

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

TRIVANDRUM - 695 011, KERALA



Annual Report

2017-18

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Sree Chitra Tirunal Institute for Medical Sciences and Technology
Trivandrum

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History

The origin of the Institute dates back to 1973 when the Royal Family of Travancore gifted a multi-storey building for the people and Government of Kerala. Sri P N Haksar, the then Deputy Chairman of the Planning Commission, inaugurated the Sree Chitra Tirunal Medical Centre in 1976, when patient services including inpatient treatment got under way. The Biomedical Technology Wing followed soon at the Satelmond Palace, a gift from the Royal Family, located 11 km away from the Hospital Wing.

The concept of amalgamating medical sciences and technology within a single institutional framework was regarded sufficiently important by the Government of India to declare the Centre an Institute of National Importance under the Department of Science and Technology by an Act of Parliament in 1980, and name it as Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum.

Dr Manmohan Singh, the then Hon'ble Finance Minister, Government of India, laid the foundation stone for the third dimension of the Institute, the Achutha Menon Center for Health Science Studies (AMCHSS), on June 15, 1992. AMCHSS was dedicated to the nation by Dr Murali Manohar Joshi, the then Hon'ble Minister of Science and Technology and Human Resource Development, Government of India, on January 30, 2000.

— Our Mission —

- Promote research and development in biomedical engineering and technology
- Deliver high quality patient care in selected specialties and sub-specialties
- Develop innovative postgraduate training programs in advanced medical specialties and biomedical engineering and technology
- Participate in public health reforms through research, training and interventions

— Our Vision —

- Become a global leader in affordable medical devices development, high quality patient care and health science studies





Message from the President

On 23rd June 2018, the Institute witnessed an event of exceptional significance. Dr Harsh Vardhan, Hon'ble Union Minister for Science and Technology, Environment, Forest and Climate Change, and Earth Sciences, formally launched, in one auspicious act, four major initiatives of the Institute - the Swasthya Suraksha Block under the Pradhan Mantri Swasthya Suraksha Yojana, the Combinational Devices Block, the Regional Technical Resource Centre for Health Technology Assessment and the Data Centre. The occasion symbolized our undeterred resolve as an institution to step into the future where a fast-changing and fiercely competitive world beckons us with boundless possibilities and big challenges.

The trek to the eventful day was long and arduous. However, as in the affairs of men, there is a tide in the affairs of even organizations which, taken at the floods, leads on to fortune. When our performance and persistence were matched in equal measure by the benevolence of the Department of Science and Technology and the Ministry of Health and Family Welfare, events began to unfold, carrying the imperative of a new hospital block into the realm of reality. I place on record our most profound sense of indebtedness to the Government of India, the Department of Science and Technology and scores of others for their unstinted support at a critical juncture in the life of the Institute. Personally, I am beholden to Providence that I am associated with an institution that is relentless in the pursuit of its lofty mission. I express my deep sense of admiration for all those who have endeavored to sculpt the Institute's future, in consonance with soaring societal needs.

The new Medical Block is a priceless addition that would position the organization at the forefront of super-specialty care of the highest quality and foster first rate post-graduate training in cardiac and neurosciences. On the other hand, the Combinational Devices Block, an important venture made possible with support from the Government of India, would boost biomedical device development and testing in the Institute. The Regional Technical Resource Centre for Health Technology Assessment is yet another feather on the cap of the Achutha Menon Centre for Health Science Studies that has already carved a very special niche for itself in India in the realm of Health Sciences. The state-of-the-art Data Centre is an essential addition achieved through combined funding from the Ministry of Electronics and the Department of Science and Technology, Government of India. Needless to say, the new ventures would fortify the forward trajectory of the organization.

Looking back, it appears to me that June 23rd was waiting to happen. The event marked the consolidation of the Institute's recent efforts to scale up its hospital services and biomedical device development program, in line with its mandate. During the past year, the Institute did extremely well in the important domains of patient care and health sciences, and the effort to bolster medical device development continued with renewed dynamism. Several important projects were undertaken under the Technical Research Centre for Biomedical Devices at the Institute. The Technology Business Incubator continued to attract a good number of incubatees. Vision 2030-Perspective Plan, a beacon of hope for the Institute's commitment to biomedical technology, envisages a 350-Crore project for developing biomedical devices. The Medical Devices Park, to be set up in partnership with the Kerala State Industrial Development Corporation, is a 180-Crore venture that would lead to the development of useful medical devices that in turn would reach the common man of this country as cost-effective solutions to human ailments. As I script this message, I can foresee what the future may hold, now that biomedical engineering and technology have taken the more visible and central seat at the Institute's academic table.

I have just presented a ringside view of a mission undertaken by the Institute with uncommon dedication. I must, however, hasten to add that, even as we exult in our singular achievements, we need to be cognizant of the enormous fiscal, technological and cultural shifts that are profoundly changing our world-view, our priorities and preferences, and the way we work. We live in an 'age of acceleration' that could be ruthless to those who fail to keep pace. On display at the recent Biennial US Science and Engineering Festival in Washington DC was "a slice of the future" that was an indication of what is coming. Micro-sensors on the human body that would capture health parameters round the clock, nano robots that would swim through the bloodstream and talk with robot doctors, and airport cameras that scan passengers for infection that they may inadvertently be carrying into the country - these are just a few examples but they amply illustrate how the human mind works today, and what we need to be prepared for. What is unprecedented and, in a sense, alarming, about the current advancement of technology is the pace at which it is advancing human capabilities, posing a veritable challenge to human adaptability. As an institution and as individuals, all our endeavors would remain inextricably caught up in the vortex of change. We need to be sensitive and responsive to the rapid transformations that come upon these fields.

The new initiatives mark a watershed in our impressive history and augur well for our journey forward. The overwhelming support of the central and state governments for these is a tacit tribute to our accomplishments as an organization and a re-affirmation of faith in our mission. While these are no mean achievement by any reckoning, our success will ultimately be measured not by what is given to us, but by what we do with all that is given to us. May that thought remain with us forever as we move on!

K M Chandrasekhar



2017-18: Looking back

Prof Asha Kishore, Director, SCTIMST

For the Institute, the past year was not just about the continuity of a mission conceptualized and commenced long ago. It was about laying the foundations of a future that identifies new opportunities in the domains in which the organization has its roots, even as it expands the current programs to serve its unique mandate. There was a concerted effort on many fronts to turn long-felt needs into a coveted reality that is in sync with the Institute's intrinsic character. As the year nodded to its fall, there was a palpable sense of accomplishment and a hope that what is to come will be even better than what has been.

A major milestone in the recent history of the Institute has been the recognition, by the Government of India, that an organization that has done exceptionally well in living up to its mandate has been grappling with an unmet need to expand its activities in vital domains. Such recognition found explicit expression during the year in the munificent support of the Government for four major initiatives that strengthen the Institute's commitment to health care through R&D in Biomedical Engineering and Technology, high quality patient care in advanced medical specialties and sub-specialties, innovative post-graduate training programs in advanced medical specialties, and research and training in health sciences. It was a sublime moment when, on 23rd June, 2018, Dr Harsh Vardhan, Hon'ble Union Minister for Science and Technology, Environment, Forest and Climate Change, and Earth Sciences, unveiled the Swasthya Suraksha Block under the Pradhan Mantri Swasthya Suraksha Yojana, the Combinational Devices Block, the Regional Technical Resource Centre for Health Technology Assessment and the Data Centre. The event, which marked the dawn of a new era in the life of the Institute, was clearly the culmination of hard work done at the Institute for which I salute every member of the Chitra family.

In admirable harmony with national missions such as "Make in India", several medical device technologies were transferred to Industry for manufacture and commercialization. Prominent among them were the Rapid Urinary Tract Infection diagnostic kit with antibiotic sensitivity test, Fibrin sealant, the process for preparation of extracellular matrix scaffolds from mammalian cholecyst/jejunum/urinary bladder, Vein Viewer, Blood and IV Fluid Warmer, Infant Warmer Bassinet and Infant Warmer Wrapper. Under the Technical Research Centre (TRC) for Biomedical Devices, 29 mission mode R&D projects aimed at developing medical device technologies are being executed. The 1st technology from TRC, extracellular

matrix scaffolds, was transferred to industry during the Technology Conclave organized at the Institute in May 2017. The Industry-Institute Partnership Cell was set up as part of the Technical Research Centre Programme, which aims at supporting the Indian Medical Device Industry in the areas of training, problem solving and consultancy. The Technology Business Incubator (TIMed) supported 7 resident and 2 virtual incubatees in the healthcare domain during the year. The 3D Bioprinting Facility at the Institute was inaugurated in September 2017, signaling the start of a programme that would strengthen the Institute's engagement with tissue engineering and regenerative medicine. The proposal for the development of a Combinational Devices Block at an estimated cost of Rs 44.48 Crores was approved by the Governing Body in July 2017. As part of the Union Government's Digital India Initiative, SCTIMST implemented the e-governance facility, with funds from the Ministry of Electronics and Information Technology under the scheme "Develop a value-based e-delivery system for health care management and research".

Hospital services at the Institute matched the Institute's performance in the realm of technology development. The focus was on the treatment of complex heart diseases, interventional cardiology, pediatric congenital cardiac problems, cardiac electrophysiology, comprehensive heart failure care, cardiac and thoracic surgery, treatment of brain tumors, epilepsy, movement disorders, developmental brain disorders, neuromuscular disorders, sleep disorders, stroke and pediatric neurology. The Comprehensive Care Centre for Neurodevelopmental Disorders, in collaboration with the National Institute of Speech and Hearing, Trivandrum, was inaugurated in August 2017. The 2nd Digital Subtraction Angiography Laboratory for Interventional Radiology was inaugurated in November 2017. The Heart Team of the Institute successfully performed replacement of diseased heart valve in two patients, using Transcatheter Aortic Valve Replacement (TAVR) without open-heart surgery and cardio-pulmonary bypass. The procedure is minimally invasive and can be done in inoperable patients and in patients who carry high risk for conventional surgery.

