NATIONAL INSTITUTE OF IMMUNOLOGY

ANNUAL REPORT
2020-21

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MANDATE OF THE INSTITUTE

- To undertake, aid, promote, guide and co-ordinate research of high calibre in basic and applied immunology
- To carry out research for development of new vaccines and immunological reagents for communicable diseases
- To develop immunological approaches for regulation of male and female fertility
- To interact with industry for manufacture of vaccines and immunological reagents
- To organise postgraduate courses, workshops, seminars, symposia and training programmes of a specialized nature in the field of immunology, vaccine development and related areas
- To organise training programmes for technicians in immunological methods and related techniques
- To establish affiliation with recognised universities and institutions of higher learning for the purpose of enabling research scholars to register for postgraduate degrees
- To serve as a national reference centre for immunology and to provide consultancy services to medical and veterinary institutions, public health agencies and industries in the country
- To provide and promote effective linkages on a continuing basis between various scientific and research agencies/laboratories and other organisations working in the country in the field of immunology, vaccine development and related areas
- To collaborate with foreign research institutions, laboratories and other international organisations in fields relevant to the objectives mentioned above

FOREWORD

It is an honour and a pleasure to present this Annual Report of the National Institute of Immunology. The Institute perpetually strives to expand its intellectual and academic horizons in the life sciences. Each year brings with it scientific achievements and accomplishment, as well as demonstration of ever-higher levels of technical expertise and skills. As these pages depict, our interests our wide – ranging from description of the structure and function of biomolecules, to immune pathways that help preserve organismal homeostasis during periods of health, to the elucidation of mechanisms of patho-physiology that operate in infectious and non-infectious diseases, and onward to the development of novel diagnostics, therapeutics and vaccines. Medical afflictions of particular concern to the country form a special focus.

The last year and a half have been particularly trying, with the world dealing with the SARS-CoV-2 pandemic. I am proud of the fact that we did not waver in our commitments or in our efforts. In service to the nation's containment efforts, we now run a SARS-CoV-2 qPCR diagnostic facility. Skilled manpower is vital in the fight against any infectious disease. We have undertaken the training of medical and technical personnel (hailing from across the country) in qPCR technologies; they have returned to their native lands, with their newly-acquired expertise now assisting in pandemic surveillance. We have also contributed significantly towards an enhanced understanding of the immunopathological role of T cells in COVID-19. In addition, several scientists are focusing on developing a better appreciation of the biology of SARS-CoV-2 infection, as well as of immune responses elicited upon infection or vaccination.

Our pursuits primarily lie in the ambit of four broad areas - (i) Immunity and Infection, (ii) Reproduction and Development, (iii) Chemical Biology, Biochemistry and Structural Biology, and (iv) Genetics, Cell Signalling and Cancer Biology.

The write-ups that follow briefly outline our scientific pursuits over the course of the year. Due to space constraints, descriptions do not do the contributions full justice. Please feel free to contact members of the Faculty if you seek more information.

IMMUNITY AND INFECTION

Earlier studies had established that *Mycobacterium indicus pranii* (MIP) therapy in tumor-bearing mice results in reduced tumor volumes by helping to transform an immunosuppressive tumor milieu into one characterized by immune activation. Tumors derived from MIP-treated mice demonstrate reduced levels of several tumor-associated moieties. Interestingly, MIP was shown to have direct effects on tumor cells, inducing cell cycle arrest, and enhancing the expression of cell death receptors.

Immunomodulatory effects arising as a consequence of *Salmonella* Typhi infection are being discerned; infection appears to alter the ratio of B1 to B2 subsets of B cells (an effect probably mediated by IFN-γ), corelating with a state of induced hypo-responsiveness to T-dependent antigens.

Studies looking into the causes of disease progression in lupus have continued. Apoptotic blebs generated upon the action of different drugs were demonstrated to be differentially antigenic, and also demonstrated differential immunogenicity in lupus-prone mice; synergy of particular blebs with hCG was demonstrated, a finding that might help explain pregnancy-associated disease flares. Hemoglobin was additionally inflammatory when incubated with cells derived from lupus-prone mice and SLE patients, and served to accelerate disease onset in the former; neutralization of Hb could therefore prove beneficial.

Work to decipher the molecular and cellular basis of immune responses against protein and polysaccharide surface antigens of *Streptococcus pneumoniae* is ongoing. Extensive studies on V-region analyses of polysaccharide-specific antibodies (generated as a consequence of immunization with either glycoconjugates or unconjugated polysaccharide) revealed evidence of antigen-driven selection, with higher mutational loads observed upon glycoconjugate immunization; polysaccharides therefore appear capable of inducing the B cell clonal expansion, as do protein antigens.

Studies have focused on the identification and characterization of *Plasmodium* effector molecules which are introduced into the hepatocyte cytosol to manipulate host metabolic and/or signaling pathways. The aim is to evaluate the vaccine potential of such moieties, and also to investigate if they can be employed as drug targets. Deletion of a newly-identified target induced apoptosis-like cell death at erythrocytic stages and reduced the formation of gametocytes. Inhibitors with multi-stage activity which are effective against an artemisinin-resistant strain of *P. falciparum* have also been identified.

The canonical NF-κB signalling pathway, which can be triggered by several stimuli and mediates a large number of inflammatory responses, is critical to organismal health. Context-specific control of such responses is critical, since dysregulated signalling is associated with several disorders. Data suggests that the specific composition of the NF-κB complexes in the nucleus have a significant bearing on cellular responses. Systems-level readouts are beginning to provide deeper mechanistic insight into the factors that influence inflammatory responses and help maintain homeostasis.

How synergy between different transcription factors influences dendritic cell development and function forms the focus of ongoing studies. While *Batf3* and *Id2* synergistically influence *Irf8*-directed classical cDC1 development, IRF8 was shown to interact with BATF3 but not with ID2. By employing ChIP-seq analysis on pDCs, cDC1 and cDC2 subtypes, as well as by use of $Irf8^{-/-}$, $Irf8^{R294C}$ and $Batf3^{DCKO}$ mice, ongoing work seeks to identify genes that display IRF8-BATF3 occupancy in promoter regions and are also transcribed.

T follicular helper (Tfh) cells are indispensable for the generation of long-lasting humoral immunity, and enhancing knowledge of Tfh cell biology is expected to assist in the design of the next-generation vaccines, as well as in the better understanding of post-infection immune responses. Studies are currently focused on Japanese Encephalitis Virus, Dengue Virus and SARS-CoV-2.

The incorporation of carbohydrate antigens in nano formulations has previously been shown to enhance immunogenicity; molecular mechanisms are now under investigation. Such polymeric nanoparticles were demonstrated to stimulate the formation of a greater number of germinal centres with a better engagement with Tfh cells, a phenomenon that could contribute to superior immune memory. Detailed analyses of germinal centre generation with nano formulations could help establish immunological principles that may assist in the future development of potent single-dose vaccines against carbohydrate antigens of interest.

The establishment of immunological memory subsequent to infection or vaccination is the basis of long-term immunity. CD4+ cytotoxic memory T cells (CD4-CTLs) constitute a population of cells whose contributions to protective immunological responses remain relatively obscure. The study of such cells, and delineation of the factors that propel their growth, could aid in the development of more effective vaccination strategies. The program seeks to study CD4-CTLs in viral infections (CMV, EBV, Dengue Virus and Influenza Virus) using multi-omics and immunological approaches. Viruses exploit the host cellular machinery for their advantage. Studies aimed at elucidating the mechanistic details of host-pathogen interaction upon infection with dengue virus have continued. In particular, the role of both host and viral factors in the generation of platelets is now being investigated. Infection with dengue virus leads to decreased PI3K/AKT/mTOR signaling and the death of megakaryocytes, and use of specific inhibitors has implicated this signaling axis pathway in megakaryopoiesis. Emerging data could help in the design of next generation antiviral strategies.

Nano-immunotherapeutic platforms for cancer are being developed. Along with other approaches, artificial antigen-presenting cells displaying MHC molecules (bound with tumor-associated peptides) along with co-stimulatory molecules have been designed in order to engender potent anti-tumor responses. Anti-chaperone strategies are also being employed to enhance antigen presentation.

The role β-catenin plays in immunity to parasitic infections is being assessed. During *Toxoplasma gondii* infection, β-catenin was shown to be involved in IRF3 transcription. Proteosomal degradation of IF3-mediated IDO appears to favour parasite survival, indicating that *T. gondii* selectively utilizes tryptophan to produce the anti-oxidant melatonin, thereby preventing the apoptosis of infected cells.

REPRODUCTION AND DEVELOPMENT

Novel contraceptive vaccines are being developed for the control of the stray dog population. Antibodies generated by these vaccines react with dog zona pellucida proteins which form the coating around the egg. Studies have revealed that vaccination is safe and can reduce the fertility of female beagle dogs. In other work, the roles different miRNAs play in the fusion and differentiation of trophoblast cells are being discerned.

The roles Sertoli cell-derived miRNAs and transcription factors play in germ cell division and differentiation are being elucidated. Sertoli cell-specific knockdown of *Meis1* in mice induces germ cell apoptosis and leads to infertility, while over-expression of miR-382-3p in Sertoli cells results in severe oligozoospermia and infertility. Such studies could shed light on factors contributing to cases of male infertility currently classified as “idiopathic”.

CHEMICAL BIOLOGY, BIOCHEMISTRY AND STRUCTURAL BIOLOGY

Studies into enzyme action, kinetics and regulation have continued. Regions responsible for the dimerization and tetramerization of hGBP-2 were identified by employing recombinant proteins that had been systematically truncated. GTPase assays revealed the role of individual domains in GTP hydrolysis. That the hGBP-2 tetramer was demonstrated in mammalian cells provides biological relevance of these studies. Mechanistic insight along with structural data is expected to assist in the design of therapeutic inhibitors.

The use of novel computational approaches for prediction of biomolecular structures and inter-molecular interactions has been a long-standing interest. Molecular dynamics simulations revealed the structural basis of allosteric activation of the kinase domain of PfCDPK1 (an essential kinase and an important drug target of *Plasmodium falciparum*) by CaMLD, and machine learning helped identify several compounds that can potentially block this interaction. Such approaches were also employed to identify molecules that could potentially inhibit the binding of SARS-CoV-2 spike protein receptor binding domain with hACE2.

It is increasingly recognized that physiological responses to disease involves both metabolic re-programming and immune stimulation. Enhanced knowledge about the interplay between these phenomena can assist in the development of novel therapeutics. Two lipidic metabolites (polyketide quinones and kupyaphores) were initially identified from cultures of *Mycobacterium tuberculosis* during biofilm formation. Mass spectrometry was employed to detect these molecules in the lungs of infected mice. While polyketide quinones act as electron shuttling molecules, kupyaphores are involved in zinc transport. Further elucidation of their potential pathophysiological roles is in progress.

The development of more effective vaccines/ delivery systems for tuberculosis remains a significant public health goal; ease of administration and long-term stability of such formulations would be important attributes. Towards this end, an aerosolized formulation of BCG encapsulated alginate particles was demonstrated to be safe and efficacious when evaluated in infant rhesus macaques.

Over the last few years, several properties and characteristics of transpeptidase sortases have been described. While such enzymes have been employed to create defined bioconjugates, studies have also attempted to corelate structure with function. Towards this end, the unusual substrate specificity of a class E sortase (TfSrtE) from *Thermobifida fusca* was further explored, and the criticality of the Tyr128 residue demonstrated.

The Institute has been designing tools for probing glycoconjugates of relevance to immune function. *In vivo* inhibition of *O*-glycosylation was demonstrated by employing Ac_5GalNTGc, a synthetic analogue of GalNAc. Such studies expand avenues for the development of novel therapeutics for autoimmune and inflammatory disorders.

Elucidation of structure-function relationships of proteins involved in fatty acid metabolism in *Leishmania* has continued. Current studies are focused on defining the substrate specificities of lipoate protein ligase B and lipoic acid synthase; such work assumes importance in light of the fact that loss of lipoylation of mitochondrial enzymes is associated with several neurological disorders.

In a mouse model of Alzheimer's disease, administration of under-carboxylated osteocalcin induced immunomodulatory and anti-inflammatory effects - possibly by interacting with Abeta42 - resulting in microglial activation. Such work

enhances understanding of neurological dysfunction in disease, and could lead to the discovery of novel therapeutics.

Employing a histidine pathway gene knockout strain of *Mycobacterium tuberculosis*, the essentiality of histidine to bacterial survival was demonstrated *in vitro* and *in vivo*. A number of triazole scaffold inhibitors and imidazole scaffold inhibitors have been designed; the former bind the active site of HisB and are effective at sub-micromolar concentrations. In other studies, a potential kinase domain in the RNA polymerase of SARS-CoV-2 virus was identified using structure-based virtual screening approaches; Sorafenib, a kinase inhibitor, exhibited anti-viral effects.

Taking advantage of structural insights, specific inhibitors of *Leishmania* phosphoglycerate kinase and its isoforms are being designed.

GENETICS, CELL SIGNALLING AND CANCER BIOLOGY

More than 80% of patients of cervical cancer, breast cancer and ovarian cancer have circulating antibodies to SPAG-9 - a cancer-testis antigen of long-standing interest - raising the possibility of using their presence as a diagnostic aid. Therapeutic vaccination (using autologous dendritic cells pulsed with recombinant SPAG-9) have been initiated in patients of cervical cancer and ovarian cancer.

Mycobacterium tuberculosis deficient in uracil DNA glycosylases were shown to exhibit a higher mutation rate in the presence of antibiotics, accumulated a large number of SNPs, and demonstrated higher survival *in vivo*. The absence of a base excision repair pathway could therefore result in superior adaptation in the host, under conditions of stress. Such studies could facilitate the identification of new drug targets.

The polymerase γ subunit (PolγA) plays a key role the replication of mitochondrial DNA. Data indicated that the E3 ligase MITOL ubiquitylates PolγA; only non-ubiquitylated PolγA was shown to be capable of entering the mitochondrial matrix to exert its function. In patients of progressive external ophthalmoplegia, mutant PolγA proteins are hyper-ubiquitylated and therefore cannot enter the mitochondria, diminishing mitochondrial genome integrity.

The TCR blocus is precisely regulated. The role of CTCF (a DNA binding protein) in regulation of transcription and VDJ recombination at murine TCRb locus is being assessed. Mouse mutants in which specific CTCF binding sites had been ablated exhibit altered usage of V segments during V-to-DJ recombination. Transcripts generated at Eb enhancer (an important regulatory element of the TCRb locus) are being characterized.

The study of signalling events involved in the survival and propagation of *Plasmodium falciparum* and *Toxoplasma gondii* have been long-standing interests; recent studies have focussed on VPS15 orthologues. In *Toxoplasma gondii*, TgVPS15 regulates PI3P, facilitating critical down-stream events (via effects on TgATG18) such as autophagy and replication. miRNAs aberrantly expressed in neurons derived from Alzheimer's Disease transgenic mice were identified, some of which could play a role in suppressing the cell cycle. A greater understanding of cell cycle-related neuronal apoptosis in Alzheimer's disease is the expected consequence of such work.

Studies aimed at determining how miRNAs and lncRNAs regulate the cell cycle to prevent genomic instability and cancer have continued. The contribution of replication proteins in these events are also under study; Sld5 deficiency results in dissipation of centriolar satellites, effectively preventing centrosome maturation, thereby disrupting mitosis.

Tumorigenesis is characterized by the aberrant expression of several proteins; in many instances, consequences remain unknown, however. PRAMEF2, a cancer-testis antigen, was demonstrated to form part of the cullin-2 based E3 ubiquitin ligase complex. PRAMEF2 mediated the degradation of the LATS1 kinase and caused the nuclear accumulation of YAP; depletion of PRAMEF2 was shown to reduce tumor cell invasion.

Work aimed at understanding the molecular basis of aging using *Caenorhabditis elegans* as a model system is moving apace. Dietary restriction is known to enhance life-span in a number of organisms; novel kinases appear to be involved in the response to dietary restriction. How genes in the Insulin/IGF-1-like signalling pathway are regulated is being elucidated. Approved drugs are being re-purposed in attempts to reduce hyperglycemia-related complications.

Muscle wasting is associated with several chronic disorders. Studies are aimed at investigating the crosstalk between different organs during muscle wasting and recovery; the influence of nutritional intervention in these events is also being assessed. Data suggests that myopathies associated with a deficiency of Vitamin D are characterized by an increase in the uptake of glucose by skeletal muscle, as well as by the abnormal accumulation of glycogen.

The contributions of microbiota and their metabolites in the development of colorectal cancer are under investigation. Sensitive sensors for the detection of the microbiota metabolites trimethylamine N-oxide and indoxyl sulphate have been developed. Trimethylamine was demonstrated to induce cytotoxic and genotoxic effects on epithelial cells.

Much of how individual organs communicate - either to maintain homeostasis during periods of health, or during ongoing disease - remains unknown. Studies currently focus on murine models of obesity and associated metabolic diseases. Initial findings suggest the involvement of hepatokines and adipokines in the pathogenesis of inflammatory bowel disease. Small molecules capable of interrupting inter-organ communication may comprise novel therapeutics.

Overview

At the outset, I must acknowledge the unwavering support - Financial, Administrative, Technical, Scientific - we receive from the Department of Biotechnology. It goes without saying that, in the absence of such a vital co-partnership, none of what we do would reach fruition.

Students represent a significant driving-force in our efforts; funnelling their passion and energy can be challenging, but is also invariably rewarding. Members of the Faculty have always demonstrated an overarching sense of commitment towards the Institute and its ideals. Their expertise and dynamism, coupled with an insatiable intellectual curiosity, are critical components in our journey.

The efficient and timely support we receive from our administrative and technical services is a blessing, and allows for the optimal use of our human resources and infrastructure. Personnel are willing to go above and beyond the call of duty in selfless service, as has been repeatedly borne out over the last couple of years, as we have collectively negotiated our way through the pandemic.

Though times have indeed been challenging, new initiatives have been taken up with the vigour that has become our hallmark. To name a few: An immunoengineering programme seeks to standardize methods for the large-scale culture of defined T cell populations. The Primate Research Centre is being upgraded to accommodate a GMP facility. And finally, a number of young immunologists have been recruited as Faculty members, with the aim of providing impetus to our endeavours in both basic and translational immunology.

We take great pride in our legacy and in our achievements, and look to the future with anticipation. I thank you for your interest in this fine Institution, which I have been fortunate to be part of, and to serve.

With best wishes.

Amulya K. Panda
Director

Date: 6th April 2021

RESEARCH REPORTS

A. IMMUNITY AND INFECTION

1. Functional analysis of host and viral genes that affect HIV, Covid and Dengue pathogenesis

– Dr. Akhil C Banerjea

Viral pathogenesis (for example, induced by HIV, Corona virus or Dengue virus) is very complex, involving multiple viral and host genes. Viruses exploit the host cellular machinery for their advantage and it is our goal to understandmechanistic details of host-pathogen interactions. This understanding is necessary to generate specific anti-viral approaches.

Dengue virus (DENV) infection can cause either a self-limited dengue fever or hemorrhagic complications. Megakaryocytes are sole producers of platelets. However, the role of both host and viral factors in megakaryocyte development, maturation and platelet production is largely unknown in DENV infection. PI3K/AKT/mTOR pathway plays significant role in cell survival, maturation and megakaryocyte development. We observed decreased expression of major molecules associated with PI3K/AKT/mTOR pathway in DENV infected MEG-01 cells. Involvement of PI3K/AKT/mTOR pathway in megakaryocyte development and maturation was confirmed with the use of specific inhibitors in infected megakaryocyte cells. Our results showed that direct pharmacologic inhibition of this pathway greatly impacted transcription factors (GATA-1and GATA-2) involved in megakaryopoiesis. Additionally, we observed apoptosis in megakaryocytes due to DENV infection. These results may suggest that DENV impaired PI3K/AKT/mTOR axis and molecules involved in the development and maturation of megakaryocytes. It is very important to investigate the role of these molecules in context of megakaryopoiesis during DENV infection to better understand the pathways and mechanisms which in turn might provide insights on development of antiviral strategies. The role of extracellular vesicles in dengue pathogenesis was also explored.

2. Study of immunotherapeutic potential of *Mycobacterium indicus pranii* (MIP) and the underlying mechanisms in animal models of Tumor

– Dr. Sangeeta Bhaskar

Generation of antitumor immunity is difficult in the tumor-bearing host because of various negative regulatory mechanisms which can be overcome by activation of innate and Th1 immune response. MIP induces Th1 response which is also important for antitumor activity. Hence, we had started this study to evaluate the immunotherapeutic activity of MIP in mouse model of tumor; both direct and indirect effect of MIP on cancer cells is being studied. Also, role of MIP on metastasis and angiogenesis in murine melanoma model and underlying mechanisms are being studied.

- To evaluate Immunotherapeutic activity of MIP and its 'cell wall fraction' in mouse syngeneic tumor models and simultaneous study of underlying mechanism of MIP mediated anti-tumor activity.
- Analysis of the role of macrophages in TB-IRIS development.

Direct and indirect effect of MIP on cancer cells

Earlier studies from our lab on very aggressive melanoma tumor model provide evidence of immunotherapeutic potential of MIP for cancer. MIP therapy altered the immunosuppressive tumor milieu to immunologically active one, which contributed to tumor volume reduction. Apart from the role of MIP in activation of immune response against tumor, direct effect of MIP on cancer cells was observed. Cancer cells treated with MIP *in vitro* showed decreased survival and proliferation along with cell cycle arrest at G1/G0 phase. It decreases the expression of cancer progression marker, CD44 which has an extensive role in EMT transition and metastasis of cancer. MIP treatment increases the cell death receptor expression on tumor cells.

Role of MIP on metastasis and angiogenesis in murine melanoma model

In repeated experiments it was observed that after one month of B16F10 s.c. tumor implantation, the number of metastatic nodules in the lungs of MIP treated mice were significantly less as compared to control, untreated group. Differentially expressed genes and factors responsible for metastasis and angiogenesis in Control and MIP treated mice are being analyzed. MMPs are one of the important factors allowing the tumor cells to migrate through the blood vessels and lymphatics. MIP treated tumors showed two and three fold less expression of MMP2 and 9 respectively. Concentration of VEGF from tumor lysate was also found to be significantly less in the MIP treated group. Besides VEGF, PDGF was also found to be down-regulated by MIP, which is a soluble factor secreted from the tumor cells and contributes to the invasion and migration of tumor cells. Effect of MIP on expression of different chemokines and cytokines in tumor microenvironment is being evaluated.

Analysis of the role of regulatory T cells in MIP mediated anti-tumor activity

Tregs promote tumor growth by down-regulating the anti-tumor immune response. Significant reduction in the frequency of $FoxP3^{+}CTLA4^{+}$ and $FoxP3^{+}PD\text{-}1^{+}$ Treg cells infiltration in tumor microenvironment was observed in MIP treated mice. Treg cell reduction was a consequence of reduced intra-tumoral CCL22 in MIP treated tumors. The chemokine CCL22 is abundantly expressed in many types of cancer and is instrumental for intra-tumoral recruitment of Tregs. Further studies to gain insight into the detailed immunological mechanisms involved in MIP immunotherapy to reduce tumor burden are underway.

3. **Studies on immune response from antigen loaded biodegradable polymer particles and protein refolding from inclusion bodies**

– Dr. Amulya K. Panda

Improved immunogenicity of antigens using polymeric particles

The main objective of the project is to improve the immunogenicity of antigens entrapped in biodegradable polymer particles. Another research activity of the laboratory is the development of mild solubilization processes for improved recovery of bioactive proteins rom inclusion bodies.

Immunogenicity of polymeric nanoparticle entrapped pneumococcalantigens

Polymeric particles entrapping protein/carbohydrate antigens are being routinely used in the laboratory to improve their immunogenicity. The major research effort of the laboratory is to develop nanoparticle based Pneumococcal vaccine and conjugation of pneumococcal protein (SP0845) with polysaccharides and its immunological evaluation. SP0845 protein was purified to homogeneity and conjugated to PCP1 and 14 using CDAP conjugation method. Mice immunized with polymer particle entrapped conjugate elicited long lasting primary and memory antibody titer from single dose immunization.It was observed that delivery of polysaccharide in polymeric nanoparticle promoted higher number of germinal centers. This was associated with enhance interaction with Tfh cells. This indicated the capabilities of PLA nanoparticle for enhancing germinal center formation when used for immunizations. This may be one of the reasons for generation of memory antibody response from single dose of polymer particle-based immunization.

