appropriate Guidelines, Acts, through appropriate regulatory authorities and structures to evaluate and recommend technologies, programmes, studies *etc.* for introduction into the public health system

- Enactment of an Ethics Bill and the establishment of the National Bioethics Authority.
- Creation of National Health Research Forum for implementing National Health Research Policy.
- Establishment of mechanisms for mapping, accreditation/ recognition *etc.* of health research institutions.
- Research for establishment of mechanisms for knowledge management for better service, education and research.

Development of robust ethical systems to promote ethical animal and human research programmes and its implementation was considered as a top priority by the Working Group. It was also suggested that the existing regulatory and related loopholes emerging from the current experience should be plugged and used to develop regulatory framework.

Outcome of the establishment of above systems and regulation will be reflected in improved ethical standards in biomedical research; proper allocation and utilization of resources for health research; better environment for product development for domestic and international purposes and optimum usage of infrastructure as well as human resources for health care, medical/ biomedical education, training and research.

vi. ***Strengthening and expansion of programmes of ICMR***

The Indian Council of Medical Research (ICMR) continues to provide critical support to various national programmes by generating new knowledge about the diseases, developing and evaluating tools for diagnosis and treatment and provide help in the framing of its policies for guiding research and providing feedback to the governments:

- During the XI Plan the ICMR has created a dedicated system of **translational research** in which the leads obtained by its scientists as well as other researchers in the country are being explored for their application in the health care system.
- The ICMR continues to synergize/ harmonize its agenda with national health programmes. Over the years, ICMR has established **a large number of Institutions** [32 of which two - the National Institute for Research in Environmental Health (NIREH), Bhopal and National centre for Disease Informatics (NCDI), Bangalore were established during current plan], field centres and has created networks of Institutes/centres/units on diseases ranging from vector borne diseases, viral infections, tuberculosis, leprosy, kala-azar to nutrition, cancer, genetics, blood disorders and reproduction as well as traditional medicine and herbal remedies.
- Establishment of a **Tribal Health Research Forum** for promotion of health of marginalized communities and creation of a **Vector Science Forum** are recent landmarks. A major initiative on Health Systems Research and initiation of programmes on newer areas like nano medicine were other important developments.
- While the Council has maintained its focus on diseases of poverty, several other initiatives have been launched such as special drive to develop projects in medical

colleges in the periphery, strengthening the fellowship programmes, further strengthening international partnerships, increasing attention on maternal and child health, mental health and through DHR mechanism is working towards **better synergy with other science departments and user departments** in MOHFW to ensure faster transfer of technology to end users. All the above programmes need to be further strengthened and consolidated during XII Five Year Plan.

- During XII Plan, it is proposed to further **expand and strengthen its extramural research** programme with focus on medical and other institutions, programmes on mental health, social and behavioural research, health system research, climate change and health, gender issues, complementary aspects of traditional and modern medicine, trauma and other non-communicable diseases while continuing its emphasis on infectious diseases.
- **Strengthening of the human resource base** (number of scientific, technical and managerial/ administrative) of ICMR is further proposed to be strengthened by restructuring and creation of new positions. New positions are proposed to be created for long term programmes that are currently run as extramural yet will always be important. New schemes for development of dedicated Research Cadre in medical colleges will be initiated by the DHR/ ICMR.
- **Opening of new centres on Primate research, other animal models** (National Animal Resources), Policy Research, Zoonotic diseases, Drug resistance, NCDs, Health Systems Research, Health Economics, Clinical pharmacology, Genetics, Transplantation Immunology, Clinical research, oral health, social and behavioural research *etc* is being targeted as future priorities.
- **Encourage schemes to develop health research in a holistic approach** (integration of different systems/guidelines for better service and to provide support to investigate on reportedly useful treatment methods not covered by any other medical system) will be explored.

While all the above aspects for areas need to be strengthened to fulfil the aspirations and needs of different stakeholders, ICMR proposes to give special emphasis to the following areas:

1. **Extramural research programmes:** Though the ICMR is proposing to expand and strengthen its own institutions, this will only partially meet the needs of the Country. Further empowerment of medical college system across the country is expected to provide greater capacity for not only research but service and good education as all three are interlinked. Keeping this in view, it has been decided that the ICMR Institutions/Centres will focus only on selected areas and strengthen the research in the country by expanding the extramural research programme with a special emphasis on public health aspect and implementation research through medical and other institutions in the periphery. Further, the ICMR plans to continue its focus on communicable diseases, vector borne diseases, mental health, social and behavioural research, health systems research, gender issues, climate change and health, complementary aspects of traditional/ alternative systems and

modern medicine, oral health, trauma and other non communicable diseases. The extramural research programme of the ICMR which has expanded several fold during recent years will be further expanded in the XII Plan.

2. **Specialized Centres:** During the XI Plan, ICMR had proposed to open several centres mainly on non-communicable diseases. Due to various constraints, only the National Centre on Disease Informatics, Bangalore and National Institute for Research in Environmental Health, Bhopal could be established. During the XII Five Year Plan, it is proposed to establish the centres for which action has already been initiated. In addition, it has been planned to open centres on policy research, drug resistance, health systems research, health economics, clinical pharmacology, clinical research, social and behavioural research, transplant immunology and other cutting edge/ relevant areas. Wherever, permanent institutions take long time to establish, as an interim measure it proposed to set up centres of advanced research/ Centres of excellence in extramural mode.
3. **Application of e-governance/ management in health research:** The Working Group emphasized on the need to go for e- governance by creating IT-enabled systems for public, project review process and analysis. As suggested, the IT component is being proposed in the DHR budget for efficient e-management for not only governance but also as a research tool for operational research to implement knowledge management policy developed by the department during the XI Plan utilizing NKN.