Commencement of work on the new super-specialty hospital block was a clear vindication of the fact that "if you can dream it, you can do it", provided your dreams are backed by tenacity and unflinching devotion to their realization. The Institute and the people of the region are deeply grateful to the Government of India for their generous support.

Academic life at the Institute flourished and contributed substantially to human resource development. The 41 academic courses offered by the Institute attracted aspirants from all over the country. 278 candidates were offered admission to various programs last year. The candidates admitted to these programs were from 48 Indian universities, institutions or boards, which testified to the eclectic character of the Institute. Additionally, candidates sponsored by Government and Autonomous Institutions or Health Sector Organizations were offered short-term training. While 14 students were awarded PhD, the number of Research/Technical Manpower trained other than PhDs (DM, MCh, PDCC, PDE, Diplomas, Nursing) was 552. Further, 25 MTech/MPhil/MPH projects were underway during the year. Manpower trained against affiliated programmes (CMC-Vellore, NIE- Chennai, IIPH-Delhi, IIITM-K, Trivandrum) was 141. Affiliated postgraduate and doctoral programs in Health Sciences, Bio-engineering/Biomedical Sciences, Clinical Engineering and Biomedical Devices and Technology with the National Institute of Epidemiology, Chennai, CMC Vellore, Indian Institute of Public Health, New Delhi and IIT Madras and CMC Vellore, continued as before.

During the year, 213 research articles were published, 180 of which were in international journals. 28 patent applications and 7 design registrations were filed and 1 patent was granted during the year. 6 technologies/designs were commercialized and 8 technology leads are awaiting transfer. An impressive total of 37 research projects were initiated during the year. The Achutha Menon Centre for Health

Science Studies was involved in 7 Public Health-related projects for a total outlay Rs 6.47 Crores. The project funded by the Health and Family Welfare Department, Government of Kerala, titled “Control and Prevention of Non-Communicable Disease in Kerala” was granted extension for a year with an additional allocation of Rs 3.86 Crores. The good work done by the Institute in different spheres was amply rewarded at the state and national levels. Several awards were won by our students as well at national and international conferences.

It was very gratifying that revenue to the tune of Rs 126.47 Crores was generated by the Institute during the current financial year, which constituted 79% of the grant-in-aid received from the Department of Science and Technology, excluding a special grant of Rs 45 Crores for the construction of a new super-speciality block. DST contributed Rs 205.02 Crores this year, as against Rs 160.49 Crores in 2016-17. In addition to the Rs 45 Crores from DST, an amount of Rs.10.06 Crores was directly credited to CPWD by the Ministry of Health & Family Welfare, Government of India, for the new super-speciality block. Total Extramural Research Funding was Rs 28.05 Crores, including Rs 14.60 Crores from DST for the Technical Research Centre. The total number of ongoing projects funded by DST was 13, out of which 5 were initiated during 2017-18. The Institute is extremely grateful to the Department of Science and Technology for its immense support to the Institute over the years, which has helped us immensely and ensured that we live up to our mandate. I would be failing in my duty if I do not place on record the Institute’s deep sense of gratitude to Professor Ashutosh Sharma who has been with us through thick and thin, guiding and propelling us forward. The Institute owes its recent accomplishments, in no small measure, to his support on many counts.

The mark of a healthy organization is that it ceaselessly builds the foundation for the future as it transits through the present. Aspiring, in the words of Walt Disney, to “keep moving forward, opening new doors, and doing new things”, the Institute prepared the Vision 2030-Perspective Plan, which was approved by the Governing Body and the Institute Body. The Perspective Plan envisages a 350-Crore project for developing biomedical devices at affordable costs. The Institute aims to develop and transfer 40 innovative medical technologies to Industry, and take another 20 to advanced stages of development by 2030.

Talking of the future, an MoU was signed during the year with the Kerala State Industrial Development Corporation for setting up a Medical Devices Park on the premises of the Bio 360 Life Science Park being developed by the Kerala State Industrial Development Corporation in Trivandrum. It is a 180-Crore project with financial assistance from the State Government and from schemes under various departments of the Central Government. The Park aims at creating an environment for research and development in the area of medical devices, testing and evaluation of medical devices and biomaterials, manufacturing support, technology innovation and knowledge dissemination.

This is a brief account of what we did last year. It says why we are different – and why our work matters. In a sense, it is also the ‘chronicle of a future foretold’ with great expectations. Sree Chitra has quite an ambitious journey ahead but, as a popular contemporary Japanese writer notes, “Life is not like water. Things in life don’t necessarily flow over the shortest possible route”. Hurdles may arise and the road to the cherished destination could be longer than we would like it to be. Nonetheless, no institution can fail or fade when it has a good history, a unique structure, robust work culture, passionate dreams and, more importantly, realistic and socially relevant goals conjured up painstakingly by stalwarts. I would unhesitatingly say that the best is yet to be for the Institute because it is founded on the sacrosanct principle that service to society is the highest goal of human life.



Highlights of the Year

CONTRIBUTIONS TOWARD NATIONAL MISSIONS

1. “Make in India”

◆ Transfer of Medical Device Technologies

The following technologies developed at the Institute were transferred to industrial partners for manufacture and commercialisation:

- Process for preparation of extracellular matrix scaffolds from mammalian cholecyst/jejunum/urinary bladder to M/s. Optimus Life Sciences, Kerala
- Rapid Urinary Tract Infection diagnostic kit with antibiotic sensitivity test to M/s. Agappe Diagnostics Ltd., Kerala
- Fibrin Sealant to M/s. Zum Heilen Healthcare Pvt. Ltd., Bangalore
- Vein Viewer to M/s. Agappe Diagnostics Ltd., Kerala
- Blood/IV Fluid Warmer, Infant Warmer Bassinet and Infant Warmer Wrapper - to M/s. HLL Lifecare Ltd., Trivandrum
- Products transferred to M/s. Onyx Medicals Pvt. Ltd.: Beta Tricalcium Phosphate, 60% synthetic Hydroxyapatite and 40% Beta Tricalcium Phosphate

◆ Technical Research Centre (TRC) for Biomedical Devices

- 29 mission mode R&D projects aimed at developing medical device technologies are being executed
- The 1st technology from TRC (Extracellular matrix scaffolds) was transferred during the Technology Conclave organised at the Institute in May 2017
- Institution-Industry linkages were strengthened
- Received Rs 14.6 Crores from DST as funding for TRC projects during the year

◆ Technology Business Incubator (TIMed)

- TIMed supported 7 resident and 2 virtual incubatees in the healthcare domain during the year
- TIMed start-ups, Indriyam Biologics and Evelabs, won various prizes and grants during the year
- TIMed was selected for NIDHI Seed Funding Scheme of DST, which enabled TIMed to provide seed funds to its incubatees
- TIMed launched Social Innovation Immersion Programme in the area of Ageing and Health with BIRAC support, and 4 TIMed Innovation Fellows were selected
- A number of events took place under the aegis of TIMed, including participation in the International Trade Fair in New Delhi as part of a DST delegation



2. “Skill India”

◆ Industry-Institute Partnership Cell (IIPC)

The Industry-Institute Partnership Cell was set up as part of the Technical Research Centre Programme, which aims at supporting the Indian Medical Device Industry in the areas of training, problem solving and consultancy. The Cell conducted many programmes during the year.

3. “Digital India”

◆ e-Delivery System for Health Care Management and Research

As part of the Union Government’s Digital India Initiative, SCTIMST implemented the e-governance facility, with funds (12.5 Crores) from the Ministry of Electronics and Information Technology under the scheme “Develop a value-based e-delivery system for health care management and research”

- ◆ Development of software and mobile app to facilitate the preparation of agenda for and conduct of Governing Body/Institute Body Meetings, and archival of old documents
- ◆ Development of online application for SCTIMST Compendium with document upload and view option for DST

4. “Swachh Bharat”

Swachhta Hi Seva Fortnight Campaign was observed from 16 September 2017 to 2 October 2017. Several activities were carried out as part of the Campaign. Swachhta Pakhwada was also observed from 1 November 2017 to 15 November 2017.

NETWORKING WITH OTHER INSTITUTIONS

The Institute entered into the following MoUs with government departments, institutions and industries to facilitate networking:

- ◆ The tripartite agreement for collaboration for the project “Preclinical evaluation and commercialization of anti-snake venom (IgY), anti-hemotoxins and anti-neurotoxin’ was signed between SCTIMST, DST and New Medicon Pharma Ltd., Chennai on 12 May 2017
- ◆ An MoU was signed between SCTIMST and The South India Textile Research Institute for “Development of medical textiles for biomedical devices”. The event was at Gandhinagar, Gujarat, on 1 July 2017 during TEXTILES India 2017, a mega event conducted by the Ministry of Textiles, Government of India.
- ◆ An MoU was signed between the Institute and the Department of Health Research (DHR), Ministry of Health and Family Welfare, on 17 July 2017 for collaboration in the field of Health Technology Assessment (HTA) in India. SCTIMST will provide the necessary input and technical support to DHR for developing a policy perspective for HTA: for using public health programmes in the country, to promote introduction and assessment of new and existing health/medical technologies, and to provide support for adoption of health/medical technologies.
- ◆ An MoU was signed between SCTIMST and the Kerala Government for the Kerala Health Surveillance Project
- ◆ An MoU was signed between SCTIMST and the Kerala State Industrial Development Corporation for setting up a Medical Devices Park at the Life Science Park Campus in Trivandrum



INFRASTRUCTURE DEVELOPMENT

◆ Inauguration of the “Comprehensive Care Centre for Neurodevelopmental Disorders”

The “Comprehensive Care Centre for Neurodevelopmental Disorders” was set up in collaboration with the National Institute of Speech and Hearing, Trivandrum. The 2.19-Crore project, funded by the Federal Bank Hormis Memorial Foundation, was inaugurated by Shri Harish Engineer, Head, CSR Committee, Federal Bank Ltd. on 8 August 2017. The objectives of the Centre are to rehabilitate children with various developmental disorders of the brain and promote academics and research in the field.