Refolding of RBD of S1 protein from inclusion bodies of E.coli

RBD of the S1 protein of corona virus was cloned and expressed in *E.coli.* The protein was

expressed in *E.coli* as inclusion bodies around 60 mg/L in shaker flask culture. The protein from inclusion bodies were solubilized with mild denaturing condition at alkaline pH and refolded. The *E.coli* expressed and refolded RBD was found similar to RBD expressed in mammalian cells using receptor binding assay. It was observed that immunization with 10 µg of alum adsorbed RBD in two doses elicited long lasting neutralizing antibody titers. The RBD expressed in *E.coli* thus can be used as protein for development of subunit vaccine against corona virus.

4. **Analysis of *Salmonella* - Host cell interactions**

– Dr. Ayub Qadri

Pathogenic *Salmonella* serovars continue to be a major public health problem particularly in the developing world. We have been investigating host-pathogen cross-talk during infection with this pathogen. Our objective is to understand how this pathogen modulates immune responses in order to establish infection.

Inflammation induced with *Salmonella* reduces antibody response to protein antigens

We showed previously that infection of mice with live *Salmonella* Typhi results in splenomegaly accompanied by significant changes in cellularity. These changes reduced the ability of these mice to elicit antibody response to protein antigens such as tetanus toxoid (TT) but not to a T-independent polysaccharide antigen such as Vi. We now show that infection with *Salmonella* Typhi reduces the number of $CD5^{hi}B220+$ B cells indicative of changes in the proportions of B1 and B2 subsets of B cells. Preliminary results suggest that the reduction in antibody response to TT may be in part mediated by IFN-γ.

LPC-stimulation produces a low phagocytic and poorly co-stimulatory phenotype in TLR-primed macrophages

LPC is considered a major damage associated molecular pattern (DAMP) due to its role in inflammation associated with chronic disorders including atherosclerosis and neurodegeneration. We reported previously that LPC activates caspase-1 - dependent release of proinflammatory IL-1β from TLR-primed macrophages by triggering release of ATP (eATP) from cells. We now show that eATP induced by LPC also inhibits induction of MHC class II and CD86 in a proportion of LPS-primed mouse macrophages thereby reducing their antigen-presenting capability. These cells also show reduced ability to phagocytose bacteria. These results have significant implications for the manifestations promoted by LPC during chronic inflammation.

5. **Disorders of proliferation: Analysis of novel pathways and targets**

– Dr. Rahul Pal

Research focuses on systemic autoimmune diseases and tumorigenesis, two conditions associated with proliferative aberrance.

Aberrant cell death characterizes systemic lupus erythematosus (or lupus); autoreactive and inflammatory stimuli provided by apoptotic debris and hemoglobin (Hb) are under study.

Lupus flares occur during pregnancy; the influence of human chorionic gonadotropin (hCG) on autoimmune responses is being elucidated.

Tumor-derived hCG is associated with poor prognosis; the role of hCG in tumor progression is being delineated.

Hb enhanced secretion of lupus-associated cytokines when incubated with PBMCs from SLE patients or with cells from lupus-prone mice. Infusion of Hb in lupus-prone mice induced antigen spreading and nephritis; neutralization of Hb could therefore be beneficial.

Tamoxifen blebs generated superior autoreactive responses than did other blebs in lupus-prone mice; bleb-hCG co-incubation

increased autoantibody secretion *in vitro*. These findings enhance understanding of factors that can contribute to lupus flares.

Ovariectomy in hCG transgenic mice increased the growth of implanted lung tumor cells; progesterone supplementation reduced tumor volumes. The incidence of some cancers increases post-menopause, coincident with enhanced circulating levels of hCG, making such findings clinically relevant.

βhCG induced multiple signalling pathways in tumor cells, and diminished the effects of anti-cancer drugs. Judicious combinations of luteinizing hormone (which antagonized hCG's protective effects), signalling inhibitors and chemotherapeutic drugs could result in therapeutic benefit.

6. **Microbial interface biology and associated host immune response**

– Dr. Devinder Sehgal

The theme of research is to decipher the molecular and cellular basis of B-cell responses against protein and polysaccharide antigens present on the surface of the human bacterial pathogen *Streptococcus pneumoniae* (pneumococcus). Our other research interest involves deciphering how pneumococcus causes disease and what interventions can be made to stop this from happening. The research is focused on the pneumococcal products and strategies that allow the bacterial pathogen to avoid being destroyed by the mammalian immune system, and the types of immune response that can circumvent these strategies and products.

The aim of this work is to broadly compare previously reported polysaccharide-specific antibody sequences from subjects who received a single dose of pneumococcal glycoconjugate or unconjugated polysaccharide vaccine. The sequence comparison revealed some resemblance and some differences in VH and VL gene family usage. The HCDR3 size range in the individuals who received the glycoconjugate vaccine (8-22 residues) was narrower than in the unconjugated polysaccharide (5-31 residues) vaccinated subjects however this was not statistically significant. We observed that the glycoconjugate vaccinated subjects showed higher mutation and replacement frequency as compared to unconjugated polysaccharide vaccinated individuals. The contribution of HCDR1 and HCDR2 towards antigen binding was higher compared to HCDR3 in the case of polysaccharides. Higher mutational load was observed in glycoconjugate vaccinated subjects compared to unconjugated polysaccharide vaccinated subjects. Anti-polysaccharide antibody sequences from subjects given glycoconjugate and unconjugated polysaccharide vaccines showed signs of antigen driven selection. Glycoconjugate vaccine induced larger polysaccharide-specific B cell clonal bursts compared to unconjugated polysaccharide vaccine. Our data suggests, like the protein antigens, polysaccharides are capable of inducing the B cell clonal expansion.

7. **Plasmodium proteins involved in virulence and host modulation: Host-Parasite interactions in plasmodium liver stages**

– Dr. Agam Prasad Singh

Plasmodium species introduce effector molecules into hepatocyte cytosol to manipulate host metabolic and /or signaling pathways for its own benefit. Basic theme is to identify new parasite molecules that affect the host cellular processes. Such parasite proteins are potential antigens and should be evaluated for their vaccine potential or possibly as drug targets.

Target discovery: MCA-2 deleted *P. berghei* (ΔPbMCA-2) displayed unregulated stress-mediated apoptosis-like cell death at the erythrocytic stages and reduced formation of gametocytes. A significant reduction in oocysts, ookinete and sporozoites load along with two days delay in hepatocytes invasion in the ΔPbMCA-2 parasite line was observed. Two inhibitors C-532 and C-533 inhibited parasite growth with an IC_{50} of 3nM and 2.1nM, respectively. C-532 and C-533 also blocked the

transmission of *P. falciparum* and *P.berghei* in *An. stephensi*.

New multi-stage inhibitors: We identified two new molecules that have low nanomolar activity and high therapeutic index (TI > 100). The compounds exhibited notable activity against the artemisinin-resistant strain of *P. falciparum* blood-stage culture. They have malaria multi-stage activity.

Drug delivery: We enhanced the aqueous phase solubility of artemisinin by encapsulating it in two nanocarriers based on the polymer polycaprolactone (ART-PCL) and lipid-based Large Unilamellar Vesicles (ART-LIPO) respectively. Both nanoformulations exhibit *in vitro* parasite killing activity against *Plasmodium falciparum* with the ART-LIPO performing at comparable efficacy to the control drug solubilized in ethanol.

Host directed therapy: Identified serine/threonine kinase 35L1 (STK35L1) as target for host directed therapy. We confirmed that STAT3 activation is crucial for STK35L1 upregulation during sporozoite infection in hepatocytes.

8. **The NF-κB signaling system in human health and disease**

– Dr. Soumen Basak

The canonical NF-κB pathway instructs the expression of inflammatory genes by the RelA:p50 transcription factor in response to diverse cell-activating stimuli, including microbial substances. However, this mainstay RelA:p50 transcriptional output must also be curated so as to provide for stimulus-type-specific and cell-type-specific inflammatory responses adapted to the local tissue-microenvironment. Indeed, unabated inflammation has been implicated in a wide spectrum of human ailments, including inflammatory bowel disease. We have been investigating the fundamental mechanisms regulating RelA:p50-mediated gene expressions and attempting to develop an understanding on how the NF-κB system imparts specificity in the inflammatory gene program. Our work has led us to put forward a conceptual framework where the dynamical attributes and the composition of the nuclear NF-κB complexes cumulatively instruct context-specific inflammatory gene patterns. We propose that integrating mechanistic knowledge and systems-level analyses may offer further insights on NF-κB-mediated inflammatory gene control in the future.

9. **Understanding the role of Interferon Regulatory Factors (IRFs) in dendritic cell (DC) development and innate immunity**

– Dr. Prafullakumar B. Tailor

DCs are heterogeneous populations that collectively guide immune responses. IRFs play critical role in DC development and functions. We are focused towards understanding the mechanisms of DC diversity development and recently diversified towards understanding role of DCs in lupus, microbial infections and applied immunology.

Irf4 and *Irf8* plays pivotal role in generation of diverse DC subtypes. We have extensively studied the synergism between IRF8, BATF3 and ID2, transcription factors that regulate $CD8\alpha^{+}$cDC1 subtype and in current year our objective was to get deeper understanding of transcriptional regulation by IRF8 and BATF3 interaction.

Generation of DC diversity from progenitor stage is tightly regulated by complex molecular inter-play between transcription factors. We earlier demonstrated that *Batf3* and *Id2* expression have a synergistic effect on the *Irf8* directed classical cDC1 development. Our in-house developed Bi-molecular fluorescence complementation assay and immuno-precipitation experiments confirmed that IRF8 interacts with BATF3 but not with ID2. To further understand cDC1 specific genome wide transcriptional regulation by IRF8-BATF3 complex, we performed ChIP-Seq data analysis from pDC, cDC1 and cDC2 subtypes. We identified 10,515 and 1,673 IRF8 specific peaks associated with cDC1 and pDC subtypes

respectively. Similarly, we identified 15,218 and 314 BATF3 specific peaks associated with cDC1 and cDC2 subtype respectively. Further, we fished-out cDC1 specific 6,921 IRF8 and BATF3 overlapping peaks implying a possible recruitment of this complex. We next performed transcriptome analysis from FLDC derived $CD24^+$ cDC1 subtype and performed three-way analyses for the genes that are displaying IRF8-BATF3 occupancy in promoter region with genes that are actively transcribed not only in FLDC cDC1 population but also in spleen to decipher physiological significance of these gene expression profiles. Currently we are validating our study by employing *Irf8*$^{-/-}$, *Irf8*^{R294C} and *Batf3*^{DCKO} mouse models to define the pathways that are being regulated by IRF8-BATF3 complex towards better understanding of the transcriptional regulation of cDC1 development.

10. **Biology of follicular T helper cells in protective immunity**

– Dr. Nimesh Gupta

Understanding the determinants of long-lastingprotective immunity may provide significant lead for rational design of vaccines. The conceptual framework of our program is to resolve the traits and function of specialized subset of $CD4^+$ T cells (Tfh cells) that are indispensable for optimal humoral responses. The global aim is to identify and harness the positive attributes of Tfh cells for rational development of the immunization strategies.

The major objective is to determine the positive traits and function of Tfh cells in establishment of sustained and broad protective immunity. We are investigating the Tfh cells in controlled human vaccination and acute virus infection like Japanese encephalitis, dengue and COVID-19.

Biology of Tfh cells in long-lasting protective immunity

Here, we are studying the characteristics of immunological memory and clonotype diversity of Tfh cells in response to human vaccines. To determine the optimal traits of Tfh cells in long-lasting protective immunity, the vaccine responses are also compared with successful recovery from natural infection.

Function of Tfh cells in humoral immunity establishment to virus

In this program, our attempts are focused on providing the insight into the determinants of antibody response to dengue virus. Here, we are exploring the biology of Tfh and related $CD4^+$ T-cell subsets in various outcomes of dengue virus infection.

11. **Systems biology approaches to understand the biology of human CD4+ helper T cells with cytotoxic potential (CD4-CTLs) in viral infections**

– Dr. Veena S Patil

The acquisition of immunological memory to infections is a hallmark of protective immunity and hence forms the basis for vaccinations. We are interested in understanding how the T cell memory is formed during the primary infection and maintained over the years to defend the subsequent secondary infection from the same pathogen. Currently our lab is focused on understanding the protective role of CD4+ cytotoxic memory T cells (CD4-CTLs) in viral infections. Broadly, our research goal is to understand the biology of such specialized memory subsets and utilize this knowledge in designing and developing strategies to boost durable immune responses following therapeutics and vaccination against these pathogens. Since the establishment of immunogenomics program at NII, through clinical collaborations we have established cohort of PBMCs and plasma samples from over 100 healthy blood donors. The FACS analysis revealed that the CD4-CTL memory proportions varies from 0.5% to >16% across these 100 donors in our cohort. The ELISA for virus (CMV, EBV, DENV and influenza)-specific IgG revealed that majority of the donors were sero-positive for >1 virus. To understand the phenotypes and molecular features of CD4-CTL memory compartment and various virus-specific CD4-CTLs in comparison to other

memory compartment we employ multi-omics and immunological approaches.

12. **Nanotechnology-based immuno-therapeutic platform for cancer**

– Dr. Santiswarup Singha

The lab is working on the development of the nano-immunotherapeutic platform for cancer by considering the interdisciplinary approaches that integrate nanotechnology, biochemistry, and immunology. Our approach includes nano-scale artificial antigen-presenting cells (APCs) that display multiple copies of tumor-associated antigen (TAA) presenting major histocompatibility complex (MHC-I/II) and co-stimulatory molecules to induce the antigen-specific immune response. Additionally, we are formulating nanoparticles to empower professional APCs to present TAA on MHC-I/II. We are also modulating the chaperone activity of tumor cells to promote the presentation of TAA on class-I MHC molecules. We integrate these approaches to find the appropriate treatment regimen for achieving the maximum therapeutic benefits.

1. Formulation of nano-scale APC as a therapeutic tool to expand tumor-specific T-cells

2. Empowering professional antigen-presenting cells through stimulator of interferon genes (STING) agonist

3. Reprogramming of tumor cells using anti-chaperone nanotechnology platform to present tumor-associated antigen

4. Combined therapeutic approach to induce sustainable anti-tumor immune response

13. **Integration of nutritional therapy with innate and adaptive immunity in infectious disease model**

– Dr. Tanmay Majumdar

Stimulation of IRF3-mediated tryptophan-kynurenine pathway by β-catenin impedes replication of *Toxoplasma gondii*

The β-catenin plays a critical role in development, survival, and proliferation of cells, but its role in immunity during parasite infection is only beginning to be understood. Our current research is focused on deciphering the role of the β-catenin pathway in innate immunity against the protozoan parasite, *Toxoplasma gondii* infection. We found that in the *T. gondii*-infected cells, AKT1-mediated phosphorylated β-catenin migrates into the nucleus in the process of infection. The TCF subunit of β-catenin-TCF4 protein complex binds to the promoter region of IRF3 and initiates IRF3 transcription, which was abrogated in β-catenin knockout cells. *T. gondii* infection augmented IRF3-dependent IDO1 transcription, but proteasomal degradation of IDO1 favored parasite's replication further. With IDO1 depletion, tryptophan was catabolized into melatonin, which circumvent cellular reactive oxygen species (ROS) production and augmented parasite growth further. Conversely, treatment with tert-butyl-hydroperoxide, a ROS inducer, abrogated parasite replication. We propose, *T. gondii* selectively utilizes tryptophan to produce the antioxidant, melatonin, which prolonged the survival of infected cells for better parasite replication. Stable IDO1 in presence of IFN-γ catabolized tryptophan into kynurenine, which impeded parasite replication by promoting cell death. Kynurenine or its analogue, teriflunomide, suppressed AKT1 activity and triggered caspase-3 dependent apoptosis of *T. gondii* infected cells, suppressing parasite growth. Our results reveal a new paradigm in which the transcriptional induction of IRF3 by β-catenin-TCF4 signalling plays a cell-intrinsic pro-parasitic role. We propose that IDO1-reliant tryptophan catabolites and their analogues would be effective immunotherapeutic molecules to control *T. gondii* replication and pathogenesis without directly affecting the parasite.

Microbiome based nutritional therapy: A new arsenal against *Toxoplasma gondii* treatment induced obesity

The project based on the disruption of synchrony between gut microbiome and metabolic rhythms by *Toxoplasma gondii*

infection. We ask the question, how does altered microbiome population develop obesity due to metabolic dysfunction in course of treatment of chronic *T. gondii* infection. Competition between symbionts vs pathobiont determines tolerance (Treg/Tr1/Breg/Br1) vs inflammation (Th1/Th17/Inflammatory B1). Chronic infection leads to uncontrolled inflammation towards obesity. This translational research will examine mechanisms of the beneficial effects of probiotics, and will discover microbiome based new generation of anti-inflammatory small molecules against *T. gondii* induced obesity.

- Earlier, we have found that activation of Wnt molecule has facilitated *T. gondii* replication smoothly in the host. Here, we have found that Wnt inhibitor (JW55) recovered mortality of *T. gondii* infected mice significantly.
- Infected mice lost their body weight significantly, nonetheless, Wnt inhibitor recovered body weight of parasites infected mice significantly.

B. REPRODUCTION AND DEVELOPMENT

14. Biology of trophoblast cells and immunocontraception

– Dr. Satish K. Gupta

Development of contraceptive vaccine

Female beagle dogs (n = 4/group) were immunized with three contraceptive vaccine formulations along with an adjuvant control. Follow-up of the immunized animals revealed good antibody titres in the dogs immunized with *E. coli*-expressed recombinant dZP3-$GnRH_2$ and physical mixture of TT-KK-pZP3 & bRNase-KK-pZP4. Single booster dose of contraceptive vaccines on day 383 led to an increase in antibody titres suggesting that primary immunization led to immune memory. Immune serum samples reacted with dog native zona pellucida. Mating studies revealed that dZP3-$GnRH_2$-based contraceptive vaccine has a promising *in vivo* contraceptive efficacy with significant reduction in pregnancies as well as new pups born as compared to other groups. Ovarian and uterine histology revealed that immunization with the recombinant proteins-based contraceptive vaccines is safe.

Molecular mechanisms associated with trophoblast migration and differentiation

HGF-mediated increased in HTR-8/SV neotrophoblast cells migration involve downregulation of miR-18a-3p and increased expression of AKT and SMAD5. During forskolin-induced BeWo cells fusion the reduced expression of miR-27b-5p leads to loss of its repression control on HSD3β1 and WNT2B thereby increasing secretion of progesterone and hCG with concomitant increased cell fusion miR-27b-5p inhibits HSD3β1 and WNT2B expression through direct interaction with the predicted complementary sequences present in their respective 3'-UTR.

15. Studies of Sertoli cells and spermatogonial stem cells of the testis and other endocrinology related research

– Dr. Subeer S. Majumdar

Our lab seeks to elucidate causes underlying idiopathic male infertility by studying the regulation of spermatogenesis and fertility by testicular Sertoli cells (Sc).

In addition, studies to determine the role of specific microRNA, proteins and transcription factors of Sc origin in germ cell division and are ongoing.

Using high-throughput and transgenic approaches, we have identified genes and miRNAs that are critical for Sc mediated regulation of male fertility. We have deciphered a role of transcription factor MEIS1 in Sc maturation and spermatogenesis (Meis1 was selected from TRANSFAC data, previously generated in our lab). Sc specific knockdown of *Meis1* in transgenic mice disrupted Sc maturation, induced germ cell apoptosis and led to infertility, establishing an essential role of Sc expressed MEIS1 in pubertal onset of

spermatogenesis and male fertility. We have also investigated the effect of TNF receptor (TNFR1) knockdown on spermatogenesis. Transgenic mice with Sc specific knock-down of *Tnfr1* had low sperm counts and were sub-fertile. In addition to this, we have identified a role of miRNA mir382-3p in Sc mediated regulation of male fertility. Transgenic overexpression of miR-382-3p in Sc impaired the formation of blood testes barrier, led to severe oligozoospermia and infertility. To summarize, our studies have identified Sc expressed genes/miRNAs, the defects in which may be an underlying cause of idiopathic male infertility.

C. CHEMICAL BIOLOGY, BIOCHEMISTRY AND STRUCTURAL BIOLOGY

16. Molecular mechanism of enzymatic reactions and enzyme-ligand interactions

– Dr. Apurba Kumar Sau

The aim of our research is focused on the mechanistic study of enzyme regulation with respect to human and bacterial enzymes. The mechanism along with their structural data may help to design therapeutic inhibitors.

IFN-γ induced human GTP-binding proteins and their role in the regulation of GTP hydrolysis

To identify, which region(s) of hGBP-2 are important for dimerization and tetramerization, several truncated proteins were prepared, in which the GTP-binding domain was kept intact, but the other regions were systematically omitted. Analytical SEC studies of these proteins were performed in the absence and presence of analogues, GppNHp or GDP.AlF_4. The results indicate that the intermediate region and R-II region (residues 482-556) of the helical domain are crucial for dimerization and tetramerization, respectively. To examine the role of individual domains in GTP hydrolysis, GTPase assays of different truncated proteins were performed. The data suggest that the helical domain has no role in GMP formation. Surprisingly, the GTP-binding domain alone is capable of hydrolyzing GTP only to GDP. However, this domain can hydrolyze the second phosphate of GTP only when it is present along with its intermediate region. Overall, these data provide an important insight that the GTP-binding domain of hGBP-2 can carry out the second phosphate cleavage of GTP through dimerization when this domain is present along with its intermediate region. The formation of hGBP-2 tetramer was also observed in mammalian cells, which may be important for its biological functions.

17. Molecular modelling of proteins and protein-ligand complexes using knowledge-based approaches and all atom simulations

– Dr. Debasisa Mohanty

The main theme of the research projects is to develop novel computational approaches for prediction of biomolecular structure, interactions and substrate specificity.

Deciphering activation mechanism of PfCDPK1 and design of allosteric inhibitors

Molecular dynamics simulations were carried out to decipher the structural basis of allosteric activation of PfCDPK1, an essential kinase and important drug target of *Plasmodium falciparum*. After establishing the structural basis of allosteric activation of PfCDPK1 kinase domain by CaMLD, attempt was made to search for inhibitors which can disrupt this PfCDPK1 kinase-CaMLD interactions, leading to allosteric inactivation of the kinase domain. Using a combination of machine learning and structure based approach for identifying PPI modulators, a set of 74 compounds have been identified which can potentially bind to pockets on CaMLD inhibit interactions with the kinase domain.

Prediction of inhibitors for different drug targets in SARS-CoV-2

Information on water and small molecule fragments bound to M^{pro} was utilized to develop a novel Water Pharmacophore (Waterphore) model. It was encouraging to note that, even though no inhibitor data was used in developing

the Waterphore model, it could successfully identify the known inhibitors from a library of decoys with a ROC-AUC of 0.81 and active hit rate (AHR) of 70%. The Waterphore model is also general enough for potential applications for other drug targets.

Using machine learning based approach more than 300 novel small molecule scaffolds were predicted as inhibitors for RBD: hACE2. Docking studies for some of the compounds reveal that they can inhibit RBD_hACE2 interaction by high affinity binding to interaction hotspots on RBD. Finally by combining structure based docking method with results from ML based screening, we have identified a small set of 5 compounds for experimental validation.

For fast screening of potential peptide inhibitors of RBD:hACE2 interaction, a pharmacophore feature model has been developed based on the interaction hotspots identified by MD simulations. Validation of the model shows that it can reproduce the known binding poses of the peptides. Using this pharmacophore model screening of a natural product derived cyclic peptide library has resulted in identification of few interesting candidates as potential inhibitors of RBD:hACE2.

18. **Delineating immune metabolism interaction in disease pathogenesis of tuberculosis and vitiligo**

– Dr. Rajesh Gokhale

The thematic focus of our laboratory is to elucidate the interplay between metabolic reprogramming and immunity in the context of pathogenic disease Tuberculosis and autoimmune skin disorder Vitiligo.