All model projects, appropriate administrative systems are proposed to be established during the XII Plan.

- vii) **Use of Information Technology:** During the consultations, experts have made several general recommendations which cut across specific areas/ aspects mentioned above :
 - The DHR should have IT-enabled systems for dealing with public and a paper-less project management system.
 - DHR/ ICMR should have an user-friendly electronic system for the applicants to know the real-time status of their proposals.
 - A IT-component should be included in the DHR budget for e-management.
 - A system of research audit should be established by the DHR.
- viii) **Strengthen synergy and co-ordination:** The Working Group emphasized that appropriate mechanisms may be considered to strengthen the synergy/ coordination between the DHR, DCGI and FSAI which have common objectives and mandate towards ensuring safe food to Indian people.

Expansion and strengthening of the ICMR will be reflected by the overall improvement in quality and quantity of health research by medical colleges, universities, other academic institutions as well as ICMR network. Output of these research will also be measurable by the research leads translating into products/ processes and interventions introduced into the programmes and practices. These will also be in the form of ICMR' inputs into policy change for disease prevention and management at patient and public health level. Number of publications and patents; persons trained

through capacity building; contributions to disaster management as well as new leads/ knowledge generated will also be measurable outcome.

PRIORITY AREAS – THE 10 POINT AGENDA:

All the areas listed above were considered important and strongly recommended by the Working Group and basing upon their suggestions, the Department proposes the following areas to be of top priority agenda for the health research during the XII Plan.

1. **Strengthening of research infrastructure:** Establishment of multi-disciplinary research units in medical colleges, model rural health research units in the states; creating a network of laboratories for infectious diseases; non-communicable diseases and specialized areas is considered as one of main priorities.
2. **Strengthening of human resource and creating enabling environment for research** in medical colleges, universities and health research institutions and to consider pathways for developing a good environment to promote health research.
3. **Efficient research governance and regulatory frame work** on core areas pertaining to ethics, clinical trials on new drugs/ devices; ensuring well defined mechanisms for approvals and passage as well as implementation of bills / policies developed is considered as among high priorities.
4. **Development of centres on policy related areas** such as vaccine preventable and other chronic diseases, health economics and health systems research, social and behavioural sciences are proposed to be major thrust areas for XII Plan.
5. **Translational and implementation research** is proposed to be given special emphasis. Besides specific programmes in governmental and academic institutions promotion of public-private partnership will be given special attention for translating research leads into development of affordable diagnostic technologies and pharma products including vaccines to achieve broader objectives of providing better affordable healthcare for the people.
6. **Establishment of efficient mechanisms for the selection, promotion, development, assessment and evaluation of affordable technologies** and their judicious application has been identified as priority. For this purpose structures like Technology Development Board/ Technology Assessment Boards *etc* have been envisaged.
7. **Creation of efficient mechanisms for inter-sectoral coordination and national/ international collaboration** is among the high focus action areas in XII Plan. This would include development of mutually acceptable systems/mechanisms for collaborative action among departments, institutions and other stake holders in the country and other countries.
8. **Strengthening of ICMR institutions**, establishment of new specialized centres within and outside the ICMR and expansion of existing extramural programmes of the Council.
9. **Optimum use of Information Technology using the National Knowledge Network** as backbone for health research aimed at service, education and research and research management.
10. **Research priorities will be guided and focused on problems of tribal and other marginalized communities** and addressing gaps in the knowledge in diseases affecting these populations.

BUDGET

For the XII Plan, an outlay of ₹ 16000 crores is proposed. Main budgetary items are:

DHR other than ICMR: (₹ 7500 crores)

- **Infrastructure Development** (₹ 3000 crores; 250 multidisciplinary units in medical colleges; 50 MRHRU units; specialized centres/ units)
- **Human Resource Development** (₹ 1000 crores; 1000 midcareer and 2500 young investigators; 2/3 from medical colleges)
- **Laboratory network for research on viral and other infectious diseases** (₹ 900 crores; 6 regional BSL III; 50 cat. I state level labs and 200 Cat. II district level labs in medical colleges)
- **Grant in Aid scheme for projects requiring inter-sectoral coordination, translation specially in PPP mode and IT enabled governance, implementation research** (₹ 2000 crores)
- **Transdisciplinary and Integrative Research** (₹ 500 crores)
- **Governance and Departmental Expenses** (₹ 100 crores)

ICMR: (₹ 8500 crores)

- **Funding of Extramural Projects** (₹ 2500 crores including the ongoing projects);
- **Funding of Intramural Programmes through ICMR Institutes/ Centres** (₹ 2500 crores including the ongoing studies)
- **New Institutes/ Centres/ upgradation of existing ones** (₹ 3150 Crores – Non communicable diseases - Cardiovascular, neurological, mental health, ageing ; Primates and other animal models; Health Systems Research, Health Economics, Policy Research on Drug resistance, Vaccine Preventable Diseases, Clinical Pharmacology, Molecular and Transplant Immunology *etc.*)
- **Outbreak /Disaster Response Fund-** ₹ 50 crores
- **New Positions – (₹ 300 crores)** – Mostly scientific for creating essential structure in DHR, its outreach units/ labs; ICMR Institutes/ Centres in deficient areas as well as new Institute and Hospital at Bhopal.