◆ 3D Bioprinting Facility at Biomedical Technology Wing

The 3D Bioprinting facility at the Institute was inaugurated on 26 September 2017. Apart from the custom-made bioprinter, the facility is also equipped with advanced cell culture capabilities to isolate and culture mammalian primary cells. A state-of-the-art multipurpose bioprinter will be added soon.

◆ Digital Subtraction Angiography (DSA) Laboratory

The 2nd DSA Laboratory for Interventional Radiology was inaugurated on 22 November 2017. These interventions are useful for the treatment of patients with vascular diseases, arresting bleeding from various sites such as bowel, uterus and liver, and palliative procedures related to cancer.

NEW INITIATIVES

◆ Vision 2030 – Perspective Plan

The Institute prepared the Vision 2030 – Perspective Plan, which was approved by the Governing Body and the Institute Body. The Perspective Plan envisages a 350-Crore project for developing biomedical devices, particularly those related to artificial organ development and bio-inks, orthotics, robotics and in vitro diagnostic devices. The goals, infrastructure and resource requirements and other capabilities that need to be developed or augmented were identified. The Institute aims to develop and transfer 40 innovative medical technologies to Industry, and take another 20 to advanced stages of development by 2030.

◆ Medspark

An MoU was signed with the Kerala State Industrial Development Corporation for setting up a Medical Devices Park on the premises of the Bio 360 Life Science Park being developed by the Kerala State Industrial Development Corporation at Thonnakal in Trivandrum. It is a 180-Crore project with financial assistance from the State Government and from schemes under various departments of the Central Government. The Park aims at creating an environment for research and development in the area of medical devices, testing and evaluation of medical devices and biomaterials, manufacturing support, technology innovation and knowledge dissemination. The proposal was approved by the Governing Body and the Institute Body. Two meetings were held in NITI-Aayog and the proposal for starting a Section 8 Company is awaiting Cabinet approval.

◆ Commencement of work on the new Super-speciality Block under the Pradhan Mantri Swasthya Suraksha Yojana (PMSSY)

Technical approval for the new Super-speciality Block in the Hospital Wing under the PMSSY was obtained and construction work was initiated during the year



◆ **Combinational Devices Block**

The proposal for the development of a Combinational Devices Block at an estimated cost of Rs 44.48 Crores was approved by the Governing Body on 8 July 2017

◆ **Transcatheter Aortic Valve Replacement (TAVR)**

The doctors of the Heart Team of the Institute successfully performed replacement of diseased heart valve in two patients, without open-heart surgery and cardio-pulmonary bypass. The advantages of TAVR over surgery are that the procedure, being minimally invasive, can be done in patients who carry high risk for conventional surgery and in inoperable patients. Durability of this valve is similar to the valve systems used for surgical valve replacement and long-term outcomes are extremely good. These surgeries were made possible by the financial assistance provided by Rashtriya Arogya Nidhi of the Ministry of Health and Family Welfare of the Government of India and Karunya Benevolent Fund of the Government of Kerala.

◆ **Public Health Programmes**

7 Public Health-related projects for a total outlay of Rs 6.47 Crores were ongoing during the year. The project funded by the Health and Family Welfare Department, Government of Kerala, titled “Control and Prevention of Non-Communicable Disease in Kerala” was granted extension for a year with an additional allocation of Rs 3.86 Crores.

RESEARCH PROJECTS/PUBLICATIONS/PATENTS

◆ **Number of Research Projects initiated during the year: 30**

- Nationally-funded: 28
- Internationally-funded: 2

◆ **Number of Research Publications: 213**

Books/Chapters in Books: 17

◆ **Patents**

- Granted: 1
- Applications filed: 28
- Design Registrations Filed: 7

HUMAN RESOURCE DEVELOPMENT/TRAINING

◆ **PhD: 14**

◆ **Research/Technical Manpower trained other than PhDs (DM, MCh, PDCC, PDF, Diplomas, Nursing): 552**



- ◆ Manpower trained against affiliated programmes (CMC-Vellore, NIE-Chennai, IIPH-Delhi, IIITM-K, Trivandrum): 141
- ◆ M Tech/M Phil/MPH Projects guided: 25
- ◆ First MD Transfusion Medicine candidate passed in December 2017
- ◆ Scientists/research students/technical manpower trained through Workshops/conferences, training programmes: 595
- ◆ Number of school/college/university students exposed to Science and Technology through open houses/scientific talks/training programmes/ awareness camps/seminars /Workshops/exhibitions: ~1500

EVENTS/CONFERENCES/WORKSHOPS

◆ Annual Convocation 2017

The Annual Convocation of the 33rd batch of SCTIMST was conducted on 15 May 2017. 122 students received their degrees from the Hon'ble Union Minister for Health and Family Welfare, Shri Jagat Prakash Nadda, who was Chief Guest at the event. Dr Anil Kakodkar, former Chairman, Atomic Energy Commission, was Guest of Honor.

◆ 2nd Technology Conclave

The 2nd Technology Conclave was held during 15-16 May 2017. Hon'ble Union Minister for Health and Family Welfare, Shri Jagat Prakash Nadda, inaugurated the event in the presence of the Hon'ble State Minister for Health and Social Justice, Smt K K Shailaja Teacher, and MP of Trivandrum, Dr Shashi Tharoor, MLA of Nemom Constituency, Shri O Rajagopal, President of the Institute, Shri K M Chandrasekhar, and Director, Dr Asha Kishore. The Union Minister transferred the following medical technologies developed by the Institute to various companies: Blood/IV fluid Warmer, Infant Warmer Wrapper/Bassinets (HLL Lifecare Ltd.), Fibrin sealant (Zum Heilen), Rapid UTI diagnostic kit (Agappe Diagnostics), Cholecyst-derived scaffold (Optimus Lifesciences) and the egg yolk immunoglobulin as anti-snake venom (New Medicon Pharma Lab Pvt. Ltd.). The event also included the release of the Vision 2030 for Biomedical Technology, the Technology Compendium and the Technology Transfer Policy.

◆ 100 meetings of the Governing Body

100th GB and 51st IB commemoration event was held on 14 October 2017. Past Directors and Heads of BMT Wing were honoured at the event. An album on the history of the Institute, 'Emergence: A Journey Through Five Decades', was released during the meeting.

◆ DST Conclave 2017

Dr Asha Kishore, Director, SCTIMST, presented the activities of DST institutions under the Health Care Sector on 2-3 May 2017, Kolkata

◆ Medical Devices Industry Meet

Industry representatives were given a one-day exposure of the facilities at the Biomedical Technology Wing on 16 May 2017. Medical Devices Expo was also organized showcasing the Institute's technologies.



◆ **Economic Analysis for Health Technology Assessment**

A Workshop on 'Introduction to Economic Analysis for Health Technology Assessment' was conducted from 8-13 May 2017, supported by the Department of Health Research, Government of India. The Workshop was inaugurated by Dr Soumya Swaminathan, Director General, ICMR, and Secretary, DHR.

◆ The Institute hosted the **"6th Asian Biomaterials Congress" (ABMC6)**, organized jointly by the Society for Biomaterials and Artificial Organs (India), SCTIMST, Society for Tissue Engineering and Regenerative Medicine (India) and Asia Pacific Society for Artificial Organs, Japan, and was held in Thiruvananthapuram from 25-27 October 2017

◆ The Institute hosted the **10th The Cytometry Society-India Annual Meeting and Workshop (TCS-2017)** on "Applications of Flow Cytometry in Health & Disease" from 28-31 October 2017

◆ National Conference on **"Health Inequities in India: Transformative Research for Action & AMC-CON 2018"** was organized by AMCHSS between 8-11 January 2018

◆ An International EMG/SFEMG/QEMG Workshop and Neuromuscular Symposium – **Super EMG India 2018** - was organized by the Department of Neurology during 23-25 March 2018

◆ Workshop on **"Biological Safety and Efficacy Evaluation of Medical Devices"** was held on 19-21 March 2018 at Hotel Central Residency, Trivandrum. Representatives from the medical device industry and the Central Drug Standard Control Organization participated in the programme.

◆ **Visit of Health Equity Fellows**

19 'Health Equity Fellows' from the Health Equity Fellowship Programme of the China Medical Board visited the AMCHSS on 11-12 May 2017. They were accompanied by Prof Lincoln Chen, Distinguished Public Health Scholar and Director of the China Medical Board, as well as Dr A K Shivakumar, Advisor to UNICEF, India.

◆ **Leadership Training Sessions with TATA Trusts were conducted during the year**

◆ **Events were organised in connection with:**

World Health Day 2017-2 April 2017; World Parkinson's Day 2017-11 April 2017; Hand Hygiene Day-5 May 2017; World Multiple Sclerosis Day-31 May 2017; World No Tobacco Day-31 May 2017; World Environment Day-5 June 2017; International Yoga Day-21 June 2017; Independence Day; World Stroke Day 2017-29 October 2017; National Voluntary Blood Donation Day 2017-27 October 2017; International Women's Day 2018-8 March 2018; Republic Day; National Science Day-9 March 2018; World Sleep Day -16 March 2018

◆ **Hindi Fortnight and Vigilance Awareness Week observed**

◆ **Conferences attended by Staff and students: 193**

◆ **Number of Conferences/Workshops organized at the Institute: 29**

MEETINGS OF VARIOUS COUNCILS

◆ The 5th meeting of the **Research Council** was held on 27 January 2018 to review 8 TRC projects and to consider 6 new proposals for funding by TRC



- ◆ The 2nd meeting of the **National Advisory Committee for Technical Research Centre for Biomedical Devices** was held on 9 February 2018. A summary of the status of all R&D projects was presented.
- ◆ The 14th and 15th meetings of the **President's Committee** were held on 3 October 2017 and 13 January 2018 under the Chairmanship of Prof M S Valiathan. 5 projects related to Left Ventricular Assist Device (LVAD), 3D Printing, 3D Virtual Brain Anatomy Project, Deep Brain Stimulator System and TIMed were reviewed during the meeting.