Diseases and host metabolic processes are intimately connected to the mechanisms of disease pathogenesis.We are therefore interested to discern the knowledge of dysregulated immuno-metabolic axis to develop novel therapeutic strategies.

Mycobacterial lipid metabolism and its implications in TB disease pathogenesis

During the recent year, my laboratory has identified two new lipidic metabolites, *Polyketide quinones* and *Kupyaphores* from *Mycobacterium tuberculosis* (*Mtb*). We identified these molecules from the cultures from *Mtb* during biofilm formation. To understand their role in pathophysiology of infection, our endeavour was to detect these molecules from the lungs of the infected host. We therefore developed novel extraction methods to identify these molecules using mass spectrometry. By using semi-quantitative methods, we are able track induction, concentration build-up and disappearance during various phases of mouse infection. Our earlier studies has provided the evidence for the involvement of polyketide quinones in hypoxic respiration as electron shuttling molecules. We now show that kupyaphores are important to transport zinc during acute stress conditions.

Deciphering mechanisms underlying melanogenesis and depigmenting disorder Vitiligo

Our study has revealed metabolic control mechanisms of melanocytes that could govern the balance between pigmentation and proliferation in a variety of cutaneous diseases. The induction phase is concomitant with increased anabolic metabolism. The melanogenic phase shows rapid uptake of glucose and fatty acid, transiently forming lipid droplets through SREBF1-mediated regulation of fatty acid metabolism. The heightened bioenergetic activity impairs mitochondria and the recovery phase is marked by a shift to aerobic glycolysis and activation of the NRF2 detoxication pathway. Finally, we show that inhibitors of lipid metabolism can resolve hyper-pigmentary conditions in a guinea pig UV-tanning model.

19. **To develop strategies for making sensors and actuators for biological processes**

– Dr. Pramod K. Upadhyay

Our lab seeks to study the biological processes like differentiation, hybridization etc. and to develop devices and sensors based on such studies.

In addition, we are developing tools for needle free immunization and cell therapy.

Effects of immune dysregulation in Retinitis Pigmentosa (RP)

Retinitis Pigmentosa is a heritable ocular disease leading to progressive photoreceptor degeneration. Classically anti-inflammatory response is elicited against self-antigens, however RP patients displayed significantly lower anti-inflammatory response to retinal antigens.

Role of monocytes in Hepatitis B infection

Hepatitis B virus infection is a serious threat to public health with over a million deaths globally each year. We investigated role of monocytes in disease and its utility for biomarkers in HBV infection. Initially we found 22 significantly upregulated genes HBV inactive carrier blood. We further elaborated this finding to find nature of monocyte and HBV interactions.

Aerogenic route immunization on non-human primates

We evaluated safety and efficacy of a dry powder aerosol formulation of BCG encapsulated alginate particle (BEAP) in infant rhesus macaques. The ease of delivery and thelonger shelf life of at least six months at room temperature are the unique advantages which make BEAPa promising candidate vaccine for TB.

20. **Protease-catalyzed splicing of peptide bond**

– Dr. Rajendra P. Roy

We have been exploiting the peptide ligation propensity of transpeptidase sortase for semisynthesis of proteins and well defined bioconjugates. Contemporaneously, we also study interrelationship between structure, function, and dynamics of sortase family enzymes.

Studies on structure, dynamics and function of sortases

In the past year, we reported the generation and characterization of a class E sortase (TfSrtE) from *Thermobifida fusca.* The TfSrtE displayed somewhat unusual substrate specificity. In view of this, rational site-directed mutagenesis of a crucial and critically placed residue, Tyr128, was carried out to create Y128F and Y128A mutants of TfSrtE. Transpeptidation assays of mutants yielded interesting results. Y128F in TfSrtE mutant was found to be as active or slightly better than the wild type enzyme with respect to the LPXTG substrate but its activity against the LAXTG substrate was almost abrogated. In contrast, Y128A mutant was endowed with high proteolytic activity. Taken together the above results highlighted the critical role of the above conserved Tyr residue in fine tuning of substrate preference in sortase family of transpeptidases.

The above results raise the possibility of engineering a novel protease as well as a novel transpeptidase with orthogonal substrate preference. However, this endeavour will require details of the sortase-substrate interaction. Towards this, we initiated studies on delineating the crystal structure of TfSrtE. However, all attempts to crystallize a 64-residue truncated version carrying a His-tag at the N-terminus of TfSrtE failed to crystallize. Accordingly, new constructs of TfSrtE were made and subjected to crystallization trials. Recently, in collaboration with Dr Vengadesan at RCB, Faridabad, we have been able to obtain diffraction quality crystal of a further truncated (90-residues deleted from the N-terminus)

version of TfSrtE that contains a His-tag at the C-terminus. The structural data is being analyzed and additional co-crystallization experiments are in progress.

Sortase-mediated protein labeling and conjugation

We had previously reported the homogeneous acetylated histones by sortase-mediated ligation of appropriate complementary fragments generated by chemical synthesis, proteolysis or recombinant expression. Studies on screening of erasers of H2BK5Ac and H3K4Ac were described. HDAC 1 and HDAC6, respectively, were found to be the prime acetyl eraser of H2BK5Ac and H3K4Ac. Continuing the studies, we have now evaluated the ability of HDAC6 to erase acetyl mark of H3K4Ac in nucleosomes. Towards this, an octamer composed of H3K4Ac and other native histones (H2A, H2B, and H4) was prepared and reconstituted with purified 147bp DNA (nucleosome positioning sequence) into nucleosomes. The ability of HDAC6 to deacetylate H3K4Ac in embedded nucleosomes was examined using HDAC6 overexpressed cell lysates. The acetylation signal was found to be significantly reduced in the sample that was incubated with HDAC6 as compared to the neat lysate control sample (input) or the HDAC1 treated sample. The results indicate that HDAC6 was able to specifically deacetylate H3K4Ac in nucleosomes. The deacetylation of H3K4Ac nucleosomes by overexpressed lysates was inhibited in the presence of tubacin, a specific inhibitor of HDAC6.

The deacetylation of H2BK5Ac or H3K4Ac nested nucleosome was further examined for cross-reactivity of HDACs to unequivocally establish the site-selectivity of the HDAC1 or HDAC6. Here, each semisynthetic nucleosome was treated separately with recombinant HDAC1 or HDAC6 and probed with respective acetyl mark specific antibody. Immunoblots of the deacetylation reaction of H2BK5Ac nucleosomes with HDAC6 or H3K4Ac nucleosomes with HDAC1 did not show any significant alteration in the acetylation levels while expected diminution of acetyl signal was observed in the same nucleosome samples of H2BK5Ac treated with HDAC 1 or H3K4Ac treated with HDAC6. Besides, the respective deacetylation reactions were also inhibited by pyroxamide or tubacin.

21. Chemical Glycobiology: Glycoform modulation, carbohydrate-based drug design, and glycomics

– Dr. Srinivasa-Gopalan Sampathkumar

Carbohydrates form one of the four major building blocks that govern life, health, and disease. Unlike technologies that exist for studying genes and proteins, biological investigations of glycans suffer from lack of robust tools. We strive to design and develop modulators of glycosylation for probing structure and functions of glycoconjugates in the immune system.

Inhibition of protein *O*-glycosylation by GalNAc analogues.

Mucin-type *O*-glycosylation (MTOG) is initiated by the addition of α-GalNAc to Ser/Thr and elaborated to complex glycans, including blood group antigens (A, B, H(O)) and sialyl-Lewis-X (CD15s). Only limited small molecule inhibitors are available for probing the functional roles of *O*-glycosylation in immunological processes. Using Ac_5GalNTGc, a synthetic analogue of GalNAc, we have shown the inhibition of *O*-glycosylation *in vitro*, *ex vivo*, and *in vivo*. Treatment of mice with Ac_5GalNTGc resulted in reduced migration of neutrophils in an acute inflammation model providing new avenues for exploitation of glycans for modulating autoimmune and inflammatory disorders.

β-*O*-GlcNAc-ylation of nuclear/ cytoplasmic proteins.

Apart from phosphorylation and acetylation, β-*O*-GlcNAc-ylation of Ser/Thr of transcription factors adds another layer of complexity in cellular signaling. We have profiled the

multiple post-translational modifications on Foxp3-FLAG, a key transcription factor in T-regulatory cells, by glycoproteomics and ETD mass spectrometry.

22. **Structural studies on proteins, dynamics and ligand interactions using NMR**

– Dr. Monica Sundd

The theme of our research is to understand the structure, function, dynamics, and ligand interactions of proteins involved in fatty acid metabolism *viz*. the acyl carrier protein, ACP Synthase, 4'-Phosphopantetheinyl transferase, lipoate protein ligase, biotin protein ligase *etc* with special emphasis on *Leishmania.*

The primary objective of our research is to understand fatty acid metabolism, and other pathways dependent on it, using NMR and other biophysical techniques. We intend to relate their function with structure, and interactions. Following two pathways are being pursued:

A) Fatty acid biosynthesis
B) Lipoic acid/biotin modification

Lipoic acid is an important cofactor, necessary for the function of several mitochondrial enzymes, *viz.* 2-oxoacid dehydrogenases, pyruvate dehydrogenase (PDH), glycine cleavage system (GcvH) *etc.* Loss of lipoylation interferes with the function of these enzymes, leading to a range of neurological disorders (in humans). In prokaryotes, two separate lipoylating pathways are present, a) lipoic acid biosynthetic pathway, catalyzed by Lipoate protein ligase B (LipB), and b) a salvage pathway, catalyzed by Lipoic acid synthase (LplA). The two enzymes differ remarkably in their substrate requirements, *i.e.* LipB requires C_8-ACP, a by-product of fatty acid synthesis pathway (FAS), while LplA utilizes free lipoic acid in presence of Mg^{2+} and ATP. Eukaryotes lack the salvage pathway. Thus, genetic defect in any of the FAS enzymes, can lead to lipoic acid deficiency defects. *Leishmania* being a eukaryote, its LipB displays sequence and functional similarities with the human enzyme LipT2. Using NMR, SPR and biochemical studies, we show that its LipB has a strong affinity for C_8- and holo-ACP, but weakly binds free ACP. It can also use C_8-ACP from other sources as a substrate. These results lead us to speculate an indispensable role of the 4'-phosphopantetheine arm in substrate recognition by LipB. To test this hypothesis, C_8-CoA was used as a substrate. LipB efficiently used C_8-CoA. In NMR experiments, LipB displayed interaction with the adenine base, and phosphate of CoA, akin to LplA. Structural comparison of *E. coli* LplA and *M. tuberculosis* LipB highlights residue conservation at sites that interact with adenine and phosphates in LplA. Based on these observations, we propose that LipB and LplA have very similar substrate requirements.

23. **Therapeutic interventions in chronic diseases**

– Dr. Sarika Gupta

My group is a multi-disciplinary group adapting an integrated approach in drug discovery that combines medicinal chemistry, basic biology and biochemistry principles for efficient drug design process. Interests of the group lie in identifying underlying principles in a disease pathogenesis to discover new targets, designing molecular intervention strategies and confirming the biological/therapeutic activities of the designed compounds.

During a therapeutic regimen involving biologically active peptides to reduce amyloidosis in 5xFAD transgenic (Tg) Alzheimer mouse model, we discovered that certain immunomodulatory complexes get formed in the brain of mice. Herein we administered 300 ng of undercarboxylated osteocalcin or Glu-OC to 5xFAD Tg mouse for 60 days and found co-localization of “Abeta42” with “osteocalcin”. We comprehended that these were associated with microglial activation that was otherwise absent in 5xFAD Tg control mice. The interaction of Abeta42 and Glu-OC was facilitated in situ and tested for immunomodulatory potential. The complex demonstrated immunomodulatory potential. We envisage this complex with its

immunomodulatory and anti- inflammatory potential will have industrial application for the treatment of immune and inflammatory disorders. Further we checked the effect of Carboxylated osteocalcin or Gla-OC is a vitamin K dependent protein that is synthesized mainly by osteoblasts. During bone remodelling the carboxylated osteocalcin is converted into undercarboxylated-OC and released into blood. The Carboxylated-OC has also reduced the amyloid burden in the brain significantly and improved memory deficit in 5XFAD mouse model of AD.

24. **Structural and functional and inhibition studies of *M. tuberculosis* proteins**

– Dr. Bichitra Kumar Biswal

A major project of my laboratory aims at deriving a molecular level understanding of Histidine (His) production by *Mycobacterium tuberculosis* (*Mtb*), the causative agent of tuberculosis (TB) in humans. Intracellular pathogens including *Mtb* have evolved with strategies to uptake amino acids from host cells to fulfil their nutrition requirements. However, *Mtb* also possesses de novo biosynthesis pathways for all the amino acids. We intend to address a pertinent question- how does *Mtb* fulfil its histidine requirements within an in vivo setting? Further, we plan to design specific anti-TB inhibitors disrupting the histidine biosynthesis pathway. In addition, to identify anti-COVID19 molecules, we focus on developing strategies to abolish the activity of an important enzyme RNA dependent RNA polymerase key to the life cycle of the COVID19 causing virus.

To evaluate the essentiality of the *Mtb* de novo histidine biosynthesis pathway in an in vivo setting, we performed a series of experiments using wild type and a histidine pathway gene knockout strains of *Mtb* (H37Rv) at in vitro and in vivo levels. We show that Histidine auxotrophy of *Mtb* is bactericidal and hinders pathogenesis. We observed that to clear the pathogen the host by up-regulating its histidine catabolizing enzymes (histidine ammonia lyase and histidine decarboxylase through interferon gamma (IFN-γ) mediated signalling, exerts an immune response directed at starving the bacillus of intracellular free histidine. However, the wild-type *Mtb* evades this host immune response by biosynthesizing histidine using its de novo pathway, whereas a histidine auxotroph fails to multiply. Notably, in an IFN-$\gamma^{-/-}$ mouse model, the auxotroph exhibits a similar extent of virulence as that of the wild-type. Further, using mass spectrometry, we show that the levels of free histidine in the host cellular pool decreases over the course of infection. The results augment the current understanding of host-*Mtb* interactions and importantly suggest that *Mtb* histidine biosynthesis is essential for its pathogenesis. Using the structural, biochemical and infection studies and building on our previous studies we have designed a number of triazole and imidazole scaffold inhibitors and have carried out structural and biochemical studies of a few of them. We have demonstrated that these triazole scaffold inhibitors exhibited minimum inhibitory concentration $(MIC)_{99}$ values at sub-micro molar level. We show that these inhibitors bind in the active site of HisB (imidazole glycerol phosphate dehydratase) which is situated in the interface of three monomers. The triazole ring of each of these inhibitors is firmly anchored between the two active site manganese atoms. The others parts of the inhibitors make hydrogen and van der Waals interactions mainly with Asp, Arg, His and Glu, which protrude from the three different subunits. In another project, employing a structure-based virtual screening approach, we have identified a number of available kinase inhibitors that dampen the kinase-like activity of the RNA polymerase of SARS-CoV-2 virus. One of these compounds, sorafenib shows anti-COVID19 activity.

25. **Biophysical and biochemical characterization of *Leishmania mexicana* phosphoglycerate kinase: an enzyme in the glycolytic pathway of parasitic protozoa.**

– Dr. Vidya Raghunathan

It is known that *Leishmania* sp. uses multiple isoforms for many enzymes of the energy pathway, one of which is Phosphoglycerate kinase or PGK. *Leishmania* PGK isoforms has

some distinct structural features, as PGKB and PGKC differ primarily in the presence of a long extension at the C-terminus of PGKC. Drug development efforts can be targeted, either at the glycosome itself or at the enzymes present within them for which, targeting unique structural features is critical.

We are interested to use structural and enzymology methodsto study thebehavior of PGK isoforms in *Leishmania* spp.

1. Expression, purification and determination of specific activities of PGKB-*Lmex* and PGKC-*Lmex* and steady state kinetic studies.Comparison between PGKB-*Lmex* and PGKC-*Lmex*of, pH optimum of activity and enzyme inhibition by salt and suramin.
2. Peptide based studies ofglycosomal membrane association of PGKC-*Lmex* with a view to understand the structural basis of the biochemical differences between PGKC-*Lmex* and PGKB-*Lmex*.
3. Determination of the three-dimensional structure of the PGKC glycosomal enzyme from *Leishmania mexicana*
4. Further extend the studies to PGK isoforms in other species of *Leishmania,* towards their functional diversities.

We have been studying the relevance of information theory (Shannon CE, 1948, Bell Sys Tech J, 27:379-423) used in developmental/ evolutionary/genomics biology specifically to protein folding. Coding in protein folding is symbolic but degenerate in that while one sequence does give one structure, in the reverse, similar folds can be generated from multiple sequences. The probabilistic nature of protein structural code but not the sequence code is evident. The applications of this theory on protein structure/function evolution specifically in the case of PGK of *Leishmania* is highly relevant evolutionarily. Residual entropy and shared entropy are unique to non-equilibrium probabilistic systems such as folded proteins which serves as source of information for directing further changes of the structure. The relevance to evolutionary acquisition of new functions by the same protein is an important subject of study especially in relation to newly emerging pandemics caused by RNA viruses like the SARS-CoV-2.

D. GENETICS, CELL SIGNALING AND CANCER BIOLOGY

26. Cellular and molecular biology of human cancer

– Dr. Anil Suri

Our vision is to 'translate' cancer research findings into medical practice to have an immediate societal impact. SPAG9 protein is being used for early detection, recurrence and for immunotherapy in cervical, ovarian and breast cancer.

Early detection and diagnosis in cervical, breast and ovarian cancer

Anti-SPAG9 antibodies were detected in 83% cervical (639/770), 80% breast (520/650) and 80% ovarian cancer (224/280) patients. Further large-scale studies are continuing for cancer management.

Clinical trials in cervical cancer patients stage IIIbPhase 2, [DCGI approval: 03/03 2015; CTRI/2016/12/007530]:

Clinical trials were started in June 2017. Currently, patients completed required 10 doses. 43 patientsof 53 have had their re-evaluation done by PET-CT scan and are in CR and will be followed for two years.

Clinical trials in ovarian cancer patients stage IV (recurrent/metastatic)Phase 2[DCGI approval: 04/03/ 2020;CTRI/2020/ 11/029436]

Clinical trials in 75 patients have been initiated January, 2021. Jointly NII and Cancer Institute has developed 1000 particle free facility at SRCC, MG hospital, Jaipur, for future ovarian cancer trials.

Immunotherapy by monoclonal antibodies

We have generated monoclonal antibodies against SPAG9 that target surface of the cancer cells. Targeted immunotherapyh as a direct translational pathway to the clinic.

27. **Deciphering the role of cell signaling in *Mycobacterium tuberculosis* biology**

– Dr. Vinay K. Nandicoori

Tuberculosis caused by *Mycobacterium tuberculosis* (*Mtb*) is a significant public health concern, exacerbated by the emergence of drug-resistant TB. Mutation in the genome of bacteria contributes to the acquisition of drug resistance. Mutations in bacteria can arise due to exposures to antibiotics, oxidative, reductive, and many other stresses that bacteria encounter in the host. *Mtb* has multiple DNA repair mechanisms, including a base excision repair pathway to restore the damaged genome. *Mtb* possesses a GC-rich genome, rendering it highly susceptible to cytosine deaminations, resulting in the occurrence of uracils in the DNA. UDGs encoded by *ung* and *udgB* initiate the repair; hence we investigated the biological impact of deleting UDGs in the adaptation of pathogen. We generated gene replacement mutants of uracil DNA glycosylases, individually (*RvΔung*, *RvΔudgB*) or together (*RvΔdKO*). The double KO mutant, *RvΔdKO* exhibited remarkably higher spontaneous mutation rate, in the presence of antibiotics. Interestingly, *RvΔdKO* showed higher survival rates in guinea pigs and accumulated large number of SNPs as revealed by whole-genome sequence analysis. Competition assays revealed the superior fitness of *RvΔdKO* over *Rv*, both in *ex vivo* and *in vivo* conditions. We propose that compromised DNA repair results in the accumulation of mutations, and a subset of these drives adaptation in the host. Together, data suggest that the absence of a base excision repair pathway leads to higher mutations and provides a survival advantage under stress. They could be an invaluable tool for identifying targets of new antibiotics. Importantly, this property allowed us to utilize *RvΔdKO* for the facile identification of drug targets.

28. **Determining the signaling and repair pathways that are altered in human cancer**

– Dr. Sagar Sengupta

PolγA levels are decreased by MITOL

Towards an effort to determine the mechanism of turnover PolγA, overexpression of five known mitochondrial E3 ligases (MITOL, PARKIN, MULAN, RNF185, KEAP1) were carried out and the levels of endogenous PolγA determined. Only MITOL decreased the levels of PolγA. The decrease in the level of PolγA was reversed upon MG132 treatment and occurred only in presence of wildtype MITOL (MITOL WT) and not its catalytically-dead counterpart (MITOL CD). Depletion of MITOLled to increased levels of PolγA and TFAM. The half-life of endogenous PolγA were increased upon depletion of MITOL as revealed by cycloheximide chase experiment. Importantly, neither the overexpression nor the ablation of MITOL had any effect on PolγA transcript levels.

Ubiquitylated PolγA cannot enter mitochondrial matrix

Having determined that PolγA was ubiquitylated by MITOL, we took the next logical step to understand whether this ubiquitylation affected its entry into the mitochondria. We found that compared to the ubiquitylated variant, non-ubiquitylated PolγA entered the matrix with much better efficiency. To investigate is more detail how ubiquitylation regulated the entry of PolγA, we next carried out an import assay with either PolγA wildtype or PolγA K1060A (which cannot be ubiquitylated by MITOL). PolγA K1060R entered mitochondrial matrix with much greater efficiency than PolγA WT.

PEO mutants have compromised mitochondrial entry and functions

To understand whether the enhanced entry of the non-ubiquitylated PolγA into mitochondrial matrix have any pathological implication, four PEO patient mutations were chosen, all of which led to their respective missense mutations. Using *in vitro* transcribed and translated PolγA WT and four PEO missense mutants, it was determined by mitochondrial import assay that 50% of the tested PEO mutants entered mitochondrial matrix with drastically lesser efficiency compared to PolγA WT. The PEO mutants which could not enter the mitochondrial matrix were found to be ubiquitylated to a higher extent compared to PolγA WT. Unlike PolγA WT expression of PEO mutants led to decreased incorporation of BrdU within the mtDNA, as observed both by southwestern and slot blot western analysis. A long-range DNA amplification assay based on qPCR provided evidence that in contrast to cells expressing PolγA wildtype, the mtDNA repair ability of PEO mutants was highly compromised.

29. **Epigenetic regulation of the eukaryotic genome: Role of CTCF in organizing chromatin**

– Dr. Madhulika Srivastava

Specific interactions of myriad *cis*-acting elements and *trans*-acting factors within the eukaryotic nuclear milieu is governed by an appropriate organization of chromatin at various levels. CTCF, a DNA binding protein, is an important contributor to chromatin organization. Intriguingly, CTCF has multifunctional attributes that lead to diversity in the functional outcomes of CTCF binding. We are investigating the role of CTCF in regulation of transcription and VDJ recombination at murine TCRb locus to decipher the nature of chromatin domains organized by this multifunctional protein,

Antigen receptor including TCRb, are precisely regulated during development for transcription and RAG mediated VDJ recombination. They serve as useful models to understand various aspects of chromatin organization as influenced by CTCF and other *cis* and *trans* acting factors. We are investigating the chromatin structure and organization of the wild type and genetically manipulated AgR loci to understand :

a. Role of CTCF in regulation of TCRb
b. Activity of enhancer Eb

Role of CTCF in regulation of TCRb

Different roles of the CTCF binding sites on TCRb locus can be hypothesized that are pertinent for various aspects of regulation of TCRb locus. We have generated few mouse mutants in which specific CTCF binding sites have been ablated. The mutants exhibited altered usage of V segments during V-to-DJ recombination as evidenced by FACS analysis as well as RT-qPCR analysis. Depending on the specisifc CTCF binding site mutated, we observe phenotypic variations. These studies are being complemented with Chromosome conformation capture analysis (3C-qPCR) to relate the alterations of the chromatin loopscape to the observed alterations in VDJ recombination profiles.