AWARDS

◆ Smrithi Puraskaram

SCTIMST received the award from Kerala Kalavedi, Kollam, for the contributions of its hospital services. On behalf of the Institute, Dr S K Jawahar, Deputy Medical Superintendent, received the award at a function held on 10 June 2017 at Kollam.

◆ Nari Sakthi Puraskar 2017

Dr Lizymol P P, Division of Dental Products, Department of Biomaterials Science and Technology, BMT Wing, SCTIMST, received the award from the Hon'ble President of India, at a ceremony held at the Rashtrapati Bhavan, New Delhi, on 8 March 2018 on the occasion of International Women's Day

◆ Dr B C Roy Award

Prof M Unnikrishnan was awarded the prestigious Dr B C Roy Award under the category of "Eminent Medical Teacher" by the Hon'ble President of India at the Rashtrapathi Bhavan, New Delhi, on 31 March 2017

◆ Lifetime Achievement Award

Dr P V Mohanan, Division of Toxicology, received the "Lifetime Achievement Award" of The Society of Toxicology, India, for his outstanding contribution to the field of Toxicology

◆ Dr Ramadas Pisharody Memorial Award

Dr Easwer, Professor of Neurosurgery, SCTIMST, was conferred the 1st Dr. Ramadas Pisharody Memorial Award by the Government of Kerala for his comprehensive contributions to the Organ Transplant Program from deceased donors of the State of Kerala, at a function marking the Organ Donation Day on 27 November 2017. The award was given by the Hon'ble Chief Minister of Kerala, Shri Pinarayi Vijayan.

◆ Healthcare Excellence Award

Dr Asha Kishore, Director, SCTIMST, received the Healthcare Excellence Award instituted by Kerala Sahridaya Vedi on 6 February 2018

◆ Awards won by students in conferences: 32

CSR ACTIVITIES

- ◆ The Board of Directors of Tata Elxsi Ltd. contributed a sum of Rs 1.4 Crores to SCTIMST for the treatment of patients from financially weaker sections



- ◆ The Managing Trustee of ANAHA Public Charitable Trust, Shri C Balagopal (former Managing Director, Terumo Penpol Ltd.) made a donation of Rs 75 Lakhs to SCTIMST for procurement of essential equipment for the Pediatric Cardiac Surgery Intermediate ICU in October 2017
- ◆ State Bank of India CSR Fund for Equipment Purchase: The Deputy General Manager (Digital & Transaction Banking and Government Business) of State Bank of India, Shri Girivasan V, handed over a cheque for Rs 23.52 Lakhs to the Director, SCTIMST, on 12 March 2018, for procurement of essential equipment for patient care
- ◆ Mr Eresha R, Director, Nucleus Analytics Pvt. Ltd., Bangalore, donated a Video EEG machine (32 Channel Nicolet V 32 Model) to the Institute. This machine will be utilized for the monitoring of patients of the R. Madhavan Nayar Centre (RMNC) for Comprehensive Epilepsy Care
- ◆ PM Foundation, a philanthropic organization based in Kochi, Kerala, donated Rs 8 Lakhs in January 2018 for providing subsidy to economically backward patients
- ◆ The Dr T S Ravi Kumar Foundation, USA, donated Rs 7.75 Lakhs for enhancement of research and clinical activities at the Comprehensive Care Centre for Movement Disorders

REVENUE GENERATED BY THE INSTITUTE

- ◆ Revenue generated by the Institute during the current financial year was Rs 126.47 Crores, which constituted 79% of the grant-in-aid received from DST, excluding a special grant of Rs 45 Crores for construction of new Super-speciality Block
- ◆ The Institute has a balance of Rs 15 Crores under the Emergency Reserve Fund, which was created out of patient care income of previous years

FINANCIAL SUPPORT FROM DST FOR 2017-18

- ◆ **Total grant received - Rs 205.02 Crores (as against Rs 160.49 Crores for 2016-17)**
 - Revenue Grant: Rs 105.61 Crores
 - Capital Grant: Rs 54.41 Crores
 - Construction of new Super-speciality Block: Rs 45.00 Crores
- ◆ **Total Extramural Research Funding from all sources - Rs 28.05 Crores**

DST contribution:

 - TRC funding by DST - Rs 14.60 Crores
 - Funding for ad hoc Projects - Rs 1.15 Crores
- ◆ **In addition, an amount of Rs 10.06 Crores was directly credited to the account of CPWD from Ministry of Health & Family Welfare, Government of India, under the PMSSY Scheme for construction of the new Super-speciality Block**
- ◆ **Total Number of ongoing projects funded by DST - 13, out of which 5 were initiated during 2017-18**

The Institute places on record its deep sense of gratitude to the Department of Science and Technology for its unswerving support at all times



The Annual Convocation of the 33rd batch of SCTIMST was conducted on 15 May 2017. Hon'ble Union Minister for Health and Family Welfare, Shri Jagat Prakash Nadda, was Chief Guest and Dr Anil Kakodkar, Former Chairman, Atomic Energy Commission, was Guest of Honor.



The 2nd Technology Conclave was held during 15-16 May 2017. Hon'ble Union Minister for Health and Family Welfare, Shri Jagat Prakash Nadda, inaugurated the event in the presence of the Hon'ble State Minister for Health and Social Justice, Smt K K Shailaja Teacher, MP from Trivandrum, Dr Shashi Tharoor, MLA from Nemom Constituency, Shri O Rajagopal, President of the Institute, Shri K M Chandrasekhar and Director, Dr Asha Kishore. The Union Minister transferred several medical technologies developed by the Institute to various companies at the event.



Signing of the MoU with Kerala State Industrial Development Corporation on 8 December 2017 for setting up a Medical Devices Park in Trivandrum



Inauguration of 3D Bioprinting Facility on 23 September 2017



Inauguration of the New DSA Lab on 22 November 2017



The "Comprehensive Care Centre for Neurodevelopmental Disorders" was inaugurated by Shri Harish Engineer, Head, CSR Committee, Federal Bank Ltd. on 8 August 2017



Signing of the tripartite agreement for “Preclinical evaluation and commercialization of anti-snake venom, anti-hemotoxins and anti-neurotoxin”



Technology transfer of bioceramic graft products to M/s. Onyx Medicals Pvt. Ltd.



Technology transfer of Rapid Urinary Tract Infection diagnostic kit with antibiotic sensitivity test to M/s. Agappe Diagnostics Ltd.



Prof Unnikrishnan M received the Dr B C Roy Award under the category of “Eminent Medical Teacher”



Dr Lizzymol P P received the Nari Sakthi Puraskar 2017



A Workshop on “Introduction to Economic Analysis for Health Technology Assessment” was conducted from 8-13 May 2017, supported by the Department of Health Research, Government of India. The Workshop was inaugurated by Dr Soumya Swaminathan, Director General, ICMR, and Secretary, DHR.



Dr Asha Kishore, Director, SCTIMST, presented the activities of DST institutions under the Health Care Sector at the DST Conclave 2017, 2-3 May, Kolkata



100th GB and 51st IB commemoration event was held on 14 October 2017



Release of the Project Report on "Prevention and Control of Non-Communicable Diseases in Kerala" on 8 August 2017



The 6th Asian Biomaterials Congress, hosted by the Institute, was held in Thiruvananthapuram from 25-27 October 2017



The Institute participated in the India Medical Device Show 2018 held at Bangalore on 15-17 February 2018



Super EMG India 2018 was organized by the Department of Neurology during 23-25 March 2018



Clinical Care Leadership Training/ Administrative Capacity Building sessions with TATA Trusts initiated on 23-24 October 2017



Talk on “Future Directions in the Management of Intracranial Haemorrhage” by Prof Craig Anderson on 13 March 2018



AMC Seminar on “Challenges in achieving universal healthcare in South Africa” by Prof Helene Schiedner, University of Western Cape, on 18 August 2017



Swachhta Hi Seva Fortnight Campaign was observed from 16 September to 2 October 2017



Commemoration of 75th Anniversary of the Quit India Movement & Independence Day Celebrations on 15 August 2017



Republic Day Celebrations on 26 January 2018



National Science Day, 9 March 2018



International Yoga Day, 21 June 2017



Hindi Fortnight and Vigilance Awareness Week celebrations on 7 October 2017

HOSPITAL WING





HOSPITAL ADMINISTRATION

The annual statistics of hospital services for the year is displayed in Figures 1-7. During the year, various services in Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences & Interventional Radiology registered 18513 new patients. A total of 11875 patients were admitted for treatment, including surgical and interventional procedures. The new registrations and admissions are steadily

increasing every year. OPD services registered 177293 patients for review in various Departments, including Speciality Clinics. The number of patients reporting to the hospital for follow-up also increased considerably. The Institute provided free treatment to 1.9% of the patients and subsidized treatment to 44.01% based on socioeconomic background.

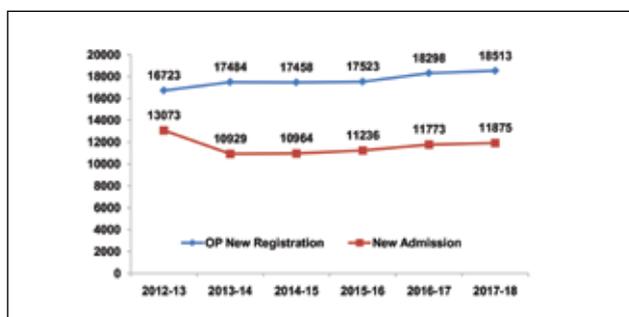


Figure 1. New registrations and admissions

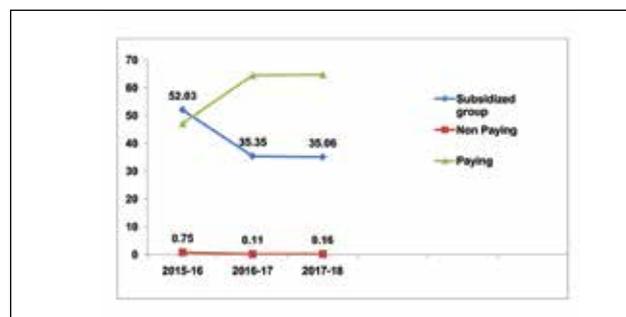


Figure 4. Paying, non-paying and subsidized group of outpatients

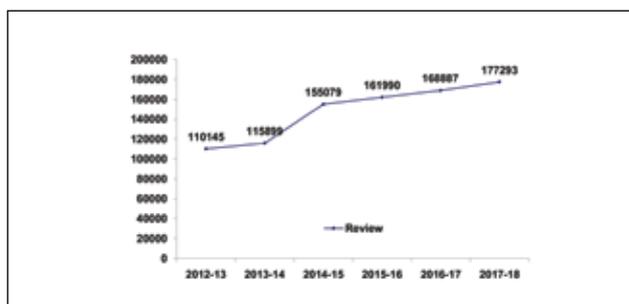


Figure 2. Patients attending Review Clinics

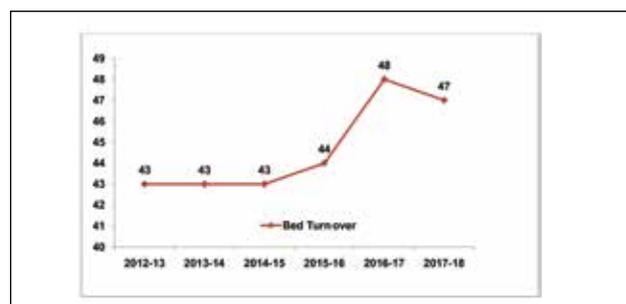


Figure 5. Bed turnover (Discharges per bed)

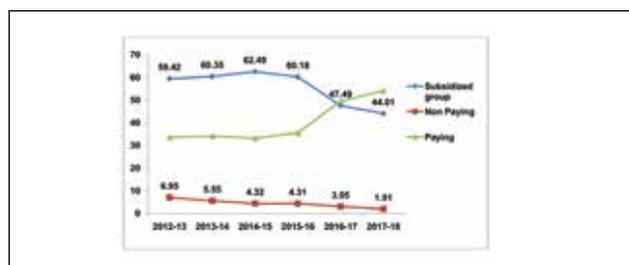


Figure 3. Paying, non-paying and subsidized group of inpatients

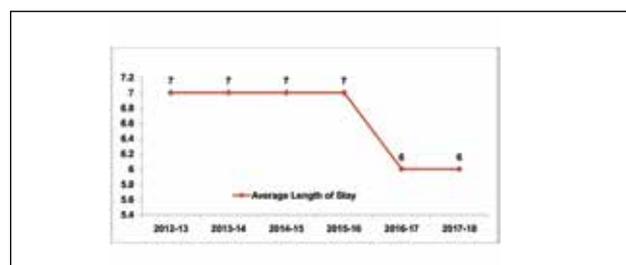


Figure 6. Average length of hospital stay

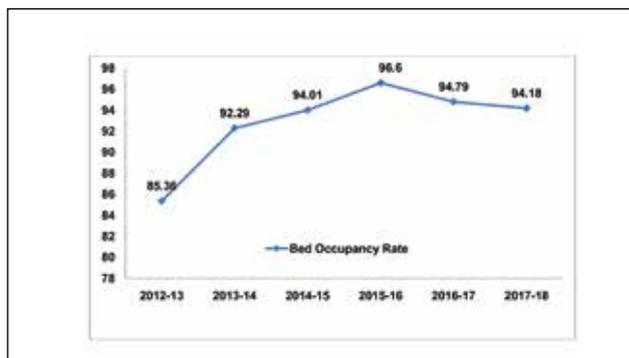


Figure 7. Bed occupancy rate

Activities

The number of patients who availed financial assistance under various schemes are summarized in the Table below:

Sl. No.	Scheme	No. of Patients	
		IP	OP
1	RBSK	2844	43513
2	CGHS	169	4703
3	Karunya	2628	0
4	CHIS PLUS	1850	0
5	Thalolam	386	0
6	Other Schemes	83	49
Total		7960	48265

Infrastructure improvement:

1. Comprehensive Care Centre for Neurodevelopmental Disorders in collaboration with National Institute of Speech and Hearing, Trivandrum, was inaugurated on 8 August 2017 by Sri Harish H Engineer, Head, CSR Committee, Federal Bank Ltd.
2. 2nd Digital Subtraction Angiography Laboratory for Interventional Radiology was inaugurated by the Director on 22 November 2017.
3. State Bank of India handed over Rs 23.50 Lakhs to the Institute on 12 March 2018 for procurement

of essential equipment required for patient care in the hospital.

During the year, two Hospital Infection Control Committee meetings were conducted and guidelines for different infection control activities were formulated.

Major equipment purchased during 2017-18 (above Rs 20 Lakhs)

Sl. No.	Equipment	Approximate cost (Rs)
1	Servo-I ventilator for neonatal to adult	47,10,000
2	Blood cell separator (Apheresis Machine)	24,67,768
3	Mobile operating Table	45,00,000
4	LED surgical OT light 600+400+400	22,51,000
5	Oracle database appliance – X6-2 HA	1,85,44,943
6	Sterrad-NX plasma sterilization system	30,00,000
7	Sterilizer plasma based, US-FDA approved	50,00,000
8	Head rest system (skull clamp)	20,00,000
9	Heartlung machine HL20 vario single	76,23,000
10	Rapid PCR machine	21,18,644
11	Portable color Doppler ultrasound scanner	21,00,000
12	Business PC HP 280 G2 small form factor	30,17,784
13	ICU ventilator for adult and paediatric use	38,31,000
14	Ultrasonic surgical aspirator	35,23,944
15	Anaesthesia machine	21,58,110
16	Storage SAN Hitachi VSP G200 for DC	1,68,39,372



17	Cisco hyperconverged system (HX2X0C-M4S)	47,54,731
18	Surgical operating microscope	1,47,87,050
19	Core switch cisco catalyst C6880-X	87,91,037
20	Transcranial magnetic stimulator	29,29,301
21	Philips EPIQ 7C echo cardiography system	96,27,760
22	Surgical operating microscope	2,87,74,800
23	128 channel long term video EEG system	22,70,450
24	Washer disinfectant (350 L)	28,86,554

New Initiatives

1. In line with the directions of the Government of India, the Institute switched over to “electronic payment mode” from 1 April 2017
2. The gymnasium, inaugurated by Sri Suresh Gopi, Hon’ble MP (RS), started functioning from 17 April 2017. The yoga classes continued.
3. Homograft Valve Bank and Telemedicine projects were institutionalized
4. Code Blue Project was initiated in the Institute on 19 May 2017 for the care of patients requiring cardiopulmonary resuscitation at SCTIMST and will be implemented in September 2018
5. Electronic Medical Records Documentation was implemented in Imaging Sciences and Interventional Radiology OPD from 12 July 2017
6. As part of “Ardran Mission” envisaged by the Government of Kerala to improve the appearance of the Medical College Campus, Trivandrum, the Institute joined hands with the Government Medical College, Trivandrum, for the implementation of “Poster-free Campus”
7. Barcoded waste collection system for biomedical waste management was implemented on 2 February 2018

Events organized

1. A talk on ‘Revised rules of Biomedical Waste Management’ was organized for hospital staff on 20 April 2017 at SCTIMST in co-ordination with Indian Medical Association Goes Ecofriendly (IMAGE), Trivandrum
2. Hand Hygiene Day was celebrated on 5 May 2017. A talk on “Fight Antibiotic Resistance, It’s In Your Hands” was delivered by Dr Aravind R, Professor & Head, Infectious Diseases, Government Medical College, Trivandrum, and a quiz competition on “Hand Hygiene Day” theme was conducted for the hospital staff and students.
3. The International Yoga Day 2017 was celebrated on 21 June 2017
4. Swachhta Hi Seva Fortnight Campaign was observed from 16 September 2017 to 2 October 2017. Several activities were carried out as part of the Campaign. Swachhta Pakhwada was also observed from 1 November 2017 to 15 November 2017.

Awards and Honours

Ms Padmaja Devi S S, Nursing Superintendent, received “Best Nurse Award 2017” by Trained Nurses Association of India, Kerala State Branch, during the 53rd TNAI State Annual Conference on 20 January 2018

Staff

Hospital Administration

Dr Kavita Raja, Medical Superintendent

Dr Rahul D Nambiar, Administrative Medical Officer

Ms Deepthi Bhaskar, Assistant Administrative Officer (OMS) - A

Physical Medicine

Dr Nandakumaran Nair U, Visiting Professor

Nursing Services

Ms Valsala Kumari C, Nursing Officer - A



Ms Padmaja Devi S S, Nursing Superintendent
Ms Thresiamma John, Senior Nursing Supervisor
Ms Gracyamma Bridget, Senior Nursing Supervisor
Ms Sara Sherly George, Senior Nursing Supervisor

Central Sterile Services Department

Ms Prasannakumari K, Chief Staff Nurse

Infection Control Unit & Biomedical Waste Management

Ms Shiny Biju, Infection Control Nurse

Construction Wing

Col (Rtd.) Vijayan Pillai K, Construction Engineer (Contract)

Usha O K, Junior Engineer (Civil) - A

Security & Safety

Mr Hemanth Kumar R P, Security & Safety Officer - A

Dietary

Ms Leena Thomas, Senior Dietician - B
Ms Jyothi Lekshmy S, Deputy Dietician - A

Laundry

Mr Umesh Sankar S, Laundry Supervisor - B

Medical Social Services

Ms Rosamma Manuel, Junior Scientific Officer & In-charge OPD & Patient Management Services

Dr Jiji T S, Medico Social Worker - A

Medical Records

Mr Thampi N G, Senior Medical Records Officer - B

Pharmacy

Ms Rosily Joseph, Chief Pharmacist

Transport

Mr Saji M S, Transport Supervisor



MEDICAL RECORDS DEPARTMENT

Medical Records Department continued to play a vital role in assisting academic and research activities, maintaining confidentiality of health information and contributed to the efficient management of hospital services.