Activity of enhancer Eb

Eb is an important regulatory element of the TCRb locus. It has been suggested that RNA PolII is first loaded onto Eb and then transferred to the cognate promoters (PDb1 and Pdb2). Eb also exhibits presence of H3K4-trimethylation suggestive of active transcription. We discovered robust transcription of Long Non Coding transcripts (LncRNA) at Eb in thymocytes but not in liver cells where Eb is not active. The transcripts generated at Eb enhancer have been characterized and will help to elucidate the role of transcripts and/or process of transcription in context of activity of enhancers.

30. **Role of cell signaling in eukaryotic development**

– Dr. Pushkar Sharma

We are interested in signaling and trafficking events in two diverse cell types: 1) Apicomplexan parasites like *Plasmodium falciparum* and 2) mammalian neurons.

Dissection of intracellular signaling and trafficking cascades that operate in *Plasmodium falciparum* and *Toxoplasma gondii*.

i. Role of a VPS15 homologue in Plasmodium falciparum and Toxoplasma gondii.

In silico analysis suggested the presence of an orthologue of VPS15 in both *P. falciparum* and *T. gondii.* Our recent studies have lead to dissection of a novel pathway that depends on the ability of TgVPS15 to regulate PI3P formation in *T. gondii*, which in-turn regulates the localization and function of TgATG18. TgATG18 is subsequently involved in TgATG8 conjugation to the apicoplast membrane and facilitates apicoplast inheritance, which is critical for parasite replication. Under nutrient limiting conditions, TgATG18 regulates autophagy in the parasite.

ii. Role of 4'-PIPs and Calcium Dependent Protein Kinase 7 (CDPK7, in phospholipid biogenesis

Our previous studies suggested that TgCDPK7 and PfCDPK7 interact with PI(4,5)P2 as well as PI4P *in vitro*. PfPI4-kinase, the enzyme involved in generation of 4'-PIPs, guides the localization of PfCDPK7 in *P. falciparum* and regulates biogenesis of key phospholipids (PLs) like PC and PE. PfCDPK7 in turn regulates the biogenesis of PC in the parasite by modulating key enzymes involved in this process; Ethanolamine kinase and phosphoethanolamine-methyl trans-ferase (PMT).

Molecular mechanisms that regulate Cell Cycle Related Neuronal Apoptosis (CRNA)

We are interested in the identification of miRNA that may target cell cycle related genes in response to Ab_{42} in Alzheimer's Disease (AD) and their role in the regulation of neuronal cell cycle in CRNA. We identified miRNA that are aberrantly expressed in neurons from AD transgenic mice (TgAD). Investigations on two of these miRNA, miR449a and miR16-5p, have suggested that these miRNA are critical in keeping the neuronal cell cycle suppressed, which prevents aberrant activation of the cell cycle and CRNA.

31. **Understanding the regulation of DNA replication**

– Dr. Sandeep Saxena

DNA replication is a vital process of life and must be completed precisely during each cell cycle. When mammalian cells experience DNA damage, checkpoint mechanisms are activated to stall the progression of DNA replication and cell cycle. Our laboratory is working towards understanding the mechanisms by which miRNA and checkpoint proteins stall the cell cycle, thereby preventing genomic instability and cancer.

We are studying the regulation of replication machinery during stress to identify the underlying mechanisms responsible for inhibition of essential replication factors during stress. Our study focuses on the role of ubiquitination machinery in regulating replication proteins under normal and stressed conditions. Further, we are investigating the cellular responses to aberrations in replication complexes. The objective is to identify yet unknown checkpoint pathways that monitor the replication apparatus. Emerging evidences suggest that miRNAs and long non-coding RNAs (lncRNAs) target genes that regulate DNA replication and our aim is to determine the role of miRNAs and lncRNAs in regulating the cell cycle. Also, studies over the past many years have implicated core replication proteins in regulating centrosome biogenesis and mitosis.

Therefore, we are also interested in establishing the role of replication proteins in the maintenance of centrosome stability. Overall, we are attempting to unravel the protective and regulatory control of mammalian cell cycle, failure of which is likely to cause genomic instability.

Role of non-coding RNAs in cell cycle and carcinogenesis

In order to identify the cancer associated lncRNAs we have further analyzed the lncRNA expression in lung (LUAD) and prostate (PRAD) adenocarcinomas. We discovered that lncRNAs represses the promoter activity of other lncRNA, which are located a few kb away by utilizing DNA methyltransferase DNMT1. These lncRNAs display an inverse expression pattern in lung cancer cells lines as well as in human cancer patient samples. Depletion of c-Myc results in downregulation of these lncRNAs, exemplifying how c-Myc and E2F1 signal transduction pathways control the network of lncRNA genes to modulate cell proliferation and differentiation.

GINS4 is required for centrosome integrity during mitosis

We have previously shown that Sld5, a DNA replication protein, apart from its role in replication, also functions to preserve the centrosome integrity. We have observed that Sld5 deficiency down regulates the dynein–dynactin complex, which mediates the movement of cargo-laden centriolar satellites toward the centrosomes. The resulting dissipation of centriolar satellites throughout the cytoplasm inhibits the recruitment of proteins essential for centrosome maturation. The outcome is a weakened centrosome that is unable to endure the traction forces prevalent during mitosis.

32. **The role of tumor suppressors in stress response**

– Dr. Sanjeev Das

The focus of the lab is to understand the perturbations in various pathways that lead to tumorigenesis. Here, we report the work carried out on two proteins viz. HDAC5 and PRAMEF2 which determine the malignant phenotype.

Understanding the role of HDAC5 in transcriptional dysregulation during malignant transformation

HDAC5 is a member of highly conserved class IIa family of ZN^{2+} dependent histone deacetylases. Dysregulation of HDAC5 has been implicated in many pathogenic conditions including cancer. A greater insight is needed on the molecular mechanisms underlying the role of HDAC5 in tumorigenesis. In order to identify novel HDAC5 interacting proteins, we performed proteomics screening using sequential immuno precipitation. Our results revealed that SATB1 is a novel interaction partner of HDAC5.

Unraveling the role of PRAMEF2 in tumorigenesis

PRAMEF2 is a member of the PRAME multigene family of cancer testis antigens, which serve as prognostic marker for several cancers. However, molecular mechanisms underlying its role in tumorigenesis remain poorly understood. Here, we report that PRAMEF2 is a BC-box containing substrate recognition subunit of Cullin 2 based E3 Ubiquitin ligase complex. PRAMEF2 mediates polyubiquitylation of LATS1 kinase of the Hippo/YAP pathway, leading to its proteasomal degradation.

33. **Elucidating the molecular mechanisms of aging and innate immunity using *Caenorhabditis elegans* as a model system**

– Dr. Arnab Mukhopadhyay

We use genetics, molecular biology and genomicsin *Caenorhabditis elegans* to understand the molecular basis of aging and how Dietary Restriction (DR) increases life span as well as delays age-onset diseases. We are also trying to repurpose FDA-approved drugs to treat diabetes-related complications.

Deciphering the coordinate regulation of genes downstream of the Insulin/IGF-1-like (IIS) pathway

We have shown that the ERK pathway and the PI3 kinase pathways co-ordinately regulate meiosis 1 arrest on *cdk-12* KD in *daf-2(-)*. We performed transcriptomics analysis to find that genes involved in germline development and DNA damage response pathways are regulated by CDK-12 and DAF-16.

Involvement of novel kinases in DR

Our experiments suggest that *flr-4(n2259)* responds to the increased Vitamin B12 levels in *E. coli* HT115, compared to OP50, by activating the p38-MAPK pathway to increase stress tolerance and prolong life span.

Using metabolomic analysis, we found that *flr-4(n2259)* responded to Vitamin B12 by enhancing the flux through the pathway, while wild-type did not. Importantly, the genes of One-carbon metabolism were also required for osmotic tolerance and life span enhancement of *flr-4(n2259)* grown high Vitamin B12 diet.

Using mice models of diabetes to study the efficacy of Rifampicin on reducing hyperglycemia-related complications

The fasting blood glucose levels of Rifampicin-treated *db/db* mice decreased while *C57BL/6J* mice showed significant increase. OGTT showed a slight improvement in Rifampicin-treated *db/db* mice while *C57BL/6J* mice that received the treatment showed no difference. Also, in insulin tolerance test (ITT), Rifampicin-treated *db/db* mice performed better. We also found that Rifampicin increases β-cell mass in *db/db* mice that may help to improve glucose homeostasis, apart from causing better insulin sensitivity.

34. **Role of metabolism-mediated gene regulation in development and disease**

– Dr. Arimbasseri AG

Our laboratory tries to understand the interaction between micronutrients and macronutrients in the maintenance of skeletal muscle mass. Muscle wasting constitutes a serious healthcare problem associated with several chronic disorders. At present there are no effective treatment for muscle wasting in these disease. We explore dietary interactions and crosstalk between multiple organs to understand the systems level changes during muscle wasting and recovery. We expect our studies will help us devise targeted nutritional interventions to address muscle wasting.

Vitamin D deficiency is known to induce muscle wasting in humans, but the mechanisms are not known. We show that mice lacking the vitamin D receptor exhibit severe energy deficiency in skeletal muscles, leading to dysregulation of proteostasis and muscle wasting. Surprisingly, this energy deficiency is associated with increased glucose uptake by the skeletal muscles, which leads to systemic glucose imbalance and hypoglycaemia. Interestingly the skeletal muscles of these mice exhibit abnormal accumulation of glycogen owing to its increased synthesis and decreased degradation. Thus our work identifies the root cause of the long-standing problem of myopathies associated with vitamin D deficiency is due to defective carbohydrate utilization in the skeletal muscles.

35. **Learning the homeostasis processes by virtue of multi-organ cross-talks in metabolic disorders**

– Dr. Devram Sampat Ghorpade

The basic idea of our research is based on the fact that nothing works in isolation and in the functioning of a body the integrative cross-talk among multi-organs is a must. We trust in the amazing capacity of the body to adjust to the insults/adverse conditions to maintain homeostasis. So far, the role of individual organs or cells has been the major focus of research. However, the details of how multiorgan's communicate and maintain homeostasis are largely unknown. Thus, there exists a tremendous scope to learn and discover novel processes. Here at NII, our laboratory is actively involved in understanding such communication processes among multi-organs using the mouse genetic models of obesity and associated metabolic diseases like diabetes, inflammatory bowel diseases (IBD), etc. The exciting preliminary observations from our laboratory suggest a potential role of hepatokines, and/or adipokinesin the disease pathogenesis of IBD during diabesity.

Broadly, our group is involved in learning about the following areas:

1. How do multi-organs communicate in high-fat diet-induced metabolic disorders like diabetes and inflammatory bowel diseases?

2. What are the messenger molecules (biofactors and/or hormones) that effectuate metabolic homeostasis?

3. Could organ-specific targeting be established as a better therapeutic platform for metabolic diseases?

36. **Towards understanding the role of gut microbiota and their metabolites in the causation and treatment of colorectal cancer**

–Dr. Anil Kumar

Understanding the events leading to development of colorectal cancer (CRC) through microbial metabolites may provide novel insight into this pathology, and potentially lead to new therapeutic modalities targeting the microbiota.

1. Identification of microbes and their metabolites in the carcinogenesis of colorectal cancer.
2. Determining the effect of biofilm and its specific microbial composition in term of quorum sensing in the causation of CRC.
3. Determining if quorum quenching may interrupt the formation of biofilm formation.

Identification of novel bacterium, Cutibacterium faecale sp. nov. in human stool sample

An anaerobic bacterial strain G13^{T} isolated last year from healthy human stool sample is characterized in the reporting year and was found novel. The neighbour-joining tree showed that strain G13^{T}create a cluster with species of the genus Cutibacterium.

Sensor developed for detection of gut microbiota derived trimethylamine N-oxide (TMAO)

A molecularly imprinted polymers (MIP) based sensor was developed with a detection range of 1–15 ppm of TMAO with a sensitivity of 2.47 μA mL ppm^{-1} cm^{-2}.

Sensor developed for detection of gut microbiota derived Indoxyl Sulphate (IS)

MIP based electrochemical sensor for the detection of gut microbial metabolite, indoxyl sulphate was developed which can detect IS upto 1mM.

Effect of gut microbiota derived metabolite, trimethylamine (TMA), on gut epithelial cells

The toxicity of Trimethylamine (TMA), a gut bacterial metabolite, was assessed on gut epithelial cell lines, HCT116 and HT29. It was found that TMA induces cytotoxic and genotoxic effects such as decreased proliferation, lesser ability to form colonies, compromised membrane integrity, oxidative stress, and DNA damage leading to apoptosis.

PUBLICATIONS

Annexure-I

ORIGINAL PEER-REVIEWED ARTICLES

1. Agarwal M, Gupta C, Mohan KV, Upadhyay PK, Jha V (2020) Correlation of vascular endothelial growth factor with the clinical regression of tubercular granuloma. **Indian J Ophthalmol.** 68: 2037-2040.

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Technology Transfer

1. Technology related to collagen based formulation for osteoarthritis treatment has been transferred to Purobien Lifesciences Pvt. Ltd.

Trademark

1. ASPAGNII™ Trademark was filed on 30/07/2020 for SPAG9 recombinant protein Cell based immunotherapeutic vaccine component for cancer treatment of various types of cancer; Adjuvants and neo-adjuvants for medical use for the treatment of cancer; Pharmaceutical preparations for the treatment of communicable and non-communicable diseases on 11th September, 2020)

Ph.D. DEGREES AWARDED TO NII SCHOLARS

Annexure-II

Eighteen scholars of the Institute were awarded the degree of Doctor of Philosophy by Jawaharlal Nehru University on the completion of their work. Details are as follows:

S.No.	Student's Name	Topic of Research	Guide
1	Mr. Avinash Kumar Singh	Structure, function, and applications of housekeeping sortases	Dr. R.P.Roy
2	Mr. Owais Rashid Hakiem	Insights into the mechanisms of regulation of stress response in *Mycobacterium tuberculosis*	Dr. Ayub Qadri Dr. J.K. Batra
3	Ms. Pratima Saini	Investigations on the functional consequences of modulation of glycosylation using hexosamine analogues	Dr. S. Gopalan Samapthkumar
4	Ms. Parul Sahu	Identification of potential diagnostic biomarkers in rheumatic fever and rheumatic heart disease	Dr. PK Upadhyay
5	Mr. Sagnik Giri	Exploring the role of autophagy under oxidative stress in *Leishmania* parasite	Dr.Ayub Qadri
6	Mr. Vipin Kumar	Investigating the role of Sld5 in regulating the centriolar satellites	Dr. Sandeep Saxena
7	Ms. Sujata Kumari	Characterization and role of purine nucleoside phosphorylases from *Streptococcus pneumoniae* in host-pathogen interaction	Dr. Devinder Sehgal
8	Mr. Virendra Kumar Patel	Role of Clp proteins in stress management In *Helicobacter pylori*	Dr. Monica Sundd
9	Ms. Shagun Shukla	Sortase-mediated semisynthesis of histones	Dr. R.P.Roy
10	Ms. Sana Ismaeel	Understanding regulation of inflammatory responses through innate immune receptors	Dr. Ayub Qadri
11	Mr. Faizan Uddin	Characterization of eRNAs of enhancer Eβ at murine TCRβ locus	Dr. Madhulika Srivastava
12	Mr. Priyank Singhvi	Studies on mild solubilization of inclusion body aggregates	Dr. Amulya K. Panda

S.No.	Student's Name	Topic of Research	Guide
13	Mr. Ajay Kumar	Biochemical and functional characterization of SPD_1629, a nucleobase transporter from *Streptococcus pneumoniae*	Dr. Devinder Sehgal
14	Mr. Priyesh Prateek Agrawal	Development of machine learning based approaches for *in silico* identification of novel natural products by genome mining	Dr. Debasisa Mohanty
15	Ms. Shalakha Sharma	Unraveling the role of HDAC5 in tumorigenesis	Dr. Sanjeev Das
16	Ms. Kshama Jain	Reprogrammed monocytes: Immunological characterization and utility as cell based therapy in sepsis	Dr. P.K. Upadhyay
17	Ms. Ankita Dabla	Generation of novel tools to facilitate genetic manipulations in intractable pathogen *Mycobacteria*	Dr. Vinay K. Nandicoori
18	Mr. Kuldeep Singh Chauhan	Understanding the transcriptional gene regulation of $CD8\alpha^{+}$ dendritic cell development	Dr. P.B. Tailor

DISTINCTIONS/HONOURS/FELLOWSHIPS

Dr. Amulya K. Panda was honored by inclusion in the list of top 2% Scientists in the World as compiled by Stanford University. He also elected Fellow of the Royal Society of Chemistry (Cambridge).

Dr. Anil Suri received a lifetime achievement award in recognition of his contributions in the field of reproductive health from the Indian Society for the Study of Reproduction and Fertility.

Dr. Arnab Mukhopadhyay was elected Fellow of the Indian National Science Academy. He also awarded the SERB Science and Technology Award for Research.

Dr. Nimesh Gupta received the early Career Faculty Award by "The American Association of Immunologists". He also awarded as "Young Scientist award at IISF 2020."

Dr. Satish K Gupta was appointed as an ICMR Emeritus Scientist in 2020.

Dr. Soumen Basak was elected as a Fellow of the National Academy of Sciences, India (NASI) He also elected as a Fellow of the Indian Academy of Sciences (IAS).

Dr. Santiswarup Singha was awarded Ramalingaswami Re-entry Fellowship (2020-21) of the Department of Biotechnology, Govt of India.

Ms. Anita Goyala, Ph D student, was awarded for the Biolegend Best Presentation Award (talks) at the Beyond Science Initiative at the 5th Annual International Remote Conference.

LECTURES AND EVENTS

Foundation Day Lecture

The 34th Foundation Day of NII was celebrated on 6th October, 2020. **Prof. N.K. Ganguly (former DG, ICMR)** was invited to as the guest of honour. He delivered an online lecture on "Innovations and Challenges in Managing COVID-19"

FitIndia Freedom Run

A FitIndia Freedom Run was organized on 5th September, 2020 to promote a culture of fitness. The message that fitness helps fight obesity, stress and chronic diseases was enunciated. COVID-19 precautions were adhered to.

Participants at the FitIndia Freedom Run

National Science Day

NII celebrated National Science Day on 28th February, 2021. Ph.D. Students and research scholars attended an online lecture on “India Response to the COVID -19 Pandemic” delivered by **Prof. Narendra Kumar Arora (Executive Director, The INCLEN Trust International)**.

Yoga Day

Dr. Nimesh Gupta hosted a webinar on **"Yoga Immunology"** on 30th October, 2020. Members of the **Morarji Desai National Institute of Yoga** made a presentation on "Immunity and Infection: In the Context of the Pandemic" on the occasion.

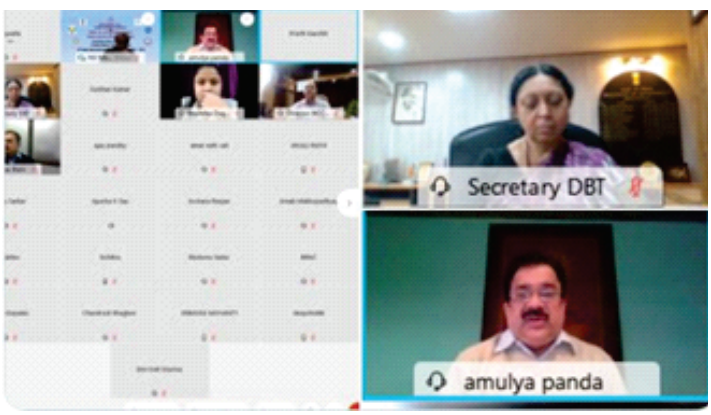
Samvidhan Diwas

On Samvidhan Diwas (26th November, 2020), the Director and Senior Manager, along with Faculty, Staff and Students, participated in a virtual reading of the Preamble of the Indian Constitution, along with the Honorable President of India.

Dr. Amulya K. Panda, and Dr. D.K. Vashist *with other participants, reading the Preamble of the Indian Constitution with the Hon'ble President of India.*

IISF 2020

DBT-NII along with DBT-CIAB and DBT-NABI has participated in the Curtain Raiser Ceremony of the 6th India International Science Festival (IISF-2020) on 16th December, 2020. An online program was conducted for the students of Masonic Public School (Vasant Kunj) and Delhi Public School, (Pataudi). Staff and Faculty members of the institutes also participated.



Dr. Renu Swarup (Secretary, DBT) and Dr. Amulya K. Panda shared their views at the Curtain Raiser Ceremony.

ONLINE INVITED SEMINARS

S.No	Topic	Online Lectures delivered by	Date
1	Development of novel nanoparticle based imaging probes and therapeutics	Dr. Pratap C. Naha Research Associate, Perelman School of Medicine, University of Pennsylvania, Philadelphia, USA	08.06.2020
2	Enzymology of human H2S metabolism and signaling and cryoelectron microscopy of biomolecules	Dr. Pramod Kumar Yadav Life Sciences Institute, University of Michigan Ann Arbor, Michigan, USA.	10.07.2020
3	Role of serine rich splicing Factor 3 (SRSF3) in liver disease	Dr. Deepak Kumar University of California, San Diego, USA	15.07.2020
4	Biochemistry and molecular pharmacology of multi - enzyme complexes in infectious diseases	Dr. Anand Balakrishnan Biology Department, Enanta Pharmaceuticals, Watertown MA, USA	21.07.2020
5	Immunogenic neoantigens and cancer immunotherapy	Dr. Raghvendra M. Srivastava Center for Immunotherapy and Precision Immuno-Oncology Carnegie Ave, Cleveland, OH, USA	28.07.2020

NII FACULTY AND PH.D. SCHOLARS ONLINE LECTURE SERIES

S. No.	Topic	Online Lectures delivered by	Date
1	Microbiota based nutritional therapy: A new arsenal to fight against Toxoplasma gondii treatment associated obesity	Dr. Tanmay Majumdar	22.05.2020
2	Enforcing the specificity: A tale of NF-kappaB signaling	Dr. Soumen Basak	06.08.2020
3	Fabrication and characterization of functionalized polymeric scaffolds for bone tissue regenration Understanding the immunotherapeutic potential of different formulations of MIP in mouse tumor model	Ms. Juhi Verma Ph.D. Scholar, Batch 2017 Mr. Anush Chakraborty Ph.D. Scholar, Batch 2017	13.08.2020
4	Mechanisms controlling genome integrity in nucleus and mitochondria	Dr. Sagar Sengupta	03.09.2020
5	Lessons from Vitiligo pathogenesis-Immunometabolic programming of melanocyte functions	Dr. Rajesh Gokhale	17.09.2020
6	A PDI and ICOS expressing CXCR3+T helper subset which expands in dengue blood promotes plasma cell differentiation Unravelling the role of C-terminal domain in enzyme *Leishmania major* biotin protein ligase and regulation	Mr. Asgar Ansari Ph.D. Scholar, Batch 2017 Ms. Sonika Bhatnagar Ph.D. Scholar, Batch 2017	24.09.2020
7	Journey of a whole bacteria candidate vaccine originally developed against leprosy	Dr. Sangeeta Bhaskar	01.10.2020
8	Elucidating the mechanism of regulation of PknB and delineating its signalling pathways To understanding the underlying mechanism by which MIP regulates the function of Regulatory T cells to prevent tumor growth	Ms. Sidra Khan Ph.D. Scholar, Batch 2017 Ms. Gargi Roy Ph.D. Scholar, Batch 2017	08.10.2020
9	Understanding new paradigms in cancer metabolism	Dr. Sanjeev Das	22.10.2020
10	C8-Phosphopantetheine is the key substrate requirement of lipoate protein ligase B, rather than the acyl carrier protein	Dr. Monica Sundd	05.11.2020

S. No.	Topic	Online Lectures delivered by	Date
11	Understanding inter-organ crosstalk in disease condition Establishing and developing novel immunotherapeutic strategies for cancer immunotherapy	Ms. Jyotsna Ph.D. Scholar, Batch 2017 Ms. Ramya Venkataraman Ph.D. Scholar, Batch 2017	13.11.2020
12	Self and self-self in disorders of proliferation	Dr. Rahul Pal	19.11.2020
13	A tale of two metabolically intertwined phosphorylases	Dr. Devinder Sehgal	03.12.2020
14	Close encounters with *Salmonella*	Dr. Ayub Qadri	10.12.2020
15	How Worms adapt to different food types to maintain normal life history traits Unraveling the role of a novel aromatic cluster located near the catalytic site of *Helicobacter pylori* N-carbamoylputrescine amidase in catalytic function	Ms. Tripti Nair Ph.D. Scholar, Batch 2016 Ms. Ditsa Sarkar Ph.D. Scholar, Batch 2016	14.01.2021
16	PRAMEF2: Story of a novel cancer testis antigen in regulating tumorigenesis Delineating the functional role of mycobacterial housekeeping Transcription intiation factor o A	Ms. Madhurima Ghosh Ph.D. Scholar, Batch 2016 Mr. Biplab Singha Ph.D. Scholar, Batch 2016	11.02.2021
17	MicroRNA mediated gene regulation in developmental maturation of testicular Sertoli cells Study on function of an essential membrance protease from Mycobacterium tuberculosis	Ms. Alka Gupta Ph.D. Scholar, Batch 2016 Ms. Indu Ph.D. Scholar, Batch 2016	25.02.2021
18	Modulation of sialy-Lewis X (CD15s) epitopes and its interactions with selections (CD62) The potential role of taurine in bone remolding	Ms. Anam Tasneem Ph.D. Scholar, Batch 2016 Mr. Parminder Singh Ph.D. Scholar, Batch 2016	11.03.2021
19	Evaluation of therapeutic potential of SG015 in mouse models of Alzheimer's disease	Ms. Shagufta Jahan Ph.D. Scholar, Batch 2016	25.03.2021

CONFERENCES/SYMPOSIA/WORKSHOPS

Molecular Biology Training for COVID-19 diagnosis

The Bill and Melinda Gates Foundation funded the training of medical and technical professionals as part of a national effort to scale-up qRT-PCR based testing for the detection of SARS-CoV-2, the causative agent of COVID-19. Viruses such as Dengue can also be detected by qRT-PCR. The training effort was coordinated by Foundation for Innovative New Diagnostics (FIND) organization. Sixty-five individuals were trained in seven batches.