Activities

1. Documentation and updation of socio-economic and personal data of patients, processing registrations and admissions, and maintenance of staggered appointment system
2. Analysis, deficiency check, ICD-coding and indexing of diseases, procedures and preservation of records
3. Providing study material and healthcare statistics for academic and research activities
4. Generation and circulation of hospital statistics to administrators and Departmental Heads periodically
5. Handling patient care-related correspondence and assisting teleconsultations
6. Processing and issue of various certificates, insurance claim and social security papers to patients
7. Online reporting of hospitalized overseas patients to Foreigner's Regional Registration Officer, and deaths to the Corporation of Thiruvananthapuram
8. Printing, storage and supply of all Medical Records forms
9. Conducting academic programme in Medical Records Science
10. Digitization of Medical Records and implementation of Electronic Medical Records.

The statistics for the year is summarized in the Table below:

Activity	No.
New Registrations	18513
Admissions	11875
Reviews	177293
Bed Occupancy Rate	94.18%

Bed Turnover Rate	47 discharges per bed
Average Length of Stay	6 days
Records released for study/research	3006
Certificates processed/issued	8565
Insurance Claims processed	414
Records Scanned and uploaded	59181
Electronic Medical Records processed	118949

Geographic Distribution of Patients

	Out Patient		In Patient	
Kerala	14861	80.3%	9652	81%
Tamil Nadu	2882	15.5%	1579	13.3%
Karnataka	36	0.2%	22	0.2%
Andra Pradesh	30	0.2%	24	0.2%
Maharashtra	47	0.3%	40	0.3%
Other states of India	594	3.2 %	549	4.6%
Outside India	63	0.3%	49	0.41%
Total	18513	100%	11915	100%

Staff

Mr Thampi N G, Senior Medical Records Officer-cum- Assistant PIO (Patient Care)

Mr Jesudin M Arul Radjvy, Medical Records Officer

Mr Varghese A M, Assistant Medical Records Officer

Ms Susan Jacob, Assistant Medical Records Officer

Ms Manna George, Assistant Medical Records Officer

Mr Christudas J, Medical Records Assistant - B

Ms Manju K K, Medical Records Assistant - B

Ms Asha Krishna R O, Medical Records Assistant - B

Ms Suma B, Medical Records Assistant - B

Ms Remya L T, Medical Records Assistant - A

Mr Ragesh D V, Medical Records Assistant - A

Ms Sandhya C K, Medical Records Assistant - A



DIVISION OF NURSING SERVICES

The Division ensures quality nursing care and provides patient education uniquely developed for our patients. Nursing service support was provided to operation theatres, intensive care units, wards and diagnostic and interventional laboratories of all departments. The team of dedicated nurses provided round-the-clock patient care.

Activities

1. 160 nurses were given CPR training
2. 40 nurses were given ambulance service training
3. All newly joined nurses were given extensive training covering all specialities and subspecialities. As part of orientation programme, a visit to BMT Wing was organized.
4. The Division trained about 140 postgraduate nursing students who came as observers from other institutions
5. All unit helpers and cleaning attendants were given training to enhance their performance and boost their morale. It incorporated counselling sessions by external experts.
6. The Staff and students participated in conferences and won prizes
7. The Staff visited the Old Age Home at

Pulayanarkotta, Thiruvananthapuram, on 28 September 2017, cleaned their premises and donated Rs 5000 for purchase of a fan.

Events organized

1. Cardiovascular and Thoracic Surgery Nursing: Clinical Updates at SCTIMST on 10 June 2017
2. COGNIZANT-'17: Neurosurgical Nursing at SCTIMST on 12 August 2017
3. Comprehensive Nursing Management of Stroke at SCTIMST on 29 October 2017
4. Nursing Management of Acute Heart Failure at SCTIMST on 21 January 2018
5. Single Ventricle Palliation in Congenital Heart Surgery- Nursing Updates at SCTIMST on 10 March 2018

Faculty

- Ms Valsalakumari C, Nursing Officer
 Ms Padmajadevi S S, Deputy Nursing Superintendent
 Ms Gracyamma Bridget , Senior Nursing Supervisor
 Ms Sara Sherly George, Senior Nursing Supervisor
 Ms Hepzibah Sella Rani J, Senior Nursing Supervisor



DEPARTMENT OF ANAESTHESIOLOGY

The Department of Anaesthesiology has two Divisions: Division of Neuroanaesthesia and Division of Cardiac anaesthesia.

DIVISION OF NEUROANAESTHESIA

The Division is involved in clinical, academic and research activities. It is mainly involved in the perioperative anaesthetic management of patients in Neurosurgery, Neurointervention suite, acute stroke and during various diagnostic procedures like MRI and CT scans. The Neuroanaesthesia team provides round-the-clock services in various neuro ICUs and is involved in the airway, ventilation and hemodynamic management of patients in the ICUs and in the conduct of various invasive procedures. The Division conducts OPD services (Pre-anaesthesia Clinic) every day.

The Academic activities of the Division include didactic lectures, clinical case discussions, journal clubs, and pro and con sessions. In addition, practical sessions on various airway gadgets, awake craniotomies, intraoperative echocardiography, intraoperative evoked potential monitoring, and transcranial Doppler are some of the highly specialized areas of teaching being conducted. Interactive academic sessions between allied neurospecialities are also conducted regularly.

Faculty and residents are actively involved in various research projects and present their research work at various national and international conferences regularly.

Activities

In 2017-18, the Division provided Neuroanaesthesia services to 1382 patients in the neurosurgery operation theater and 186 patients in the neuroradiology suite. In over 300 patients requiring MRI under general anesthesia/sedation, the procedures were completed successfully. In approximately 400 patients on ventilators, CT and MRI services were provided. Over

25 skin and muscle biopsies for various neurological disorders were performed under anaesthesia.

Home ventilatory therapy for patients requiring long-term mechanical ventilation as in neuromuscular diseases was ongoing and a significant number of patients were managed with home ventilation during the year.

Research Programmes

1. A project funded by the Institute for the development of flexible arm for ultrasound probe for central venous cannulation was undertaken. Dr Manikandan S was the PI and Mr Manoj G was the Co-PI of the project. The device will help in freeing the arms of the operator when inserting the central venous lines and will keep the ultrasound probe stable to improve the success rate of these procedures. The preliminary model of the device was made and further refinement was carried out.
2. A project on the “Development of autonomic function monitor for pain detection” was awarded internal funding of Rs 2.35 Lakhs. Dr S Manikandan and Mr Manoj G were the investigators in the project. Blueprint of the project was ready and the process of recruitment of staff for the project was underway.
3. Dr Ajay Prasad Hrishu received 5 Lakh rupees for the project ‘Code Blue implementation for hospital’.
4. The project: ‘Evaluation of temporal trends in coagulation profile in primary brain tumors in the perioperative period using thromboelastography’, funded by The Indian Society of Neuroanesthesia and Critical Care (ISNACC), was completed.

Events organized

The Division organized a one-day CME titled: ‘Neuroanesthesia and Intensive Care CME’ NICE 2017, which was held at Hotel Hycinth, Trivandrum, on 24 September 2017



Dr Sergio Bergese, Professor of Neuroanesthesia from Ohio State University, USA, visited the Division on 21 August 2017 and delivered a lecture on “Postoperative cognitive dysfunction”

Awards and Honours

Dr Karen Ruby Lionel, Resident, was awarded Best Poster Presentation in AIIMS Neuroanesthesia Update 2017 for her paper titled: “Oral pregabalin reduces pain in patients with acute subarachnoid hemorrhage” held at AIIMS, New Delhi, on 6-7 October 2017

DIVISION OF CARDIAC ANAESTHESIOLOGY

The Department provides cardiothoracic and vascular anaesthesia, and intensive care, and continues to focus on high-quality peri-procedural care. The Department also conducts quality resident training programmes in cardiothoracic and vascular anaesthesia, and promotes clinical and biomedical technology research. Another goal is to have structured initiatives like Anaesthesia Critical Care Programme, Comprehensive Heart Failure Programme, Minimally Invasive Cardiac Surgical Programme (in collaboration with Departments of Cardiothoracic Surgery and Cardiology), and acute pain services. Other initiatives include: Transesophageal Echocardiography (TEE) Laboratory for surgical patients, Fellowship Courses in TEE and Programme on Hybrid Procedures (in collaboration with Vascular Surgery and Interventional Radiology).

Activities

The routine activities are summarized in the Table below:

Surgery/Procedure	No.
Adult patients undergoing surgery in adult cardiac surgical operation theatre (open heart surgeries, closed heart & thoracic operations and vascular operations)	1351

Paediatric patients undergoing surgery in paediatric cardiac surgical operation theatre (open heart cases and closed heart cases)	695
Procedures in cardiac catheterization laboratory under general anaesthesia	550
Cardiac Magnetic Resonance Imaging under general anaesthesia	26
Cardiac CT/Aortogram/Pulmonary angiogram in CT suite under general anaesthesia/sedation & monitored anaesthesia	101
Anaesthesia in Digital Subtraction Angiography Laboratory (mostly for endovascular stenting of aortic aneurysm, embolization/stenting of blood vessels, embolization of broncho-pulmonary fistula)	9
Short procedures performed by anaesthetist in Intensive Care Units: Cardiac Medical ICU & Paediatric Surgical ICU	418
Percutaneous tracheostomies	26

The Department purchased an Anaesthesia Work Station costing Rs 17 Lakhs.