Training sessions were initiated on 5th October, 2020, participants for which hailed from different regions of Bihar.

The 3rd batch of trainees with Dr. A.K. Panda and the organizing team.

CoranaCure Webinar

Dr. Soumen Basak delivered an online lecture entitled "COVID-19 – a Viral or an Inflammatory Disease?", a CoronaCures webinar conducted by Scipreneur Pvt. Ltd. The webinar was conducted on 28th July, 2020. Dr. Basak talked about the interplay of the innate and adaptive immune responses to SARS-CoV-2 and its clinical manifestation.

Technology Transferred

A method of treatment for osteoarthritis using a collagen-based herbal formulation has been developed at NII. The formulation demonstrates efficacy against osteoathritis in mice and is non-toxic; it may have utility for the treatment of osteoarthritis in humans. The technology was transferred to Purobien Lifesciences Pvt. Ltd. for further development and commercialization.

The technology for osteoarthritis using a collagen-based herbal formulation was transferred to Purobien Lifesciences Pvt. Ltd. A photo with Dr. A. K Panda, representatives of Company and Dr. Sarika Gupta.

Scientists were invited to deliver a lectures and webinars by various institutions, in connection with conferences, symposia, workshops and training programmes in India and abroad.

Invited Talks/Lectures/Webinars delivered by NII Scientists :

Sl No.	Scientist	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
1	Dr. Sagar Sengupta	Mitochondria in health and disease – 2021	Central University of Rajasthan, India	25th February, 2021
2	Dr. Sagar Sengupta	40th Annual meeting of Indian Association of Cancer Research	Institute of Life Sciences (ILS), Bhubaneshwar, India	1st March, 2021
3	Dr. Arnab Mukhopadhyay	National Level Webinar Series on "Science amidst Covid Pandemic: Life Goes On....."	Departments of Microbiology of Raidighi College and Sammilani College, West Bengal	20th July, 2020
4	Dr. Arnab Mukhopadhyay	“Diet-Gene interactions that control longevity” National level webinar series on 'Science amidst Covid pandemic: Life goes on.....'	Sammilani Mahavidyalay and Raidighi College, West Bengal	21st July, 2020
5	Dr. Arnab Mukhopadhyay	Genomics and molecular genetics approaches to study transcription factor function	Transcriptional Dynamics in Developmental Biology, JNU Computational and Systems Biology, New Delhi	11th August, 2020
6	Dr. Arnab Mukhopadhyay	Regulatory mechanisms in longevity assurance	International Colloquium on Regulatory Mechanisms Underlying Behavior, Physiology and Development' Department of Zoology, University of Delhi,	25th March, 2021
7	Dr. Nimesh Gupta	Pandemic and its impacts	COVID Training Program-2020, Government of India, New Delhi	6thOctober, 2020
8	Dr. Nimesh Gupta	Immunity and Infection: In the context of a pandemic	Morarji Desai National Institute of Yoga, Ministry of Ayush, New Delhi	30th October, 2020

Sl No.	Scientist	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
9	Dr. Nimesh Gupta	Immune memory in mild COVID-19 patients and unexposed donors from India reveals persistent T cell responses after SARS-CoV-2 infection	Young Scientist Conclave at India International Science Festival, New Delhi	23rd December, 2020
10	Dr. Nimesh Gupta	A deep dive into the COVID-19 vaccines and its immunology	Bose Institute, Kolkata	14th January, 2021
11	Dr. Nimesh Gupta	Immunological memory in SARS-CoV-2 infection and vaccination	National Institute of Biologicals, Ministry of Health & Family Welfare, Noida	19thMarch, 2021
12	Dr. Nimesh Gupta	COVID-19: A status on the vaccine and therapeutic development	International Webinar of Asian Federation of Biotechnology	26th March, 2021
13	Dr. P. Nagarajan	Basic biology, husbandry and breeding of laboratory animals	IMTECH, Chandigarh	11th June, 2020
14	Dr. P. Nagarajan	Laboratory animal anesthesia	Preclinical Imaging and Drug Discovery Virtual Workshop ACTREC, Mumbai	10th December, 2020
15	Dr. P. Nagarajan	Mouse genetics, breeding and animal models in biomedical research	National Institute of Animal Welfare, Haryana	12th December, 2020
16	Dr. P. Nagarajan	Mouse genetics, breeding and animal models in biomedical research	National Institute of Animal Welfare, Ballabhgarh	13th January, 2021
17	Dr. P. Nagarajan	Traditional and artificial intelligence-based training program on handling and care of laboratory animals	Meerut Institute of Engineering and Technology, Meerut	11th February, 2021

Sl No.	Scientists	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
18	Dr. Tanmay Majumdar	Tuning of amino acid metabolites enable innate immune activation: A gatekeeper against tryptophan auxotroph parasites	Advancement of Biology in the 21st Century, Visva Bharati University, Santiniketan	28th February, 2020
19	Dr. Tanmay Majumdar	Viral terrorism: Riddle of herd immunity in COVID-19	Krishnagar Government College, West Bengal	22nd July, 2020
20	Dr. Tanmay Majumdar	Threats vs therapeutics in viral terrorism: Impact of microbiome	Indian Institute of Engineering Science and Technology, Shibpur, West Bengal	3rd March, 2021
21	Dr. Anil Kumar	Towards understanding the gut microbiome	Synthetic Biology and Biotechnology Department of Zoology, Deshbandhu College, New Delhi	31st October, 2020
22	Dr. Anil Kumar	Introduction to intellectual property rights	18th Refresher Course in Physical Sciences & Nano Sciences HRDC-JNU, New Delhi	20th November 2020
23	Dr. Anil Kumar	Intellectual property rights and their relevance to biological sciences	Refresher course in bio-sciences UGC-HRDC, Bharathidasan University. Tamil Nadu.	12th December, 2020
24	Dr. Rajesh S. Gokhale	Vitiligo: Understanding Mechanisms of pathogenesis – melanocyte renewal	IADVL National Vitiligo Day e-Symposium	21st June, 2020
25	Dr. Rajesh Gokhale	Moderator for session on "Infectious Diseases - Tuberculosis in the post-Covid Era"	Vaishvik Bhartiya Vaigyanik (VAIBHAV) Summit	15th October, 2020

Sl No.	Scientist	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
26	Dr. Rajesh Gokhale	Infectious diseases are complex, multisystem conditions – Can metabolism provide future solutions?	IISER-Pune	21st January, 2021
27	Dr. Rajesh Gokhale	Infectious diseases are complex, multisystem conditions – Can metabolism provide new diagnostic biomarkers?	RePORT India Annual Meeting	9-11 February, 2021
28	Dr. Rajesh Gokhale	Role of women in societal transformation in the post-COVID era	International Women's Day	8th March, 2021
29	Dr. Rajesh Gokhale	CSIR TB Day- Panel Discussion	World TB Day	24th March, 2021
30	Dr. Rajesh Gokhale	Co-chair for session on "Affordable drugs - Drugs for Neglected Diseases"	Vaishvik Bhartiya Vaigyanik (VAIBHAV) Summit	19th October, 2020
31	Dr. Veena S. Patil	Human CD4+ T cell memory and infectious diseases	Recent Research Advancements in Biological sciences “Department of Biotechnology, School of Sciences, JAIN, Bengaluru	29th July, 2020
32	Dr. Anneshkumar A.G	Recent advances in DNA sequencing technology,	Dept. of Biochemistry, Mar Athanasius College of Engineering, Kothamangalam, Kerala	7th August, 2020
33	Dr. Anneshkumar A.G	Milk fat enriched diets ameliorate skeletal muscle glycogen storage defect and atrophy induced by the abrogation of vitamin D receptor	Chintan-2021 DBT-NABI, Mohali	3rd March, 2021

Sl No.	Scientists	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
34	Dr. Prafulllakumar B. Tailor	Pattern recognition receptors	FIMSA Immunology course-2020, Indian immunology Society (IIS)	8th October, 2020
35	Dr. Soumen Basak	Crosstalk between signaling pathways: A tale of the NF-kappaB system	Indian Institute of Technology, Ropar	24th August, 2020
36	Dr. Soumen Basak	Session Chair	2nd Annual Congress of Immunooncology Society of India	31st October, 2020
37	Dr. Soumen Basak	RNA viruses and NF-kappaBsignaling: Friends or foe	School of Biotechnology, Presidency University, Kolkata	21st November, 2020
38	Dr. Soumen Basak	Trans-disciplinary areas of research and teaching	Deen Dayal Upadhyaya College, Delhi University (online)	23rd March, 2021
39	Dr. Debasisa Mohanty	Computer aided strategies to fight COVID-19: From slowing the outbreak to designing drugs and vaccines	CSIR, New Delhi & CSIR-IMMT, Bhubaneswar	5th September, 2020
40	Dr. Debasisa Mohanty	PDB-India: An Indian initiative on setting up a high fidelity structural data archival / retrieval system for Life Sciences	U Conn Health, USA	30th September, 2020
41	Dr. Debasisa Mohanty	Role of bioinformatics & machine learning in modern biology	Sharda University, Greater NOIDA	21st October, 2020

Sl No.	Scientist	Title of the Talk/Role	Organizer/Name of the Institute/ College/ School/ organization	Date
42	Dr. Debasisa Mohanty	Machine learning based approaches for deciphering 43chemical structures of secondary metabolites mediating host-microbiome cross-talk	NEHU, Shillong	4th December, 2020
43	Dr. Debasisa Mohanty	Introduction to structural bioinformatics & it's applications in discovery of drugs and vaccines using machine learning	MITS, Madanapalle, Andra Pradesh	10th December, 2020
44	Dr. Debasisa Mohanty	Data driven research on biomolecular systems using computational biology	Pune University, Pune	8th January, 2021

SUPPORT UNITS

SMALL ANIMAL FACILITY

The Small Animal Facility of the Institute is devoted to the humane care and breeding of experimental animals used in approved research. At present, the Small Animal Facility holds 104 mouse strains, including 89 mutant strains, 16 inbred strains and 1 outbred strain. In addition, the Facility also houses 6 rat strains, a stock of rabbits as well as guinea pigs.

The propagation of all defined strains is done in a three- tier system i.e., the Foundation Stock (FS), Pedigreed Expansion Stock (PES) and Production Stock (PS). Genetically modified mouse strains are bred either by 1.homozygous mutant (-/-) x homozygous mutant (-/-) 2. heterozygous mutant (-/+) x homozygous mutant (-/-) 3. Heterozygous mutant (-/+) x heterozygous mutant (-/+). Defined breeding protocols and careful management and husbandry procedures are followed to ensure the purity of murine stains. To maximize genetic purity and uniformity of mice, inbred strains are propagated and replaced periodically in a manner that minimizes the genetic drift and inbreeding depression. A random sample from a few breeders of foundation, expansion and production stocks is monitored with the help of a few microsatellite markers to ensure genetic purity. Several principal investigators assist in the genotyping of transgenic and knockout mice strains.

The health monitoring program includes regular screening for pathogens, including hepatitis virus, parvovirus, norovirus, pnemonia virus, mycoplasma and Sendai virus; ELISA and PCR are employed. Bacterial pathogens such as *Pseudomonas aeroginosa, Streptobacillus moniliformis, Bordetella, Bronchiseptica, Citrobacter rodentitium, Pasteurella pneumotropica, Staphylococci* and *E.coli* are screened for using culture, biochemical methods and PCR. Faecal samples are screened for the presence of syphacia and aspicularis species of endoparasites. Periodic FACS analyses are also carried out on immunodeficient mice to assess leakiness.

Procedures are in place to prevent transmission of infection between cages; these include careful handling of animals, washing using automated cage and bottle washers, use of sterilized corn cob bedding, autoclaving of cages and use of acidified autoclaved drinking water. The breeding and experimental colonies are maintained within a barrier system with individual ventilated cages. A veterinarian carries out necropsy/autopsy procedures on infected animals, if indicated. Are commended preventive schedule of medication is strictly followed to reduce the infections to the extent possible.

PRIMATE RESEARCH CENTRE

The National Institute of Immunology has a dedicated Primate Research Centre. Macaques are bred for generation of in-house animals of known age for approved basic, pre-clinical and toxicological research. Under the breeding programme, group mating is facilitated in large open pens. In these semi-natural conditions, food and water is provided *ad libitum*. Infants are weaned at the age of six to twelve months (depending on season and weight of infants) after which they are transferred to open enclosures/semi natural housing for optimal growth, the development of the bones and muscles, and enhanced motor coordination. Monkeys are independently housed at puberty. To prevent cross-cage contamination or infection, strict hygienic procedures are followed. Animals are regularly monitored for tuberculosis, simian herpes virus and simian hepatitis virus. Animals that are unwell are isolated and treated. Primates are fed with standardized pellet feed. In addition, bread, soaked Bengal gram, vegetables and/or fruits are also given daily. Diet is regularly supplemented with vitamins and calcium. The staff at PRC undergoes an annual preventative health check up. All surgeries, treatments for injury and the administration of medication are performed by a registered veterinarian, and all procedures such as immunizations, and biopsies are aided by experienced technical staff. A research laboratory at the Centre provides basic services to investigators. Clearance of the research proposals by the CPCSEA (after initial clearance from the Institutional Animal Ethics Committee) is necessary for conducting research on primates. Macaques have been employed in research related to infectious diseases,

reproduction, endocrinology, immunology and contraception. Staffs ensure that all procedures are pain-free, with minimum stress to the animal, and all effort is made to keep the animals comfortable. There are seventeen open enclosures with swings and shelters, which are used for rehabilitation or socializing. All attempts are made to maximize residence in such enclosures.

OTHER SERVICE UNITS

ADHERENCE TO COVID GUIDELINES

NII adheres to the COVID-19 guidelines issued by the Ministry of Health & Family Welfare, Government of India from time to time. Mass gatherings are avoided and social distancing norms adhered to. Interviews, meetings and seminars are preferentially held online, and social media platforms like Twitter, Facebook and YouTube are extensively employed to sustain high levels of interaction with the public and the scientific community at large.

Establishment, Personnel and General Administration Services

The Division continued to provide key support for optimally utilizing and integrating human and administrative resources aimed at realizing the vision of the Institute. During the reporting period, administrative support was provided for formulating policies and ensuring their effective implementation. Other key areas include handling service matters, recruitments, career development, foreign visit of scientists for training/conferences/ bilateral exchange visits, staff welfare, post retirement dispensation, preparation and submission of periodic reports to the administrative ministry, liaisoning with them and preparing responses to parliament questions. To bolster capabilities and enhance productivity, the Institute periodically sponsors administrative and technical staff for training in recognized training institutes.

The Institute's RTI Cell files the quarterly reports on the RTI portal. The Institute also has an effective grievance redressal mechanism to deal with public as well as staff grievance petitions, ensuring quick redressal.

Financial and Accounting Services

The Division has been responsible for preparation of the annual budget, management of fund utilization, receipt and disbursement of all payments, internal auditing, getting accounts audited by statutory and CAG auditors, sending reports to funding agencies and recovery and remittance of TDS from salary and contractors, filing institutional income tax return, obtaining required exemptions from the Income Tax Department, maintaining bank accounts, management of trust for CPF, Gratuity Fund and recovery and remittance of subscriptions of NPS.

Stores and Purchase Department

The Stores & Purchase Department of NII deals with procurement of chemicals, consumables, glassware, plasticware equipment and other items which are used in research laboratories of the Institute. Essentially, the Stores and Purchase Department acts as a lifeline support for research, allowing and research projects. Various Purchase Committees evaluate all critical aspects of purchase the before an order is placed. Such Purchase Committees comprise three or more scientific staff, the Finance and Accounts Officer and the Stores and Purchase Officer Occasionally, external experts with special domain knowledge are also invited to serve on these Committees. The department monitor all aspect of purchase till the payment is made. Close rapport with the other departments is maintained to mitigate any bottle-necks that may arise.

Engineering, Maintenance and Instrumentation Services

The Engineering Department of the Institute has been entrusted with all activities involving maintenance, services and capital works. It has always been the endeavor of the department to provide the best of services with the use of the latest/modern technology; as a result, systems are being continuously modernized. Major activities undertaken during the reporting year are as follows:

- Refurbishment of APU with allied works in the Experimental Animal Facility at NII. The work was successfully .

- Supply, installation, testing & commissioning of rooftop solar grid.
- Upgradation of the starter system of HVAC pumps.
- E-tendering has been initiated for procurement of goods and services through the DBT e-wizard portal.
- All general procurement is now carried out though GeM only.
- Installation of LED lighting fixtures and retrofitting of LED lamps in existing fixtures .
- Setting up of new laboratories and offices.
- Installation of sanitizer spray machines at various locations on campus.

The Department is currently working on the following projects:

- Establishment of ABSL-3 for non-human primates and associated works in all respects on turnkey basis, including comprehensive operation and maintenance for a period of 5 years.
- Up-gradation of BSL-3 Facilities.
- Establishment of new ABSL-2 & BSL-3 laboratories/facilities.
- Construction of staff quarters at Sector-5, Dwarka through CPWD.
- Installation of rain harvesting system at NII
- Replacement of cooling coil of AHUs .
- Miscellaneous civil work for staff quarters.
- Cleaning of sewer lines and inspect chamber/ man holes.
- Re-carpeting and repairing of internal roads.
- Up-gradation work in various laboratories.
- SITC of 100Kwp rooftop grid sharing solar system.
- Up-gradation of BMS system.
- Replacement 1250 KVA transformer including associated works.

Library and Documentation Services

The Library And Documentation Department is a service oriented supportive unit which works as a knowledge management centre. It provides information support to the scientific staff of the Institute, using both archival and contemporary digital resources.

The Library has a rich collection of books and journals; many resources are accessible online by scientific staff and students. NII is a member of the DeLCON consortium project of the Department of Biotechnology. The Library coordinates procedures (both online and print) for the subscription of journals, as well as processes the payment of journal publication charges. The Library has computerized all its housekeeping activities. A searchable database, Web-Online Public Access Catalogue (Web-OPAC), is being maintained.

The Library has been involved in compiling, designing and printing the Parliamentary and Scientific Annual Reports of the Institute in Hindi and English. The Library prepares monthly pictorial research publications and bibliometrics reports. Information on subscriptions, new procurements and publications is regularly updated on the NII website. The Library maintains a searchable Institutional Digital Repository, containing full texts of articles published from NII from the year 2008. The Library also conducts an induction programme for newcomers,as well as workshops on various subjects such as the use of plagiarism, and Scopus software.
The Library is responsible for all the binding and photocopying work of the Institute. A Hindi Library, which houses a collection of hindi books (including those dealing with administrative practices) and magazines, has been set up for popularizing the official language amongst staff of the Institute.

Eight reference books have been added to the Library collection. The Library participates in organizing Institutional lectures such as the Foundation Day Lecture, and the National Science Day Lecture.

The Library is taken care of the Institute's social media accounts on such as Twitter, Facebook and various blogs, and posts regular updates.

The Library conducted an online user induction programme for fresh Ph.D. students. In addition, the Library organised a webinar. Dr. Nimish Kapoor from Vigyan Prasar was invited to deliver a lecture on "Fact & fit - Combating medical misinformation in India: Identifying and debunking misinformation" on 29th December 2020.

Academic and Training Services

The Academic & Training Department is mainly involved with student affairs. Organizing Ph.D. admissions, pre-Ph.D. registration courses, Doctoral Committee meetings, Academic Committee meetings, and also coordinates the disbursal of fellowship to scholar all fall in its ambit. The Institute inducts scientists who have been awarded independent fellowships from the following Institutes/organizations, who then work under different Principal Investigators: Indian Institute of Science Bangalore (DBT-RA), ICMR (SRF/RA), DST-SERB (NPDF) DST-Inspire Faculty, DST (WOS) and CSIR (SRA/RA); DHR-young Scientists and holders of the Ramalingaswami Re-entry Fellowship are also eligible. The Institute also imparts short-term training to post-graduate students from different Universities/Institutions who are sponsored by the Indian Academy of Science Bangalore for six month project work. Under-graduate students belonging to different colleges also receive training under the Science Setu Programme. The Department has also been involved in arranging the participation of scientific, technical and administrative personnel in different training courses.

Vigilance Cell

The Institute has a Vigilance Cell headed by a scientist nominated as part-time Chief Vigilance Officer (CVO) by the Central Vigilance Commission (CVC). The CVO and the support staff perform activities related to vigilance as adjunct duties to their primary responsibilities. The Cell follows various instructions issued by the CVC from time to time to ensure effective implementation of the measures which strengthen vigilance and prevent corruption. Emphasis is laid on preventive vigilance since such vigilance, if properly conceived and executed, aids in plugging weak and vulnerable areas. The Institute has been reviewing existing procedures to identify corruption-prone areas, making policies more transparent to avoid ambiguity, and streamlining procedures to achieve a working environment free of malpractice. The staff members employed in areas prone to corruption are rotated frequently. Sizeable purchases of chemicals, consumables and instruments are handled through various Purchase Committees of the Institute, thus eliminating the possibility of collusion detrimental to quality and price of purchases. Periodically, the Institutional Committees are reconstituted. The Cell has been rendering periodical reports and returns on vigilance activities to the administrative machinery and the CVC.

'Vigilance Awareness Week' was observed in the Institute from October 27, 2020 to November 02, 2020. A banner announcing the observance was put up at the main entrance of the Institute. Placards bearing slogans against corruption were displayed inside the premises. A pledge to fight corruption was taken by the NII community on 27 October, 2020. An essay writing competition was organized online on 1st November, 2020 on the theme “Satark Bharat, Samriddh Bharat”.

The report on indicative List of areas/activities which are to be taken up in campaign mode as part of Vigilance Awareness Week 2020 was strictly adhere to extant Covid-19 prevention guidelines at all locations and economy measures as per MOF.

Computer Centre

Computer Centre has been providing all Information Technology related support to NII, which involve managing switches and Wi-Fi controllers in a 1000 node LAN, system administration of multiple LINUX based E-mail and Web servers, backup services for mail/web servers, managing UTM devices for network security and integrating internet bandwidth from multiple ISPs. Computer Center staff facilitates day to day troubleshooting, maintenance and anti-virus support of about 850 PCs and other peripheral devices. In addition, the Computer center also provides specialized services like management of HPC clusters, managing floating licenses for access to bioinformatics software over LAN and IT support for developing in house software for Pay Roll, Online complaint logging system, Online creation of Email id etc. During Covid, Computer Centre has been helping in organizing virtual meetings and lectures using Webex Meeting, Goto Meeting and Google meet.