New Initiatives

1. Use of ultrasonography to provide paravertebral block (bilateral) during intra-operative and post-operative analgesia to paediatric patients undergoing open heart surgery
2. Use of routine lung ultrasound in post-operative paediatric cardiac surgery intensive care unit
3. Involvement of anaesthetists in the peri-procedural management of transcatheter aortic and pulmonary valve implantations performed by cardiologists

Awards and Honours

1. Dr Kirubanand received the Best Paper Award for: ‘Bedside lung ultrasound versus chest x-ray for the detection of lung pathology in adult cardiothoracic vascular patients’ at the 20th Annual National Conference of the Indian Association of Cardiovascular Thoracic Anesthesiologists (IACTA) on 16-19 February 2017 at Pune



2. Dr Kirubanand S received the 1st Prize in the Clinical Section for the presentation: 'Diagnostic value of bedside lung ultrasound as compared to bedside chest x-ray for the detection of postoperative lung conditions/complications in the adult cardiothoracic-vascular intensive care unit' at the Science Fete, SCTIMST on 15 July 2017
3. Drs Rupa Sreedhar and Unnikrishnan K P won the 1st Prize in the quiz competition, "Echo Jeopardy" conducted during the 2nd International and 11th National Transesophageal Echocardiography (TEE) Workshop-cum-CME on 25-27 August 2017 at Bengaluru
4. Dr Ankur Joshi received the 1st Prize for his poster: 'Off-pump Bi-directional Glenn shunt in a patient with incidental detection of abdominal aortic thrombosis: Role of perioperative transesophageal Echo' at the 12th Annual Perioperative and Critical Care Transesophageal Echocardiography Workshop on 23-25 February 2018 at Chandigarh
5. Dr Garre Sandeep received the 2nd Prize for his poster titled, 'Diagnosis of significant Tricuspid

Regurgitation (TR) post VSD closure using TEE', at the 12th Annual Perioperative and Critical Care Transesophageal Echocardiography Workshop on 23-25 February 2018 at Chandigarh

Faculty

- Dr Rupa Sreedhar, Professor and
Head of the Department
- Dr Thomas Koshy, Professor
- Dr Shrinivas V Gadhinglajkar, Professor
- Dr Prasanta Kumar Dash, Professor
- Dr S Manikandan, Professor
- Dr P R Suneel, Professor
- Dr K P Unnikrishnan, Professor
- Dr Subin Sukesan, Associate Professor
- Dr Smita V, Associate Professor
- Dr Ajay Prasad Hrishi, Assistant Professor
- Dr Unnikrishnan P, Assistant Professor
- Dr Ranganatha Praveen, Assistant Professor



DEPARTMENT OF BIOCHEMISTRY

The Department of Biochemistry comprises research laboratories and the Central Clinical Laboratory of the Institute. The Research is focussed on the molecular basis of disease processes affecting the vascular system, leading to neurological and cardiovascular disorders. The main areas under investigation are: a) identifying macromolecules involved in carbohydrate-dependent biological recognition events, including immune complex formation and elucidating the basis of their vascular inflammatory potential, b) study of dysfunctional and structurally-modified plasma high-density lipoproteins and their contribution to atherosclerotic-vascular diseases, c) the role of mitochondrial substrate utilization and autophagy in type 2 diabetic human heart, and d) mechanisms and regulation of amyloid-beta clearance by peripheral macrophages. The Central Clinical Laboratory undertakes the laboratory diagnostics of the Institute in biochemistry, hematology and clinical pathology.

Activities

Clinical

Fully automated state-of-the-art equipments used in this service include Dade-Behring/ Siemens RXL, Aspen A1c HPLC Analyzer LD 500, Mindray 5 part Hematology analyzer-BC 5180 & BC 5000, Gem Premier 3000-ABG analyzer, Cobas U 411 (Roche) urine analyzer and Amax (Germany) coagulation analyzer. The Central Clinical Laboratory performed a total of 937206 investigations during the year, which was marginally higher than the previous year. These investigations are listed in the Table below:

Investigation	No.
Arterial Blood Gas	17800
General Chemistry	404963
Hematology & Coagulation	365820
Clinical Pathology (CSF, Urine, Stool)	148403
Neurochemistry	30
Plasma Amino Acids	190
Total	937206

Research

Three research laboratories supervised by three faculty members trained a total of 9 PhD students at various stages of their PhD Programme. This included regular mandatory seminars, mid-course comprehensive examinations and PhD thesis preparation.

Research Programmes

1. Isolation and characterization of endogenous glycoconjugates recognized by plasma anti-carbohydrate antibodies

It was earlier reported from our laboratory that proteins rich in serine-and threonine-rich peptide sequences (STPS)-like lipoprotein interacted with anti-carbohydrate antibodies like anti-Gal and ABG. Since tau and α -synuclein are STPS-rich, we aimed to check binding of these proteins to anti-Gal and ABG. On purifying these anti-carbohydrate antibodies, 2 new albumin-binding glycoproteins of molecular weight 107kDa and 97kDa were identified. We showed that AOP1 and AOP2 exist in the form of a triplet as anti-Gal/ABG-AOP1/AOP2-albumin triplet and it is the STPS in AOP1 and AOP2 that is responsible for binding these anti-carbohydrate antibodies. About 36% of albumin is AOP1/AOP2 bound. Though reports show that albumin is amyloid β binding, we showed that it is not albumin but AOP1 and AOP2 using STPS that are responsible for amyloid β binding. We have shown that tau and α -synuclein bind anti-Gal and ABG to the sugar-binding site of the antibody. Triplets enter macrophages using the STPS-rich LRP receptors abundant in these cells. We found that triplets are associated with platelets and they bind to STPS-rich receptors present on platelet surface, making platelets more vulnerable to aggregation.

2. Modulation of tumor antigen-reactive anti-gal antibodies by lipoprotein(a) concentration and its effect on tumor susceptibility

Overexpression of Mucin1 (MUC1), a glycoprotein



with extensive O-linked glycosylation, is often associated with colon, breast, ovarian, lung and pancreatic cancers. Since the MUC1 antigen which in tumor conditions is also a ligand for anti-Gal antibodies, it was hypothesized that high specific activity anti-Gal seen in individuals with small size lipoprotein phenotype, Lp(a), could protect them against cancer. The present work focused on the recognition of MUC1 expression in breast tumor tissue by anti-Gal antibody in comparison to normal breast tissue. In addition, Lp(a) characterization and anti-Gal specific activity in breast cancer patients and normal subjects was also examined. It was observed that larger size Lp(a) phenotype along with lower specific activity of anti-Gal was present in breast tumor patients compared to controls, while specific activities of other anti-carbohydrate antibodies like anti-beta glucan antibody, dextran binding-immunoglobulin did not differ. Further, no stage-wise difference in Lp(a) concentration was found in breast cancer patients, whereas the level and specific activity of anti-Gal antibody increased with the stage of cancer. Another observation was that anti-Gal bound to MUC1 expressed on the surface of tumor cells but not on normal cells due to overexpression of hypoglycosylated MUC1 on tumor surfaces as evidenced by reduced jacalin reactivity and consequent increased exposure of serine-and threonine-rich peptide sequences that are ligands for anti-Gal. This binding of anti-Gal to MUC1, confirmed by immunohistochemistry, was also found to be increased with the tumor stage. In addition, it was also found that anti-Gal-MUC1 binding increased exponentially with specific activity of anti-Gal. In conclusion, large size Lp(a) and anti-Gal with low specific activity observed in breast cancer patients suggested the feasibility of developing therapeutic strategies aimed at cancer-specific immunopotentialization of individuals by vaccination with small Lp(a) or infusion of high specific activity anti-Gal.

3. Functional characterization of high-density lipoproteins in ischemic stroke

High-density lipoprotein (HDL) attracts

particular attention because, in contrast to low-density lipoproteins (LDL), many of its physiological functions influence the vascular system in favorable ways unless HDL is modified pathologically. Our recent studies identified dysfunctional HDL in patients with coronary artery disease which did not exert anti-atherogenic properties, including anti-oxidative, anti-inflammatory and reverse cholesterol transport activities. The atheroprotective function and the functional alteration of HDL depend on its protein and lipid composition. The major objective of the present project is to identify the anti-oxidant and anti-inflammatory functions of HDL derived from patients with ischemic stroke as well as in HDL subspecies.

4. Unaltered fatty acid uptake, utilization and mitochondrial respiration in right atrial appendage of type 2 diabetic human heart

Previous studies on diabetic human heart have shown decreased utilization of fatty acid (FA)/carbohydrate substrates. We hypothesized that increased mitochondrial dysfunction with concomitant decrease in fatty acid utilization would be found in diabetic hearts of patients from the Indian subcontinent that would explain their increased propensity for cardiovascular complications. We have compared mitochondrial respiration in atrial appendage tissue, obtained from non-diabetic and diabetic human subjects undergoing elective coronary artery bypass graft (CABG) surgery, using high-resolution respirometry with FA and carbohydrate substrate combinations. In the presence of FA, diabetic mitochondria showed unimpaired complex I and electron transferring flavoprotein (ETF)-mediated respiration, while, significantly lower oxygen consumption was noted when succinate was added, indicating the possible derangement of complex II respiration. Unlike other human studies, we report no significant reduction in FA-mediated mitochondrial respiration. However, the carbohydrate protocol indicated impairment of complex I mediated respiration. There was no significant change in the expression of OXPHOS



proteins. Unchanged levels of FA uptake proteins like CD36 and FABP, FA oxidation enzyme, long chain acyl CoA dehydrogenase (LCAD), regulators of FA metabolism like sirtuins and nuclear receptors, PPAR α and transcription coactivators, PGC1 α/β were observed in diabetic heart. The acetylation status of mitochondrial-specific proteins involved in fatty acid oxidation (acetylated LCAD and PGC1 α/β) also showed no significant changes. Diabetic patients showed equal expression of the antioxidant enzymes and other markers of oxidative stress. The unimpaired FA uptake, oxidation and mitochondrial respiration indicate absence of overt mitochondrial dysfunction in type 2 diabetic human heart.