SUMMARY OF NOTABLE ACTIVITIES

ACADEMIC COURSES, TRAINING PROGRAMMES AND INTERACTION WITH OTHER ACADEMIC INSTITUTES

The Institute imparts long-term residential training, leading to a Ph.D. Degree of the Jawaharlal Nehru University, New Delhi. From a large number of applications from across the county, 30-35 scholars are admitted to this Programme on a competitive basis every year, after an examination and interviews.

The Ph.D. Programme was launched in the academic year 1986-87. So far, 510 students have been awarded the Ph. D. degree, including 18 who obtained the degree in academic year 2020-21.

In addition, the Institute accepts Fellowship awardees from various Universities/Institutions for summer internship.

The Institute also accepts students for project work during the last semester of their post-graduate course.

PUBLICATIONS

Eighty six research papers were published this year. Of these publications, seventy two were published in journals as peer-reviewed research papers and remaining as reviews/proceedings. Details of these papers are available in Annexure-I.

PATENTS AND TECHNOLOGY TRANSFER

The Institute has a policy of protecting intellectual property rights of inventions made within its laboratories. Early research leads are evaluated for commercial viability and patentability. The Institute files applications first in India and when necessary, at patent offices in other countries. During the year under report, the Institute has filed, seventeen patent applications, while nine patents were granted / issued.

LECTURES DELIVERED ON INVITATION/PAPERS PRESENTED

The scientists of the Institute continued to deliver lectures including 'Keynote Addresses and Inaugural Addresses' and 'Serial Lectures' at various institutions, conferences, symposia, workshops and training programmes in India and abroad.

LECTURES/SEMINARS BY VISITING SCIENTISTS/GUEST INVESTIGATORS

The Institute continued to receive visiting scientists and guest investigators from all over the world. Thirty eight seminars were organized (either online or on campus) by the Institute in various areas of interest. These seminars were attended not only by the scholars and scientists of the Institute, but also by the investigators from other institutions.

ANTI-TERRORISM DAY

Anti-Terrorism Day was observed on 21st May, 2020. The anti-terrorism/violence pledge was taken which stated, “We the people of India, having abiding faith in our country's tradition of non-violence and tolerance, hereby solemnly affirm to oppose with our strength, all forms of terrorism and violence. We pledge to uphold and promote peace, social harmony and understanding among all fellow human beings and fight the forces of disruption threatening human lives and values”.

SADBHAWNA DIWAS

With the aim of promoting national integration and communal harmony among peoples of all religions, languages and regions, “Sadhbhavna Diwas” was observed on the birth anniversary of Late Shri Rajiv Gandhi on 20th August, 2020 by taking the pledge, “I take this solemn pledge that I will work for the emotional oneness and harmony of all the people of India regardless of caste, region, religion or language. I further pledge that I shall resolve all differences among us through dialogue and constitutional means without resorting to violence”.

RASHTRIYA EKTA DIWAS (NATIONAL UNITY DAY)

Rashtriya Ekta Diwas was observed on the birth anniversary of Late Shri Sardar Vallabhbhai patel on 31st October, 2020. A pledge was taken which stated, "I solemnly pledge that I dedicate myself to preserve the unity, integrity, and security of the nation and also strive hard to spread this message among my fellow countrymen. I take this pledge in the spirit of unification of my country which was made possible by the vision and actions of Sardar Vallabhbhai Patel. I also solemnly resolve to make my own contribution to ensure internal security of my country".

INDEPENDENCE DAY

Independence Day was celebrated on 15th August, 2020. The event was marked by a message from the Director, followed by singing of the National Anthem by all present, led by students, as well as children of the staff of the Institute.

REPRESENTATION OF SCHEDULED CASTES, SCHEDULED TRIBES, OTHER BACKWARD CLASSES AND ECONOMICALLY WEAKER SECTIONS

The Institute complies with reservation orders as per the directives of Government of India, while making appointments, to ensure representation of Scheduled Castes, Scheduled Tribes, Other Backward Classes and Economically Weaker Sections (EWS).

REPRESENTATION OF PERSONS WITH BENCHMARK DISABILITIES

The Institute follows reservation orders for Persons with Benchmark Disabilities as per Government of India directives issued from time to time to ensure appropriate representation.

IMPLEMENTATION OF OFFICIAL LANGUAGE POLICY

The Official Language policy of the Govt. of India is followed by the Institute in letter and spirit:

1. To promote Hindi as official language in official work, Hindi Pakhwara (Hindi Fortnight) was celebrated in the Institute with great zeal from 1st to 14th September, 2020. During this period, various competitions such as Hindi Sulekh (Hindi Writing), Hindi Nibandh (Hindi Essay) and Hindi Tippad evam Praroop (Hindi Noting and Drafting) were organized in which a large numbers of faculty members, staff members and students had participated. Hindi Diwas (Hindi Day) was celebrated on 14th September, 2020 at the culmination of Hindi Pakhwara.

2. In order to reduce hesitation while doing official work in Hindi, the Institute organized quarterly Hindi workshops/lectures for employees during the year.

3. The Institute has implemented the Govt. of India scheme for the writing of notes and drafts originally in Hindi. An incentive scheme for encouraging the writing of articles and research papers in Hindi on scientific and technical subjects was also implemented.

4. The Institute published the 4th edition of its in-house magazine "JAIPRATIRAKSHA DARPAN" in Hindi in December, 2020 and the process for publishing the next edition is underway.

RTI ANNUAL RETURN INFORMATION SYSTEM (2019-2020)

NATIONAL INSTITUTE OF IMMUNOLOGY
NEW DELHI

Report on Monthly Disposal of Cases
2020-21

Sl. No.	Year	Month	Opening Balance	Receipt	Disposal	Closing Balance	Cumulative Disposal
1.	2020	April	342	1	0	343	339
2.	2020	May	343	1	1	344	340
3.	2020	June	344	3	1	347	341
4.	2020	July	347	8	6	355	347
5.	2020	August	355	6	4	361	351
6.	2020	September	361	13	11	374	362
7.	2020	October	374	6	9	380	371
8.	2020	November	380	8	5	388	376
9.	2020	December	388	1	7	389	383
10.	2021	January	389	5	2	394	385
11.	2021	February	394	2	3	396	388
12.	2021	March	396	2	3	398	391

RTI ANNUAL RETURN INFORMATION SYSTEM (2019-2020)
ANNUAL RETURN FORM

Ministry /Department /Organization: Department of Bio-Technology (National Institute of Immunology), New Delhi-110067

Year 2020-21 (upto March 2021)
Insert Mode (New Return)

		Progress in 2019-20			
	Opening Balance as on 01/04/2016	**Received during the year (including cases transferred to other Public Authority)**	**No. of cases transferred to other Public Authority**	**Decisions where request/appeals rejects/appeals rejected**	**Decision where requests/appeals accepted**
Request	347	56	0	0	56
First Appeal	1	4	0	0	4

No. of Cases where disciplinary action taken against any Officer	0

No. of CAPIOs designated	**No. of CPIO designated**	**No. of AAs designated**
	1	1

No. of times various provisions were invoked while rejecting request													
Relevant section of RTI Act 2005													
Section 8 (1)										Sections			
a	b	c	d	e	f	g	h	i	j	9	11	24	Others
0	0	0	0	0	0	0	0	0	0	0	0	0	0

Amount of Charges Collected (in Rs.)		
Registration Fee Amount	**Additional Fee & Any other charges**	**Penalties Amount**
Rs. 30	0	0

Last date of Uploading the Pro-active Disclosures on the website of PA	(Format 28.06.2021)

Name of the person who is entering/updating data	Dr. Sarika Gupta

COMMITTEES OF THE INSTITUTE

(As on 31.03.2021)

NII SOCIETY

Prof G Padmanaban
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Prof. Randeep Guleria
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Dr. Debashis Mitra
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Ms. Kiran Mazumdar-Shaw
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Bangalore

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Director
Advanced Centre for Treatment, Research &
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Tata Memorial Centre
Mumbai

Prof. Krishnendu Roy
Robert A. Milton Chair
Director, NSF Engineering Research Center (ERC)-
for Cell Manufacturing Technologies (CMaT)
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Indian Institute of Technology
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Pune

Prof. Yogendra Singh
Professor, Department of Zoology
University of Delhi
Delhi

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Chairperson
Additional Secretary & Financial Adviser
Ministry of Science & Technology
Department of Biotechnology
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Dr. Amit Sharma
International Centre for Genetic Engineering & Biotechnology
New Delhi

Dr. Subhra Chakraborty
Staff Scientist
National Institute of Plant Genome Research
New Delhi

Dr. Amulya K. Panda
Director
National Institute of Immunology
New Delhi

BUILDING COMMITTEE

Shri Ashwani Nagar
(Chairperson)
Retired Principal General Manager
& Head of Civil Engineering Division
of Department of Telecom

Director, NII
Member (Ex-Officio)
Ex-officio Director
National Institute of Immunology
Aruna Asaf Ali Marg
New Delhi

Joint Secretary (Admin), DBT
(or his Nominee)
Member (Ex-Officio)
Department of Biotechnology
New Delhi.

Sh. M.K. Gupta
Ex- Engineer(Civil)
IUAC, New Delhi
Director, ICGEB
Member(Ex- Officio)
ICGEB, New Delhi

Director, RCB
Member(Ex- Officio)
Regional Centre for Biotechnology
Faridabad

Director (Finance), DBT
Member (Ex- Officio)
Department of Biotechnology
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Senior Manager, NII
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National Institute of Immunology
New Delhi.
* Nominees of PMC Architect as special invites.

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Director
National Institute of Immunology
Aruna Asaf Ali Marg
New Delhi

Prof. Rana P. Singh
School of Life Sciences
Jawaharlal Nehru University
New Delhi

Prof. Vibha Tandon
Special Centre for Molecular Medicine
School of Biotechnology
Jawaharlal Nehru University
New Delhi

Prof. Subrata Sinha
Professor & Head
Department of Biochemistry
All India Institute of Medical Sciences
New Delhi

Prof. Yogendra Singh
Department of Zoology
University of Delhi

Prof. Satish Chandra Garkoti
Rector-II
Jawaharlal Nehru University
New Delhi

Dr. Sandeep Saxena
Staff Scientist
National Institute of Immunology
Aruna Asaf Ali Marg
New Delhi

Dr. Monica Sundd
Staff Scientist
National Institute of Immunology
Aruna Asaf Ali Marg

Dr. Debasisa Mohanty
Academic/Student Affairs
Staff Scientist-VII
National Institute of Immunology
Aruna Asaf Ali Marg
New Delhi

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(Chairperson)
Staff Scientist
National Institute of Immunology
New Delhi

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(CPCSEA Main Nominee)
EFA, Institute of Nuclear Medicine &
Applied Sciences (INMAS)
Delhi

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(CPCSEA Link Nominee)
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Dr. Poonam VIshwakarma
(CPCSEA nominated Member)
Veterinarian, Biosafety Support Unit
New Delhi

Sh. Amit Kamboj
(CPCSEA nominated Member)
MSS – Control Medical Service Society
New Delhi

Dr. Madhulika Srivastava
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

Dr. P. Nagarajan
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

Dr. Soumen Basak
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

Dr. Nimesh Gupta
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

INSTITUTIONAL BIO-SAFETY COMMITTEE

Dr. Rajesh S. Gokhale
(Chairman)
Staff Scientist
National Institute of Immunology
New Delhi

Prof. Krishnamurthy Natarajan
(DBT nominee)
Jawaharlal Nehru University
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Bio-safety Officer
IGIB
New Delhi

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International Centre for Genetics and
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(Member)
Staff Scientist
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New Delhi

Dr. Vinay K. Nandicoori
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

Dr. Arnab Mukhopadhyay
(Member)
Staff Scientist
National Institute of Immunology
New Delhi

Dr. Prafullakumar B. Tailor
(Member)
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National Institute of Immunology
New Delhi

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Prof. Subrata Sinha
(Chairman)
All India Institute of Medical Sciences
New Delhi

Dr. Sandeep Mathur
(Member)
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(Member)
Translational Health Science &
Technology Institute
Faridabad

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(Member)
Staff Scientist
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Dr. Rahul Pal
(Member Secretary)
Emeritus Scientist
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New Delhi

STAFF OF THE INSTITUTE

(As on 31.03.2021)

SCIENTIFIC STAFF

CORE & INFRASTRUCTURE SCIENTISTS

Dr. Amulya K. Panda, Director

Dr. Rajendra P. Roy, Staff Scientist-VII *(on short term contract)*

Dr. Subeer S. Majumdar, Staff Scientist-VII *(on Deputation)*

Dr. Rajesh S. Gokhale, Staff Scientist-VII

Dr. Pushkar Sharma, Staff Scientist- VII

Dr. Debasisa Mohanty, Staff Scientist-VII

Dr. Madhulika Srivastava, Staff Scientist-VII

Dr. Vinay K. Nandicoori, Staff Scientist-VII

Dr. Sagar Sengupta, Staff Scientist-VII

Dr. Sangeeta Bhaskar, Staff Scientist-VII

Dr. Devinder Sehgal, Staff Scientist-VII

Dr. Apurba Kumar Sau, Staff Scientist-VII

Dr. Sandeep Saxena, Staff Scientist-VI *(on Lien)*

Dr. Monica Sundd, Staff Scientist-VI

Dr. S. Gopalan Sampathkumar, Staff Scientist-VI

Dr. Sanjeev Das, Staff Scientist-VI

Dr. Bichitra K. Biswal, Staff Scientist-VI

Dr. Arnab Mukhopadhyay, Staff Scientist-VI

Dr. Prafullakumar B. Tailor, Staff Scientist-VI

Dr. Soumen Basak, Staff Scientist –VI

Dr. Agam P. Singh, Staff Scientist-VI

Dr. Sarika Gupta, Staff Scientist-V

Dr. Vidya Raghunathan, Staff Scientist -V

Dr. Nimesh Gupta, Staff Scientist-V

Dr. Aneeskumar A.G., Staff Scientist-IV

Dr. Veena S. Patil, Staff Scientist-IV

Dr. Devram S. Ghorpade, Staff Scientist- IV

Dr. Santiswarup Singha, Staff Scientist- IV

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Dr. P. Nagarajan, Staff Scientist-IV

Dr. Anil Kumar, Staff Scientist-IV

Dr. Ankita Varshney, Staff Scientist-III

Emeritus Scientists

Dr. Pramod K. Upadhyay

Dr. Rahul Pal

Professor of Eminence

Dr. Anil K. Suri

OTHER SCIENTIFIC STAFF

(As on 31.03.2021)

Scientist (Project)
Dr. Nirmala Jagadish

Data Entry Operator (Project)
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Project Assistant (DE)
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Lab Assistant (Project)
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Dr. Pooja Murraka
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DST- Inspire Faculty Award
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Dr. Ritu Mishra
Dr. Sneh Lata
Dr. Sanchita Das
Dr. Anismrita Lahon
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Dr. Priya Rani
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DST-WOSA Scientist
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ICMR-SRFS
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Ms. Meenakshi Chawla
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Ms. Yashika Ratra
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Mr. Amir Khan
Ms. Kshama Jain
Mr. Sagnik Giri
Ms. Pratima Saini

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Ph.D. Scholars
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Mr. Md Qudratullah
Mr. Suresh Kumar
Mr. Amit Garg
Mr. Amandeep Vats
Mr. Bhupendra Singh Rawat
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Ms. Kirti Sharma
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Ms. Savita
Ms. Shaikh Zikra Arkam
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Ms. Suvechchha Pandit
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Ms. Trisha Biswas

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Ms. Rekha Rani
Ms. Sushma Nagpal
Sh. G.S. Neelaram
Ms. Neerja Wadhwa
Sh. H.S. Sarna
Sh. Adner Bobin

Technical Officers II
Sh. Ashok Kumar
Sh. Birender Kumar
Sh. Chanderdeep Roy
Sh. Daya Nand
Sh. Dhram Vir Singh
Sh. Inderjit Singh
Sh. Kapoor Chand
Sh. Kevla Nand
Ms. Neetu Kunj
Sh. Radhey Shyam
Sh. Rajit Ram
Sh. Ram Bodh Maurya
Sh. Ramesh Chand
Sh. Ramesh Kumar
Sh. Ranbir Singh
Sh. Roshan Lal
Sh. Sunder Singh Bisht
Sh. Desh Raj
Sh. Jagdish
Sh. K.P. Pandey
Sh. Khim Singh
Sh. Kumod Kumar
Sh. Kunwar Singh
Sh. Mahesh Roy
Sh. Manoj Kumar

Sh. Mijan Khan
Sh. Nihal Singh
Sh. Pritam Chand
Sh. Mohd. Aslam

Technical Officers I
Sh. Sudipta Das
Ms. Sarojini Minj
Sh. T. Khaling
Sh. Ravi Ranjan Kumar (S/o Sh. Vijay Kumar)
Sh. Pankaj Kumar Mahto
Sh. Ravi Ranjan Kumar (S/o Sh. Shivajee Prasad)
Sh. Vimlesh Singh

Technicians I
Sh. Raghav Ram
Sh. Ajay Bansal
Sh. Vijendra Kumar
Sh. Raj Kumar Peddipaga
Sh. Babu Lal Meena
Sh. Kiran Pal
Sh. Nand Lal Arya
Sh. Rakesh Kumar
Sh. Shahnawaz Haider
Sh. Birender Roy
Sh. Rajesh Meena
Sh. Anand P. Toppo

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Sh. Naresh Kumar
Sh. Vineet Singh
Sh. Surinder Singh Rawat
Sh. Sonu Gupta
Sh. Arun Lal
Sh. Pankaj Kumar

Skilled Work Assistants
Sh. Amar Nath Prasad
Sh. Bhan Singh
Sh. Chatter Singh
Sh. Jawahar Singh
Sh. Krishan
Sh. Raj Kumar
Sh. Ram C. Singh Rawat
Sh. Vijay Pal
Sh. Rakesh Kumar-II
Sh. Hemant
Ms. Monika

SUPPORT STAFF

ACADEMIC CELL

Administrative Officer
Sh. Madan Mohan

Section Officer
Ms. Sanju Bisht

Skilled Work Assistant
Ms. Rupinder Kaur

COMPUTER & BIOSTATISTICS

Senior Technical Officers
Sh. M.S.V.V.S. Rao
Ms. Sunita Sachdev

Technical Offcier II
Sh. Naveen Chander

ENGINEERING & MAINTENANCE INSTRUMENTATION

Executive Engineers
Sh. Raj Kamal Singh, Executive Engineer
Sh. Harendra Singh, Executive Engineer

Senior Technical Officer
Sh. Mukesh Chander

Assistant Engineers
Sh. Yogesh Kumar Tripathi
Sh. Tarsem Singh
Sh. Amar Nath Sah
Sh. R.K. Bhardwaj
Sh. R.K. Saini
Sh. R.K. Sharma
Sh. Puran Singh Bangari
Sh. Iswari Prasad Sharma
Sh. Vinod Kumar Panchal
Sh. Sooraj Prakash
Sh. Mahabeer S. Panwar
Sh. Rambir Singh

Management Assistant
Sh. Mohan S Negi

Junior Assistant I
Sh. Darban Singh Rawat

Technicians I
Sh. Sharwan Kumar
Sh. Akshaya Kumar Behera
Sh. Amar Nath Gope
Sh. Pramod Yadav
Sh. Sanish Kumar
Sh. Brahm Dev

Technicians II
Sh. Deen Mohd
Sh. Rajiv Kumar
Sh. Shashi Bhushan Kumar

Skilled Work Assistants
Sh. Surender Kumar Kalra
Sh. Krishna P Gaudel
Sh. Hukum Singh
Sh. Prabhu Dayal
Sh. Ram Prasad
Sh. Gaurav Kumar Ravi

Tradesman (Plumber)
Sh. Praveen Kumar

LIBRARY & DOCUMETATION SERVICES

Documentation Officer
Ms. Prachi S. Deshpande

Techical Officers II
Ms. Meenakshi
Sh. Ranjiv Mahajan

Technical Officer II (Documentation)
Sh. Phunglianpau

Technical Officer I
Sh. Satish K Sharma

Technician II
Sh. Babu Lal

PRIMATE RESEARCH CENTRE

Technical Officers II
Sh. Rajesh Kumar
Sh. J.P. Bhardwaj
Sh. Rajinder K Thapa

Skilled Work Assistants
Sh. Shambhu Kumar Bhagat
Sh. Deepak Kumar

SMALL ANIMAL FACILITY

Technical Officers II
Sh. Sadhu Ram
Sh. Surender Singh
Sh. Shailendra K. Arindkar
Sh. Mohan K Mandal
Sh. Dinesh CPS Negi

Technicians I
Sh. Jaglal Thakur
Sh. Mukesh Kumar
Sh. Subhash Chand Dogra
Sh. Yash Pal Singh
Sh. Abhinav Kumar

Technician II
Sh. Suraj Kumar

Skilled Work Assistants
Sh. Kuldeep Kumar
Sh. Nand Kishore
Sh. Prem Chand
Sh. Ram Bhool
Sh. Ram Dev Yadav
Sh. Ram Surat
Sh. Subhash Chand III

ADMINISTRATIVE STAFF

GENERAL ADMINISTRATION

Senior Manager
Dr. D.K. Vashist

Manager (A&E)
Ms. Anju Sarkar

Administrative Officers
Ms. Chandresh Bhagtani
Sh. Pradeep Chawla

Section Officers
Ms. Sheela Satija
Ms. Daisy Sapra

Accounts Officer
Sh. Dev Dutt Sharma

Management Assistants
Sh. Sant Lal
Sh. Dharambir
Sh. Siddharth Sharma
Ms. Neha
Sh. Sandeep Patil
Sh. Deepak Yadav

Junior Translator
Ms. Nisha

Junior Assistants I
Sh. Alam Singh
Sh. Mohan Lal

Junior Assistant II
Sh. Atyush Kumar

Drivers
Sh. Madan Lal
Sh. Mahender Singh
Sh. Satyabir Singh
Sh. Suti Prakash

Technician I
Sh. Puran Singh

Skilled Work Assistants
Sh. Dinesh Singh
Sh. Nand Lal Malakar
Sh. Ajay Kumar
Sh. Rajeev Kumar
Ms. Usha
Sh. Himanshu Kumar

FINANCE & ACCOUNTS

Finance & Accounts Officer
Sh. Padam Singh Rawat

Section Officer
Sh. Suresh C. Chandel

Management Assistants
Sh. Om Prakash
Sh. Harinarayan Kumar

Skilled Work Assistant
Sh. Naveen Negi

STORES & PURCHASE

Section Officers
Sh. Mahendra Pal Singh
Sh. Aslam Ali
Sh. Rakesh Satija

Management Assistants
Sh. Than Singh
Sh. Virendra Singh Kandoriya
Sh. Ramswaroop Meena

Junior Assistant I
Sh. Debarshi Deb

Skilled Work Assistant
Sh. Balraj

BUDGET, FINANCE, AUDITOR'S REPORT AND AUDITED ACCOUNTS

BUDGET & FINANCE FOR FY 2020-21

SOURCES OF FUNDS

The financial resources of the Institute are the core grants provided by the Government of India, Department of Biotechnology, against annual budgetary projections made by the Institute, and other resources in the form of research grants provided by various National and International agencies. The components of the core grants are under Recurring head for meeting the expenditure on salaries and operating expenses and under Non-Recurring head for meeting expenses on account of equipments, infrastructure, building costs connected with Institute activities.

RECEIPTS

The total receipts during the year including opening balances were Rs. 11,695.38 lakhs as given in Diagram-1 & 2 and details of receipt as per below Table - 1:

(₹ In Lakhs)

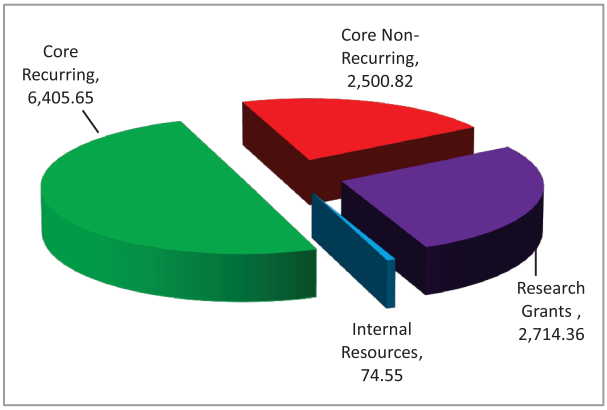

Diagram-1

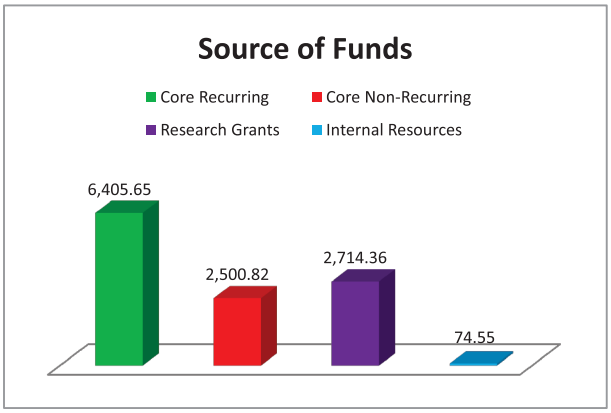

Diagram-2

Table - 1

A: Core Funds provided by Government of India, Department of Biotechnology

(₹ In Lakhs)

	Opening Balance	Receipts During The Year FY 2020-21	Total Fund	% of Fund
I - Recurring	350.65	6,055.00	6,405.65	54.77%
II - Non - Recurring	1,400.82	1,100.00	2,500.82	21.38%
Total			**8,906.47**	**76.15%**

B: Research Projects sponsored by the National and International agencies				
National and International Agencies	1,041.27	1,673.09	2,714.36	23.21%
Total			**2,714.36**	**23.21%**

C: Internal resources generated				
Core	Nil	74.55	74.55	0.64%
Others	Nil	Nil	Nil	Nil
Total			**74.55**	**0.64%**
Grand Total (A+B+C)			**11,695.38**	**100.00%**

APPLICATION OF FUNDS

The total expenditure of research activities, infrastructure development during the year as given in **Diagram – 3 & 4** and details of expenditure as per **Table - 2.**

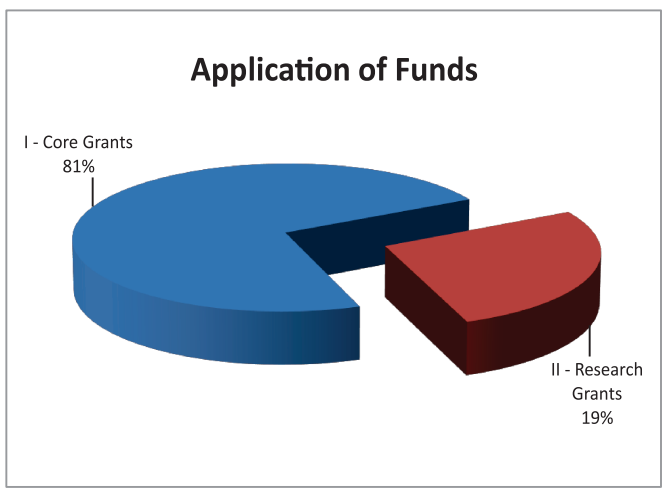

Diagram-3

(₹ In Lakhs)

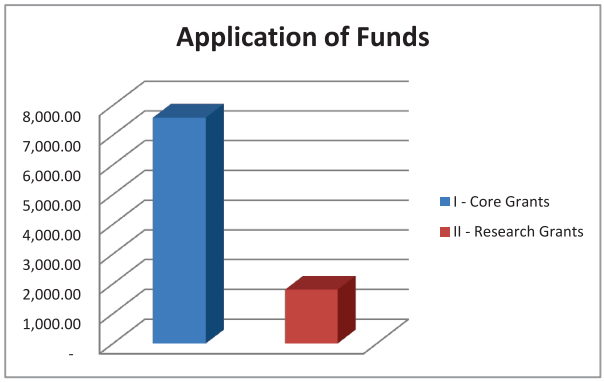

Diagram-4

Table - 2 *(₹ In Lakhs)*

Application of Funds		
Share of funds in overall expenditure	**Expenditure Amount**	**% of Fund**
I - Core Grants	7,579.02	80.81%
II - Research Grants	1,799.27	19.19%
Total	**9,378.29**	**100.00%**

OVERALL EXPENDITURE AT A GLANCE

Overall details of expenditure for the financial year as given in **Table – 3** and **Diagram – 5 & 6**

Table - 3 *(₹ In Lakhs)*

Expenditure Head	Amount	% Age
I - Recurring		
Salaries and wages	3,758.93	40.08%
Operating costs viz, chemical, Consumable, animal diet, electricity, Water, stationary, transport etc.	3,772.28	40.22%
Total	**7,531.21**	**80.30%**
II - Non - Recurring		
Infrastructure facilities/flats/land	Nil	Nil
Equipment/Furniture/Vehicle (including margin money)	1847.07	19.70%
TOTAL	**1847.07**	**19.70%**
Grand Total	**9,378.28**	**100.00%**

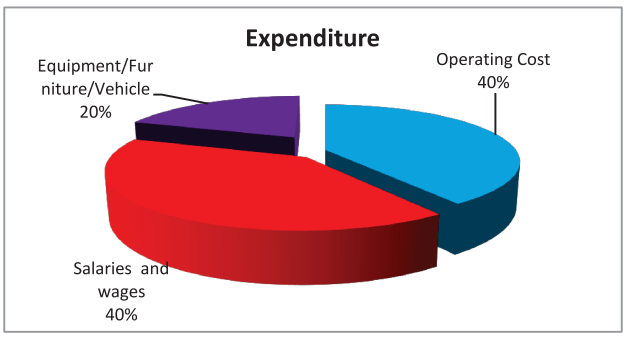

Diagram-5

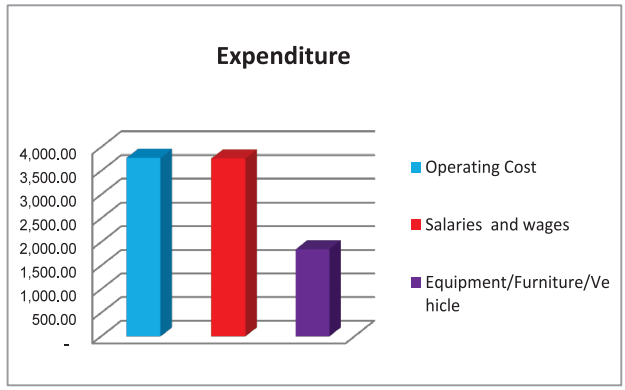

Diagram-6

BUDGETARY PROJECTIONS, SANCTIONS AND EXPENDITURE OVERVIEW

The Governing Body of the Institute approved the budget estimates for the financial year 2020-21 as under:

Plan (Recurring & Non Recurring) Rs. 8,850 Lakhs

Total **Rs. 8,850.00 Lakhs**

The Revised Estimates for the financial year 2020-21 were approved by the Governing Body Rs 8,850 lakhs against which DBT has released Rs 7,155 lakhs.

The Institute has prepared its account on accrual basis, the closing balance of Rs. 1402.00 lakhs shown above has been carried forward to the next financial year 2021-22.

The budgetary requirements projected to the Government are the need after taking into account the funds which are made available against various national and International grants. Also these provide for the capital equipment needed for specific research against the grants.

MAHESHWARI PA & ASSOCIATES
Chartered Accountants
1st Floor, Saraswati Plaza, L.R. Road, Meerut
Ph: 0121-4059052, 4059065, +91-7217000890, 9997179121,
Email : maheshwarica9@gmail.com

INDEPENDENT AUDITOR'S REPORT

Report on the Financial Statements

1. We have audited the accompanying financial statements of **M/S NATIONAL INSTITUTE OF IMMUNOLOGY** ("the Institute"), which comprise the Balance Sheet as at March 31, 2021, the Statement of Income & Expenditure A/c for the year then ended, and a summary of the significant accounting policies and other explanatory information, which we have signed under reference to this report.

Management's Responsibility for the Financial Statements

2. The Institute's Management is responsible for the matters with respect to the preparation of these financial statements that give a true and fair view of the financial position and financial performance of the Institute in accordance with the accounting principles generally accepted in India, including the Accounting Standards specified. This responsibility also includes the maintenance of adequate accounting records for safeguarding of the assets of the Institute and for preventing and detecting the frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of internal financial control, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

3. Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India and in accordance with the Standards on Auditing specified. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

4. An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments,

206, 1st Floor, Vikas Complex, Opp. Metro Pilar No. 57,37,
Veer Savarkar Block, Nirman Vihar, New Delhi-92

the auditor considers internal control relevant to the Institute's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Institute's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

5. We believe that the Audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

6. In our opinion and to the best of our information and according to the explanations given to us, the aforesaid financial statements give the information , in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India:

a) In the case of the Balance Sheet, of the state of affairs of the Institute as at March 31, 2021;

b) In the case of the Statement of Income & Expenditure A/c of the Institute for the year ended on that date.

7. *Report on Other Legal and Regulatory Requirements*

1) As required, we report that:

a) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit;

b) In our opinion, proper books of account as required by law have been kept by the Institute so far as it appears from our examination of those books;

c) The Balance Sheet and Statement of Income & Expenditure A/c dealt with by this Report are in agreement with the books of account;

d) In our opinion, the Balance Sheet, Statement of Income & Expenditure A/c, Receipt & Payment A/c comply with the Accounting Standards;

e) In our opinion and to the best of our information and according to the explanations given to us, we report as under with respect to other matters to be included in the Auditor's Report:

i) The Institute does not have any pending litigations which would impact its financial position, except seven cases which are pending.

ii) The Institute did not have any long term contracts including derivative contracts; as such the question of commenting on any material foreseeable losses thereon does not arise.

iii) The Institute has made excess expenditure over released grant amounting to ₹ 2,23,16,704/- (PY ₹ 2,17,34,033/-) in 60 Projects. For which payment has not been received from the Govt. or the Granting Agencies. Out of these 60 Projects most of the projects are older than 3 years and no amount has been received out of these projects.

FOR MAHESHWARI P A AND ASSOCIATES
(Chartered Accountants)

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

Date: 11th October, 2021
Place: New Delhi
UDIN: 21412467AAAAEJ7452

CA ABHISHEK GOEL
PARTNER
M. NO. 412467

NATIONAL INSTITUTE OF IMMUNOLOGY
Aruna Asaf Ali Marg , New Delhi
BALANCE SHEET AS AT 31st MARCH 2021

	Schedule	Current Year	Previous Year
CORPUS / CAPITAL FUND AND LIABILITIES		Amount in (₹)	
Corpus/Capital Fund	1	96,05,31,816	97,25,27,765
Reserves and Surplus	2	11,35,99,377	7,81,24,032
Earmarked/Endowment Funds	3	73,71,55,842	72,86,54,370
Current Liabilities and Provisions	4	4,86,00,492	9,42,61,876
Total (Liabilities)		**1,85,98,87,527**	**1,87,35,68,043**
ASSETS			
Fixed Assets	5	90,61,95,971	84,77,69,731
Investments - From Earmarked/Endowment Funds	6	1,74,03,333	1,74,03,333
Current Assets, Loans, Advances, etc.	7	93,62,88,223	1,00,83,94,979
Miscellaneous Expenditure (to the extent not written off or adjusted		-	-
Total (Assets)		**1,85,98,87,527**	**1,87,35,68,043**
Significant Accounting Policies & notes on accounts	17	-	-

As per our separate report
of even date attached

For MAHESHWARI P A & ASSOCIATES
Chartered Accountants
(FRN-012023C)

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

(ABHISHEK GOEL)
PARTNER

M.No. 412467
Dated: 11th October 2021
UDIN: 21412467AAAAEJ7452

Singnature for NATIONAL INSTITUTE OF IMMUNOLOGY

(DR. PUSHKAR SHARMA)
DIRECTOR

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

(PRADEEP CHAWLA)
F & A O

NATIONAL INSTITUTE OF IMMUNOLOGY

Aruna Asaf Ali Marg , New Delhi

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st MARCH 2021

	Schedule	Current Year	Previous Year
		Amount in (₹)	
INCOME			
Grants/ Subsidies	8	60,55,00,000	61,90,00,000
Fees/Subscriptions	9	23,56,004	20,99,504
Income from Investments	10	-	-
Income from Royalty, Publications	11	3,50,000	2,03,000
Interest Earned	12	-	-
Other Income	13	47,49,334	70,63,260
Deferred Revenue- Depreciation	5	12,62,80,844	10,70,88,096
Total Income (A)		**73,92,36,182**	**73,54,53,860**
EXPENDITURE			
Establishment Expenses	14	31,77,90,084	31,71,14,699
Other Administrative/Lab Expenses etc.	15	25,96,89,909	35,06,91,197
Expenditure on Grants, Subsidies etc.	16	-	-
Depreciation (Net Total at the year-end - Corresponding to schedule 8)	5	12,62,80,844	10,70,88,096
Total Expenditure (B)		**70,37,60,837**	**77,48,93,992**
Balance being excess of Income over Expenditure Before Prior Period Item (A-B)		**3,54,75,345**	-
Balance being excess of Expenditure over Income Before Prior Period Item (B-A)		-	**3,94,40,132**
Prior Period Item		-	
Balance being excess of Income Expenditure over After Prior Period Item		**3,54,75,345**	
Balance being excess of Expenditure over Income After Prior Period Item			**3,94,40,132**
Transfer to Special Reserves (Specify Each)			
Transfer to / from General Reserve			
Balance being Surplus/(Deficit) carried to Corpus/Capital Fund			
Significant Accounting Policies & notes on accounts	17		
		-	-

As per our separate report
of even date attached

For MAHESHWARI P A & ASSOCIATES
Chartered Accountants
(FRN-012023C)

(ABHISHEK GOEL)
PARTNER

M.No. 412467
Dated: 11th October 2021
UDIN:21412467AAAAEJ7452

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

Singature for NATIONAL INSTITUTE OF IMMUNOLOGY

(DR. PUSHKAR SHARMA)
DIRECTOR

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

(PRADEEP CHAWLA)
F & AO

NATIONAL INSTITUTE OF IMMUNOLOGY
Aruna Asaf Ali Marg, New Delhi
RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31st March 2021

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
	Amount in (₹)			Amount in (₹)	
Opening Balances			**Expenditure of Fixed Asstts & Capital Work-in-Progress**		
Cash in Hand	63,000	20,000	Purchase of Fixed Assets	18,04,22,189	16,53,32,028
Bank Balances					
In current account	-	- -	**Grants Refund From Government of India**		
Saving accounts	13,89,51,053	13,48,20,491	Recurring	-	-
Imprest Account			Non Recurring	-	-
Grants Received					
From Government of India			**Direct (Establishment) Expenses**		
Recurring	60,55,00,000	61,90,00,000	Salaries and Wages and allowances	27,06,30,893	27,59,69,119
Non Recurring	11,00,00,000	20,54,00,000	Bonus	-	-
Grants/Donations (Project)	16,73,08,962	27,62,71,548	Contribution to CPF	1,58,78,616	1,42,53,596
			Contribution to NSP	62,05,992	59,59,103
Interest Received			Contribution to Gratuity Fund	22,21,354	51,99,135
Interest on Bank	1,02,22,005	1,89,67,446	Staff Welfare Expenses	1,56,425	3,01,084
Loans, Advances etc.	1,47,856	1,54,591	Exp on Employes' Retirement &Terminal Benefits	1,10,55,771	30,40,765
Interest Others	3,52,094		Medical Expenses	98,48,673	1,08,24,393
			Liveries & Uniforms	1,45,000	1,65,200
Decrease in Current Assets			Leave Encashment	16,47,360	14,02,304
Advance to supplier	98,34,522	-			
Advance to Staff	6,96,695	-	**Indirect Expenses**		
Grants Recievable		8,17,958	Other Administrative & Lab Expenses	25,96,89,909	35,06,91,197
Security & other Deposits		-	Interest refunded to DBT	1,07,21,955	1,91,22,037
Claims Receivable	18,281	1,819			
TDS Receivable	32,82,351	-	**Increase in Current Assets**		
Prepaid Expenses	84,43,903	-	Advance to supplier	-	1,10,07,167
			Advance to Staff	-	4,99,630
Increase in Current Liabilities			Grants Recievable	5,82,671	-
Sundry Creditors	-	87,67,160	TDS Receivable	-	9,522
Payable to Staff	-	12,19,410	Prepaid Expenses	-	11,74,214
Payable to Other Agency	-	42,94,271			
Security Deposit-EMD	-	1,10,27,036	**Decrease in Current Liabilities**		
Expenses Payable	-	1,52,333	Sundry Creditors	2,25,47,191	
With Held Amount	1,01,149	-	Statutory Liabilities	9,19,235	10,04,412
			Payable to Staff	4,13,690	-
Other Income			Payable to Other Agency	99,25,401	-
PHD Admisssion Fees	23,56,004	20,99,504	Security Deposit-EMD	1,17,84,571	-
Income from Consultancy	50,000	2,03,000	Expenses Payable	1,72,445	-
Sale of Scrap	6,40,541	7,44,689	Stale Cheque	-	1,232
Fees for Miscellaneous Services	18,500	12,500	With Held Amount	-	1,00,000
Demurrage Charges	19,905	79,792			
Guest House Charges	5,51,900	7,54,680	**Earmarked and Endowment Funds**		
Misc. Income	3,54,579	3,39,397	**Payments**		
Overhead	18,91,758	43,70,664	Capital Expenditure	42,84,895	4,08,10,015
Tender Fees	96,320	1,54,000	Revenue Expenditure	13,32,93,125	22,62,87,878
Contingency	1,96,773	4,72,038	Refund of Grants	4,23,49,387	4,35,41,087
Utility Charges	-	1,35,500	Employees Fund	1,22,23,207	
Application Fees	9,79,058	-			
Technology Transfer Fees	3,00,000	-	**Investment**		
			Investment-From Earmarked/Endowment Funds	4,32,60,000	2,52,25,151
Earmarked and Endowment Funds			Fixed Deposit including Margin Money	-	99,68,232
Payments					
Income from Investments of Funds	3,27,44,424	4,26,00,723			
Other Income/Additions	5,98,700	1,10,000			
Advances for Expenses	-	-	**Closing Balances**		
Employees Fund	-	1,79,12,004	Cash in Hand	-	63,000
			Bank Balance		
Investment			Current Accounts	-	-
Mature Investment-From Earmarked/Endowment Funds	3,52,24,494	-	Saving Accounts	8,05,64,872	13,89,51,053
TOTAL	1,13,09,44,828	1,35,09,02,554	**TOTAL**	1,13,09,44,828	1,35,09,02,554

As per our separate report
of even date attached

For MAHESHWARI P A & ASSOCIATES
Chartered Accountants
(FRN-012025C)

(ABHISHEK GOEL)
PARTNER

M.No. 412467
Dated: 11th October 2021
UDIN: 21412467AAAAEJ7952

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

Signatures for NATIONAL INSTITUTE OF IMMUNOLOGY

(DR. PUSHKAR SHARMA)
DIRECTOR

(PRADEEP CHAWLA)
F & AO

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-1 : CORPUS/CAPITAL FUND

	Amount in (₹)			
	Current Year		Previous Year	
Corpus Fund				
Balance as at the beginning of the year		18,90,70,091		14,90,02,119
Add: Contribution towards Corpus/Capital Fund				
NII Core-Plan(Non-Recurring)	11,00,00,000		20,54,00,000	
Capitlised Portion of Fixed Assests of Projects	43,06,495	11,43,06,495	4,08,10,015	24,62,10,015
Add/(Deduct): Balance of net income/(expenditure) transferred from the Income and Expenditure Account	-		-	
Add: Sale/Adjustment of fixed assets	-	-	-	-
Less: Trf to Fixed Assets Fund	18,47,28,684		20,61,42,043	
Add: Trf From Capital Reserve	-	18,47,28,684	-	20,61,42,043
		11,86,47,902		**18,90,70,091**
Fixed Assets Fund				
Balance as at the beginning of the year	70,33,02,506		62,96,72,541	
Add: Transfer from Corpus Fund	-		-	
Add: Assets purchased during the year	18,04,22,189		16,53,32,028	
Less: Assets Transferred	-		-	
Less: Deferred Revenue Depreciation	10,99,84,098	77,37,40,597	9,17,02,063	70,33,02,506
Fixed Assets Fund (Project)				
Balance as at the beginning of the year	8,01,55,168		5,47,31,186	
Add:Assets purchased during the year	43,06,495		4,08,10,015	
Less: Assets Transferred	21,600		-	
Less: Deferred Revenue Depreciation	1,62,96,745	6,81,43,318	1,53,86,033	8,01,55,168
TOTAL		**96,05,31,816**		**97,25,27,765**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY * NEW DELHI-67 *

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-2 : RESERVES AND SURPLUS

	Amount in (₹)			
	Current Year		Previous Year	
1 Capital Reserve				
As per last Account	6,55,45,583		6,55,45,583	
Addition during the Year	-		-	
Less Deductions during the year	-	6,55,45,583	-	6,55,45,583
2 General Reserve				
As per last Account	1,25,78,449		5,20,18,581	
Addition during the Year	3,54,75,345			
Less : Deductions during the year	-	4,80,53,794	3,94,40,132	1,25,78,449
Balance as at the year end		**11,35,99,377**		**7,81,24,032**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-3 : EARMARKED/ENDOWMENT FUNDS

	Amount in (₹)			
	Current Year		Previous Year	
a) Opening Balance of the Funds	72,86,54,370	72,86,54,370	70,23,99,075	70,23,99,075
b) Additions to the Funds				
i. Donations/Grants	16,73,08,962		27,62,71,548	
ii. Income from investments made on account of Funds	3,27,44,424		4,26,00,723	
iii. Other Income/Addtions	5,98,700		1,10,000	
iv. Advances for Expenses	-		-	
v. Employees Fund	(1,23,31,687)	18,83,20,399	1,77,67,924	33,67,50,195
Total (a+b)		**91,69,74,769**		**1,03,91,49,270**
c) Utilization/Expenditure towards objectives of Funds				
I Capital Expenditure				
i. Fixed Assets	42,84,895		4,08,10,015	
	-		-	
Total		**42,84,895**		**4,08,10,015**
II Revenue Expenditure				
i. Salaries, Wages and allownaces, etc.	5,81,04,607		6,25,19,569	
ii. Reduction of Projects Debit Balances	(5,82,671)		8,17,958	
iii. Other Expenses	8,34,63,864		17,39,03,034	
Total		**14,09,85,800**		**23,72,40,561**
III Margin Money		**(76,92,675)**		**(1,09,52,683)**
IV Refund of Unutilised Grants		**4,23,49,387**		**4,35,41,087**
V Reduction of Loan and Advances to Employees		**(1,08,480)**		**(1,44,080)**
Total (c)		**17,98,18,927**		**31,04,94,900**
Net Balance at the year end (a + b - c)		**73,71,55,842**		**72,86,54,370**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-4 : CURRENT LIABILITIES AND PROVISIONS

	Amount in (₹)			
	Current Year		Previous Year	
A. CURRENT LIABILITIES				
1 Acceptances				
2 Sundry Creditors	37,41,278		2,62,88,469	
3 Statutory Liabilities	16,15,720		25,34,955	
4 Other Deposit	-		-	
5 Payable to Staff	55,74,716		59,88,406	
6 Payable to Other Agency	1,70,43,337		2,69,68,738	
7 Security Deposit-EMD	1,76,63,194		2,94,47,765	
8 Expenses Payable	3,53,030		5,25,475	
9 Stale Cheque	-		-	
10 Other Liabilities				
With Held Amount	26,09,217		25,08,068	
Loans & Advances to Staff for HBA/Conveyance				
Security Deposit - Others				
		4,86,00,492		9,42,61,876
Total (a)		**4,86,00,492**		**9,42,61,876**
B. PROVISIONS				
1 Gratuity	-		-	
2 Superannuation/Pension	-		-	
3 Accumulated Leave Encashment	-		-	
4 Trade Warranties/Claims	-		-	
5 For Expenses	-	-	-	-
Total (b)		-		-
TOTAL (a+b)		**4,86,00,492**		**9,42,61,876**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY * NEW DELHI-67 *

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi

SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-5 : FIXED ASSETS/ DEPRECIATON

	RATE OF DEPRC.	GROSS BLOCK					DEPRECIATION			NET BLOCK	
		Cost /valuation As at begining of the Year	Addition		Deductions during the Year	Cost /valuation As at end of the Year	As at begining of the Year	Depreciation for the year	Total upto the Year-end	Current year	Previous year
A. FIXED ASSETS			More than 6 Months	Less than 6 Months						Amount in (₹)	
1. LAND											
a) Freehold	0%	6,53,54,558				6,53,54,558	-	-	-	6,53,54,558	6,53,54,558
b) Leasehold	0%	-				-	-	-	-	-	-
2. BUILDINGS											
a) On Freehold Land	10%	56,64,01,432				56,64,01,432	33,51,99,775	2,31,20,166	35,83,19,941	20,80,81,492	23,12,01,658
b) On Leasehold Land	10%	-				-	-	-	-	-	-
c) Ownership Flats/Premises	10%	1,68,24,584				1,68,24,584	1,36,27,718	3,19,687	1,39,47,404	28,77,180	31,96,867
d) Project Building	10%	3,88,02,000				3,88,02,000	1,58,89,807	22,91,219	1,81,81,026	2,06,20,974	2,29,12,193
3. PLANT & MACHINERY AND EQUIPMENT							-	-	-	-	-
a) P&M	15%	1,62,94,08,063	7,20,35,239	8,29,51,029		1,78,43,94,331	1,26,77,41,891	7,12,76,539	1,33,90,18,430	44,53,75,902	36,16,66,173
b) Project Equipment	15%	14,51,78,436	32,98,707	10,07,788	21,600	14,94,63,331	5,69,20,356	1,38,05,862	7,07,26,218	7,87,37,113	8,82,58,080
c) Computer & Peripherals	40%	64,98,16,746	8,58,355	4,14,220		65,10,89,321	64,34,80,886	29,60,530	64,64,41,416	46,47,905	63,35,860
d) Project Computer	40%	21,62,001	-	-		21,62,001	17,36,875	1,70,050	19,06,925	2,55,076	4,25,126
e) Software	40%	2,14,70,102	7,316	2,48,390		2,17,25,808	1,98,37,276	7,05,735	2,05,43,011	11,82,797	16,32,826
f) Project Software	40%	12,60,892	-	-		12,60,892	11,86,858	29,613	12,16,472	44,420	74,034
g) Books & Periodicals	40%	6,35,354	16,914	24,021		6,76,289	5,54,756	43,809	5,98,565	77,724	80,598
4. VEHICLES	15%	93,77,832	-	-		93,77,832	59,30,378	5,17,118	64,47,496	29,30,336	34,47,454
5. FURNITURE & FIXTURES	10%	5,93,26,451	4,43,848	2,25,608		5,99,95,907	4,44,51,100	15,43,200	4,59,94,301	1,40,01,607	1,48,75,351
6. ELECTRICAL INSTLATIONS	15%	4,76,73,790	-	-		4,76,73,790	4,36,53,318	6,03,071	4,42,56,389	34,17,401	40,20,471
7. LIBRARY BOOKS	40%	1,49,29,276	-	-		1,49,29,276	1,49,26,232	1,217	1,49,27,450	1,826	3,043
8. TUBWELLS & WATER SUPPLY	15%	-				-	-	-	-	-	-
9. OTHER FIXED ASSETS							-	-	-	-	-
a) DG Set	15%	5,65,02,846	-	-		5,65,02,846	3,73,56,723	28,71,918	4,02,28,641	1,62,74,204	1,91,46,123
b) A/c plant and air cooling system	15%	6,54,33,299	97,000	1,35,42,591		7,90,72,890	5,96,92,393	18,91,380	6,15,83,774	1,74,89,117	57,40,906
c) Lifts	15%	37,62,195	-			37,62,195	35,75,596	27,990	36,03,586	1,58,609	1,86,599
d) Animal Cages	15%	4,58,43,737	81,33,111	-		5,39,76,848	2,66,31,925	41,01,738	3,07,33,664	2,32,43,184	1,92,11,812
TOTAL (CURRENT YEAR)		3,44,01,63,594	8,48,90,490	9,84,13,647	21,600	3,62,34,46,131	2,59,23,93,864	12,62,80,844	2,71,86,74,707	90,47,71,424	84,77,69,731
PREVIOUS YEAR		3,23,40,21,551	2,28,99,935	18,32,42,108	-	3,44,01,63,594	2,48,53,05,768	10,70,88,096	2,59,23,93,864	84,77,69,731	74,87,15,784
B. CAPITAL WORK-IN-PROGRESS											
a) Capital work-in-progress including advances,construction materials and building under construction(net of recovery)		-	14,24,547	-	-	14,24,547	-	-	-	14,24,547	-
TOTAL (CURRENT YEAR)		-	14,24,547	-	-	14,24,547	-	-	-	14,24,547	-
PREVIOUS YEAR		-	-	-	-	-	-	-	-	-	-
GRAND TOTAL (A + B)		3,44,01,63,594	8,63,15,037	9,84,13,647	21,600	3,62,48,70,678	2,59,23,93,864	12,62,80,844	2,71,86,74,707	90,61,95,971	84,77,69,731
GRABD PREVIOUS YEAR (A + B)		3,14,70,26,345	4,05,46,744	4,64,92,862	44,400	3,23,40,21,551	2,38,65,42,098	9,87,63,670	2,48,53,05,768	74,87,15,784	76,04,84,247

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

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NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021

SCHEDULE-6 : INVESTMENTS FROM EARMARKED/ ENDOWMENT FUNDS

	Amount in (₹)	
	Current Year	**Previous Year**
1 In Government Securities	-	-
2 Other approved Securities	-	-
3 Shares	-	-
4 Debentures and Bonds	-	-
5 Subsidiaries and Joint Ventures	-	-
6 Others	-	-
(i) Special Deposit Account-RBI	1,74,03,333	1,74,03,333
(ii) Fixed Deposit with Sch. Bank	-	-
TOTAL	**1,74,03,333**	**1,74,03,333**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31st MARCH 2021
SCHEDULE-7 : CURRENT ASSETS, LOANS, ADVANCES, ETC.

	Amount in (₹)			
	Current Year		Previous Year	
A CURRENT ASSETS				
1 Cash Balances in hand (including cheques/drafts and imprest)		-		63,000
2 Bank Balances				
a) With Schduled Banks				
On Current Accounts	-		-	
On Deposit Accounts (includes Margin Money-Core)	23,43,02,923		26,95,27,417	
On Savings Accounts	8,05,64,872		13,89,51,053	
FD from Earnmarked and Endowment fund	59,16,00,000		54,83,40,000	
Special Deposit Account				
		90,64,67,795		95,68,18,470
Total (A)		**90,64,67,795**		**95,68,81,470**
B LOANS, ADVANCES AND OTHER ASSETS				
1 Loans				
a) Staff	-		-	
b) Other Entities engaged in activities/ objectives similar to that of the Entity	-		-	
c) Others	-		-	
Loans & Advances to Staff for HBA/Conveyance	-		-	
Security Deposit - Projects	-	-	-	-
2 Advances and other amounts receivable in cash or in kind for value to be received				
a) On Capital Account	-		-	
b) Advance to supplier	17,06,224		1,15,40,746	
c) Advance to Staff	35,935		7,32,630	
d) Grants Recievable	2,23,16,704		2,17,34,033	
e) Security & other Deposits	23,83,235	2,64,42,098	23,83,235	3,63,90,644
3 Income Accrued				
a) On Investments from Earmarked/ Endowment Funds	-		-	
b) On invetments - Others	-		-	
c) On Loans and Advances	-		-	
d) Others	-	-	-	-
4 Claims Receivable		30,39,195		30,57,476
5 TDS Receivable		2,37,065		35,19,416
Total (B)		**2,97,18,358**		**4,29,67,536**
C Prepaid Expenses		1,02,070		85,45,973
TOTAL (A + B + C)		**93,62,88,223**		**1,00,83,94,979**

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SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-8 : GRANTS/SUBSIDIES

Irrevocable Grants & Subsidies Received	Amount in (₹)	
	Current Year	**Previous Year**
1. Central Government		
Non-Plan	-	-
Plan	60,55,00,000	61,90,00,000
2. State Government(s)	-	-
3. Government Agencies	-	-
4. Institutions/Welfare Bodies	-	-
5. International Organisations	-	-
6. Others	-	-
TOTAL	**60,55,00,000**	**61,90,00,000**

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SCHEDULE-9 : FEES/SUBSCRIPTIONS

	Amount in (₹)	
	Current Year	**Previous Year**
1. Entrance Fees	23,56,004	20,99,504
2. Annual Fees/ Subscription to Journals	-	-
3. Seminar/Program Fees	-	-
4. Consultancy Fees	-	-
5. Others	-	-
TOTAL	**23,56,004**	**20,99,504**

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SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-10 : INCOME FROM INVESTMENTS

(Income on investments from Earmarked/ Endowment Funds transferred to Funds)	Amount in (₹)			
	Investment from Earmarked Fund		Investment - Others	
	Current Year	Previous Year	Current Year	Previous Year
1. Interest				
a) On Government Securities	-	-	-	-
b) Other Bonds/ Debentures	-	-	-	-
2. Dividends				
a) On Shares	-	-	-	-
b) On Mutual Fund Securities	-	-	-	-
3. Rents		-	-	-
4. Others	-	-	-	-
TOTAL	-	-	-	-
TRANSFERRED TO EARMARKED/ ENDOWMENT FUNDS	-	-	-	-

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SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-11 : INCOME FROM ROYALTY, PUBLICATION, ETC.

	Amount in (₹)	
	Current Year	**Previous Year**
1. Income from Royalty/Transfer of Technology	3,00,000	-
2. Income from Publications	-	-
3. Income from Consultancy	50,000	2,03,000
TOTAL	**3,50,000**	**2,03,000**

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SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-12 : INTEREST EARNED

	Amount in (₹)	
	Current Year	**Previous Year**
1. On term Deposits		
a) With Scheduled Banks	-	-
b) With Non-Scheduled Banks	-	-
c) With Institutions	-	-
d) Others	-	-
2. On Savings Accounts		
a) With Scheduled Banks	-	-
b) With Non-Scheduled Banks	-	-
c) Post Office Savings Accounts	-	-
d) Others	-	-
3. On Loans		
a) Employees/Staff	-	-
b) Others	-	-
4. Interest on Debtors and other Receivables	-	-
TOTAL	-	-

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

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SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-13 : OTHER INCOME

	Amount in (₹)	
	Current Year	**Previous Year**
1. Profit on Sale/Disposal of Assets		
a) Owned Assets	-	-
b) Assets acquired out of grant, or received free of cost	-	-
c) Sale of Scraps	6,40,541	7,44,689
2. Export Incentives realized	-	-
3. Fees for Miscellaneous Services	18,500	12,500
4. Miscellaneous Income	40,90,293	63,06,071
TOTAL	**47,49,334**	**70,63,260**

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SCHEDULE-14 : ESTABLISHMENT EXPENSES

	Amount in (₹)	
	Current Year	**Previous Year**
1 Salaries and Wages and allowances	27,06,30,893	27,59,69,119
2 Bonus	-	-
3 Contribution to CPF	1,58,78,616	1,42,53,596
4 Contribution to NSP	62,05,992	59,59,103
5 Contribution to Gratuity Fund	22,21,354	51,99,135
6 Staff Welfare Expenses	1,56,425	3,01,084
7 Expenses on Employes' Retirement and Terminal Benefits	1,10,55,771	30,40,765
8 Medical Expenses	98,48,673	1,08,24,393
9 Liveries & Uniforms	1,45,000	1,65,200
10 Leave Encashment	16,47,360	14,02,304
TOTAL	**31,77,90,084**	**31,71,14,699**

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NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi

SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-15 : OTHER ADMINISTRATIVE/LAB EXPENSES, ETC.

		Amount in (₹)	
		Current Year	**Previous Year**
1	Purchases	5,26,58,730	9,18,82,621
2	Advertisement and Publicity	9,94,531	20,40,070
3	Auditor's Remuneration	35,000	35,000
4	Bank Charges	4,29,457	7,95,433
5	Balance Written Back	35,000	85,000
6	Consulatncy Charges	23,12,686	34,89,591
7	Electricity and Power	8,92,00,239	8,56,87,538
8	Expenses on Fees (JNU Affiliation)	6,00,000	6,00,000
9	Expenses on Seminars/Workshops(Regn/Mem Fee)	6,78,093	30,69,655
10	Foundation Day Expenses	-	8,46,558
11	Freight and Cartage	1,33,087	9,32,282
12	Horticulture	34,63,591	40,92,237
13	Hospitality/Local Meeting Expenses	11,81,159	48,23,664
14	Interest on TDS/GST	368	5,776
15	Legal & Professional Charges	32,20,868	5,40,150
16	Manpower Hiring Charges	2,33,60,222	2,52,16,877
17	Miscellaneous Expenses	54,184	1,42,835
18	Office Maintenance/Expenditures	79,763	1,00,883
19	Patent Fee	30,62,778	48,83,176
20	Ph.D Examination Expenses	7,292	42,24,048
21	Postage, Telephone and Communication Charges	13,92,162	22,70,936
22	Printing and Stationary	20,25,876	33,99,580
23	Rent, Rates and Taxes	45,59,838	57,22,511
24	Repairs & Maintenance	3,34,66,012	6,37,64,412
25	Publication Fees	37,83,725	36,53,502
26	Scavenging Expenses	73,81,249	77,68,082
27	Security Services	94,10,724	1,16,25,506
28	Subscription	98,52,653	1,05,82,373
29	Student Welfare Expenses	1,09,102	76,858
30	Training Expenses	-	1,81,720
31	Travelling and Conveyance Expenses	12,90,595	42,45,103
32	Vehicle Insurance	46,576	1,17,370
33	Vehicle Running and Maintenance	4,46,114	6,25,858
34	Washing Charges	1,37,209	2,29,788
35	Water Charges	51,23,782	47,55,117
36	Foreign Exchange Gain/loss	(8,42,755)	(18,20,913)
	TOTAL	**25,96,89,909**	**35,06,91,197**

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, Aruna Asaf Ali Marg , New Delhi
SCHEDULE FORMING PART OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

SCHEDULE-16 : EXPENSES ON GRANTS, SUBSIDIES, ETC.

	Amount in (₹)	
	Current Year	**Previous Year**
1 Grants given to Institutions/Organisations	-	-
2. Subsidies given to Institutions/ Organisations	-	-
TOTAL	-	-

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

NATIONAL INSTITUTE OF IMMUNOLOGY, NEW DELHI
SCHEDULE FORMING PART OF THE ACCOUNTS
FOR THE PERIOD ENDED 31ST MARCH, 2021

SCHEDULE 17 – SIGNIFICANT ACCOUNTING POLICIES & NOTES TO ACCOUNTS:-

1. **Accounting Convention:**

   The annual accounts have been prepared on historical cost convention (unless stated otherwise) & accrual system of accounting except in case of Government Grant (see point 6 below) & in case of interest on bank deposits, which are accounted for on actual receipt basis.

2. **Treatment of Grants:**

   2.1 Recurring Grants have been recognized in the Income & Expenditure Account in the year of receipt of grant in aid whereas Non-Recurring Grants have been treated corpus fund.

   2.2 Grants relatable to depreciable fixed assets are treated as deferred income and recognized in the Income & Expenditure Account on a systematic and rational basis over the useful life of such assets i.e. such grants are allocated to income over the periods and in the proportions in which depreciation is charged. During the year income recognized in respect of such Grants amount to ₹ 12,62,80,844/- including ₹ 1,62,96,745/- related to Non-recurring grant received under various projects (10,70,88,096/- in FY 2019-20 including ₹ 1,53,86,033/- in projects in that year).

3. **Investments:**

   In Investment for CPF Fund, deposit held with Reserve Bank of India is standing ₹ 1.74 Cr and RBI is giving interest on that.

4. **Fixed Assets, Depreciation & Amortization:**

   4.1 The depreciation has been provided as per the rates prescribed under the Income Tax Act, 1961 following Written Down Value method and Rule made thereunder.

   4.2 Fixed assets have been created with grants received from the various funding agencies. The condition of these grants, inter alia, stipulates that assets will be the property of Funding Agencies who will be free to sale or otherwise dispose off. The funding agencies have the discretion to gift these assets to the Institute, if it considers appropriate, but no such gifts have been made so far. None of those assets had so far been sought back by any of the funding agencies.

5. **Consumable Stores:**

   All purchases such as chemicals, glassware, consumables, animal diet and stationery have been charged to consumption at the time of purchase without working out closing stock at the end of the year.

6. **Government Grants/ Subsidies:**

   6.1 Government Grants of the nature of non-depreciable assets are treated as Capital Reserves and in respect of depreciable assets are treated as part of Fixed Assets Fund under Corpus.

   6.2 Government Grants are accounted on the basis of receipt of cheques/ transfers.

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY * NEW DELHI-67 *

7. Foreign Currency Transaction:

Transactions in foreign currencies are recorded at the exchange rate prevailing on the date of transaction and exchange differences are recognized in the Statement of Income and Expenditure.

8. Retirement Benefits:

8.1 Liability towards gratuity payable on death/retirement of employee is calculated on the actual qualifying service of each employee as of the close of the financial year (as against the requirements of AS-15 Issued By ICAI) and net amount after taking into account the interest earned on investments during the year is transferred to the Gratuity Fund.

8.2 No provision for accumulated leave encashment benefit to the employees has been ascertained and provided at the year end, in terms of requirements of AS-15 issued by ICAI.

9. Project Grants:

9.1 The Institute receives extra mural project grants from National and International agencies for specific research programmes.

9.2 The Institute has a policy of allocating its overheads and transfer of its expenditure to different projects at the year-end on reasonable estimate basis after taking into account the amount of maximum permissible limits for overheads and expenditure sanctioned by the funding agency for each project.

9.3 **The Institute has made excess expenditure over released grant amounting to ₹ 2,23,16,704/- (PY ₹ 2,17,34,033/-) in 60 Projects. For which payment has not been received from the Govt. or the Granting Agencies. Out of these 60 Projects most of the projects are older than 3 years and no amount has been received out of these projects.**

9.4 As on 31st March 2021, thirty one of earmarked project has already been closed on account of their tenure expiring/project execution, as applicable. Their respective balances included under the head "Earmarked/Endowment Funds" in the balance sheet as on that date and aggregating to ₹ 35,47,521/- Credit Balance (PY ₹ 13,39,223/- Credit Balance) are subject to reconciliation with the granting agencies.

10. Staff Advances

Staff advances of ₹ 35,935/- (PY ₹ 7,32,630/-) are subject to confirmation/ adjustment.

11. Gratuity

Gratuity amounting to ₹ 15,82,43,466/- (PY ₹ 16,09,55,911/-) payable to staff of the Institute has been ascertained up to the year ended.

12. Advances to suppliers

Advances to suppliers for Consumable and Equipment for ₹ 17,06,224/- (PY ₹ 1,15,40,746/-) are subject to confirmation/ adjustment.

13. Taxation

In view of the tax exemption status of the National Institute of Immunology, no provision for Income Tax had been considered necessary.

MAHESHWARI P.A. & ASSOCIATES CHARTERED ACCOUNTANTS

NATIONAL INSTITUTE OF IMMUNOLOGY NEW DELHI-67

14. Details of Payments to Auditors:

Particulars	Year Ended 31st March 2021	Year Ended 31st March 2020
Payment to auditors:		
- Statutory audit fee	₹35,000	₹35,000
- Other Professional fees	₹15,000	₹35,000
Total	**₹50,000**	**₹35,000**

* Payments to auditors are inclusive of taxes

15. Contingent Liabilities & Commitments

a) Claims against the Institute acknowledge as debt - Nil

b) Guarantees – Nil.

c) Estimated amount of contracts remaining to be executed on capital account and not provides for – Nil.

d) Other contingent liabilities and commitments – A case is pending of Sh. Madan Mohan & ors vide case no. W.P. © 8629/2014 filed for grant of pay scale to Section Officer, Private secretaries, management Assistant at par with CSS/CSSS cadre in Delhi High Court, but certain amount could not be identified for the above case.

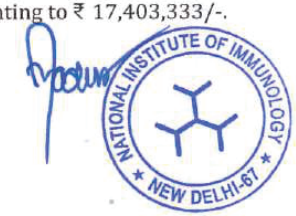
16. Others:

a) Balances from various parties on accounts of receivable and payables (not stated otherwise) are subject to confirmation/reconciliation from/with respective parties.

b) Accounting policies not referred to otherwise are consistent with General Accepted Accounting Principles in India (Indian GAAP).

c) The National Institute of Immunology (herein after called as 'Institute') had paid in Financial Year 2008-09 ₹ 32 Crores to Municipal Corporation, Faridabad (MCF) towards the cost of 160 acres of continuous piece of land situated at common boundary of village Bhankri & village Badkhal, Distt. Faridabad, Haryana. The possession of land had been handed over to the Institute but the conveyance deed has been executed only for 85.20 acres in FY 2016-17 and balance still to be executed due to stay against the same from Hon'ble High Court of Punjab & Haryana. The matter is also under representation with the Department of Biotechnology, Government of India.

d) The CPF Trust of the employees of the Institute does not prepare separate financial statements and is being managed by board of Trustees being Ex-Officio Members / Nominated from the Institute. Accordingly its balances are shown in the financial statement of the Institute. The investment of Trust includes Special Deposit made under RBI (SDS-1972) scheme amounting to ₹ 17,403,333/-.



e) The Receipt & Payment Account had been prepared using direct method presenting all receipts and payments during the year under major heads.

f) The Institute has leased out 125.20 acre of land to THSTI w.e.f. 2nd January 2018 for 30 years at the rate of ₹ 1 per year. For this, the Institute has received ₹ 30 for 30 years toward lease payments from THSTI on 17.05.2018.

g) During the year ended 31.03.2013, a loss of ₹ 66.63 lakhs, on account of fire in Structural Biology Unit was assessed on the basis of their latest replacement/ repairs cost of equipments, whereas the actual book value of the completely damaged equipments have been reported as ₹ 28.84 lakhs and ₹ 6.20 lakhs as actual repair cost of partially damaged equipments, totaling to ₹ 35.04 lakhs. The adjustment for loss is awaited approval of Ministry of Finance through DBT.

h) Schedules 1 to 16, Schedule 17 (containing significant accounting policies & notes to accounts) along with Annexures 1 to 214 are annexed to & form an integral part of financial statement (ie. Balance Sheet, Income and Expenditures Account and Receipt and Payment Account) of the Institute for FY 2020-21.

i) Upon getting the approval for waiver from DBT vide No.AID-16011/1/2019-AIPSU-DBT dated 16.03.2021, for recovery of NPA in R/o of Dr. Vineeta Bal and Dr. Satyajit Rath, the amount accrued out of Salary arrears, Leave encashment and Gratuity upon implementation of 7th CPC, has been released by the Institute to them by transferring the amount in their bank accounts directly on 19th August 2021, without affecting the recovery of NPA of Rs.41.27 lakhs.

17. Since March, 2020, COVID-19 has affected economic activities due to Country wide lockdown and slow down the Govt. revenue collection. Accordingly, DBT released Rs.2675 lakhs under GIA General for the FY 2020-21 as against the previous release of Rs.3100 lakhs during the FY 2019-20. Therefore there was major decline in allocation of GIA to the Institute, consequently, the expenditure under the various heads of the Schedule 15 have also gone down substantially.

18. Previous year figures have been regrouped/ rearranged wherever considered necessary.

Signatures for National Institute of Immunology, New Delhi-110067

NATIONAL INSTITUTE OF IMMUNOLOGY * NEW DELHI-67 *

(DR. PUSHKAR SHARMA)
DIRECTOR

(PRADEEP CHAWLA)
F & AO

For Maheshwari P A and Associates
Chartered Accountant
FRN No. 012023C

MAHESHWARI P.A. & ASSOCIATES * CHARTERED ACCOUNTANTS

(CA. Abhishek Goel)
Partner
M. No. 412467

Place: New Delhi

Date: 11th October, 2021 (UDIN: 21412467AAAAEJ7452)

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