5. Amyloid β clearance by macrophages: SHARPIN as a double-edged sword regulating inflammation and phagocytosis in Alzheimer's disease patients

Alzheimer's disease patient macrophages show decreased phagocytosis of A β and increased inflammation compared to, age-matched control samples. Using differentiated THP-1 cell lines, we showed that A β -induced oxidative stress could affect the phagocytic potential of macrophages and increase inflammatory mechanisms. The expression of SHARPIN, a regulator of the redox-sensitive transcription factor NF- κ B, was found to increase in response to A β -induced oxidative stress. Silencing of this protein was shown to have a significant effect on the expression of NLRP3, a major regulator of inflammatory cytokine production. Macrophage polarization itself was found to be controlled by SHARPIN, marked by the specific upregulation and downregulation of anti-inflammatory and pro-inflammatory markers, respectively. Further, expression of major A β receptors (SCARA1 and CD36) was found to be downregulated by SHARPIN silencing. However, the downregulation of the RAGE receptor, which shuttles A β from the cell to the exterior, could contribute to increased accumulation of A β inside the cell which could promote increased A β -degradation by the macrophages (Figure 8).

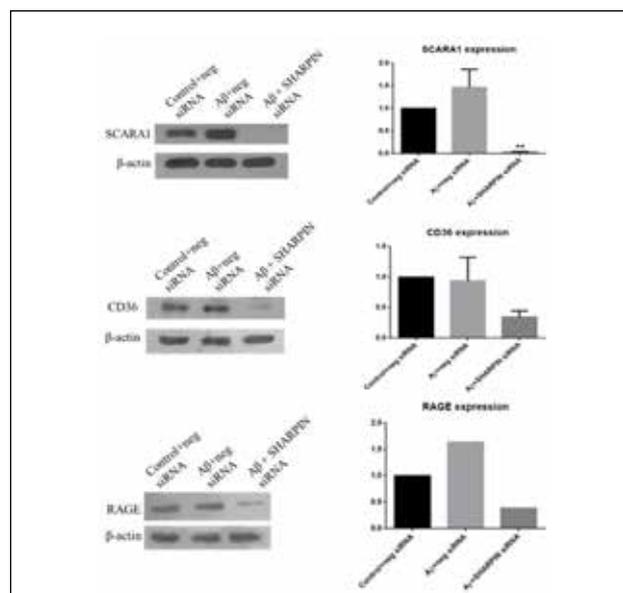


Figure 8. Effect of SHARPIN silencing on SCARA1, CD36 and RAGE receptors

Awards and Honours

- Ms Dhanyakrishnan, PhD student received the third prize for the paper titled "Amyloid-clearance by peripheral macrophages: SHARPIN as a double-edged sword regulating phagocytosis and inflammation in Alzheimer's disease", at the International Conference on Advances in Degenerative Diseases and Molecular Interventions (ADDMI 2017) on 23-24 November 2017 at Trivandrum
- Raji S R, PhD student, received the second prize for the paper titled "Altered cardiac autophagy and mitochondrial respiration in the offsprings of gestational diabetic rats" at the International Seminar on "Recent Biochemical Approaches in Therapeutics" on 23-25 January 2018 at Trivandrum

Faculty

Dr Appukuttan P S, Professor (Senior Grade) and Head of the Department (till 30.09.2017)

Dr Jayakumari N, Professor and Head of the Department (From 01.10.2017)

Dr Srinivas G, Scientist F

Dr Madhusoodanan U K, Assistant Professor



Technical

Mr Thomas T A, Scientific Officer (Lab)

Ms Jayasree K K, Scientific Officer (Lab)

Dr Geetha M, Junior Scientific Officer (Lab)

Mr Rajamohanan K, Junior Technical Officer (Lab)
(till 31.10.2017)

Mr Sajeevan Sagaram, Technical Assistant (Lab) - A
(till 30.11.2017)

Ms Vijayalekshmi L, Junior Technical Officer (Lab)

Mr Radhakrishnan B, Junior Technical Officer (Lab)

Mr Sreenivas N C, Junior Technical Officer (Lab)

Ms Sumitha K C, Technical Assistant (Lab) - B

Mr Santhosh Kumar R, Technical Assistant (Lab) - A

Ms Sheeja M, Technical Assistant (Lab) - A

Ms Sreedevi V S, Technical Assistant (Lab) - A

Dr Deepa D, Technical Assistant (Lab) - A

Ms Sreekala Balan P, Technical Assistant (Lab) - A

Ms Manju G Nair, Technical Assistant (Lab) - A

Ms Divya T Nair, Technical Assistant (Lab) - A

Mr Siju K S, Technical Assistant (Lab) - A



DEPARTMENT OF CARDIOLOGY

The Department of Cardiology provides high quality patient care, along with research and academic programmes. The training programmes include: DM Cardiology, Post DM Fellowship and Post graduate DCLT with 6 DM trainees, 2 Fellows and 3 Cath Lab technical trainees. During 2017-18, the Department conducted various Workshops, initiated new research programmes, and published in many international journals. There was emphasis on training and further advancement of the three subspecialties within the Department. The subspecialties include: Adult Cardiology and Interventions, Electrophysiology and Pediatric Cardiology.

ADULT CARDIOLOGY AND INTERVENTIONS

The focus of the Division this year was to establish the percutaneous valve replacement procedure in this part of the world. The TAVR (Transcatheter Aortic Valve Replacement) programme was successfully initiated with both the balloon-expandable and the self-expandable valves. The Percutaneous Pulmonary Valve Implantation Programme was also started during the year. These valve replacement programmes are new to the country. We are also part of new indigenous device development trials like – MyVal – the indigenous TAVR system.

The Division performed about 800 coronary interventions during the year, thereby maintaining its position as a major coronary interventional Centre. Complex coronary interventions such as left main interventions and rotablations were routinely performed in the Division. Coronary interventions were guided by state-of-the-art technologies like IVUS – Intravascular Ultrasound, OCT - Optical Coherence Tomography and FFR – Fractional Flow Reserve estimations. Instantaneous wave-free ratio, a new method to assess the coronary flow reserve, was initiated. Structural heart disease interventions like device closure of para valvular leaks, stenting of aortic coarctation and percutaneous closure of congenital and acquired defects like Ruptured Sinus of Valsalva (RSOV) were performed. We continued to be a

large volume Centre for balloon mitral valvotomy, performing more than 100 cases per year.

Adult interventions during the year:

Procedures	No.
Coronary angioplasty	705
Coronary angiogram	1436
Cardiac catheterization	44
Balloon Mitral Valvotomy	73
Transcatheter aortic valve implantation	5
Transcutaneous pulmonary valve implantation	2
RSOV Device closures	2
Device closure of valve leaks	2
Alcohol septal ablation	3
Pericardial aspiration	5
Endomyocardial biopsy	1
Aortic aneurysm to left atrium fistula device closure	1
Total	2279

CARDIAC ELECTROPHYSIOLOGY

The Division is one of the largest interventional electrophysiology Centres in the country for management of cardiac arrhythmias. The Division performed more than 350 ablations and electrophysiology procedures and close to 300 device implantations (including ICDs and cardiac resynchronization devices) during the year. The 3D electro anatomical mapping systems, CARTO and Ensite Velocity were used to aid complex ablation procedures. It was gratifying that the Asia Pacific Heart Rhythm Society (APHRS), in its monthly newsletter last year, detailed the activities of the Division as an example of the state-of-the art services in developing countries. A new dedicated EP Cath Lab with EP and Echo navigation along with 3D fluoroscopy was being installed.



Electrophysiology procedures during the year:

Procedures	No.
3D electro anatomical mapping and ablation:	106
Atrial tachycardia and flutter	45
Ventricular tachycardia – outflow tracts	25
Ventricular tachycardia – Fascicular VT	10
Ventricular tachycardia – Scar-related	8
Ventricular tachycardia – Others	18
Conventional mapping and ablation:	171
Ablation of SVT – AVNRT	104
Ablation of SVT – AVRT	67
Device implantation procedures:	318
CRT	30
ICD	52
Pacemakers and others	236
Total	595

Pediatric Cardiology

The Pediatric Cardiology Division continued to provide services to the entire spectrum of patients with congenital heart diseases from fetus to adult. Fetal medicine services included fetal echocardiography, and follow-up of high-risk fetuses with structural heart diseases and cardiac dysrhythmias. ASD device closure under transesophageal echocardiographic guidance and PDA device closure under transthoracic echocardiographic guidance pioneered in the Department, considerably reduced the radiation exposure to patients and healthcare providers.

The Division continued its programme in complex cardiac interventions including VSD device closure, RSOV closure, and coarctation stenting. Hybrid and postoperative cardiac interventions done included: hybrid VSD closure, hybrid Norwood palliation, Blalock-Taussig shunt stenting, balloon dilatation of stenotic pulmonary arteries and veins. Percutaneous Pulmonary Valve Replacement Programme was initiated during the year and two cases were performed.

The Division, along with Congenital Heart Surgery Division of the Department of Cardiac Surgery, serves as the Nodal Centre for the Hridayam Programme of the Government of Kerala to support children with congenital heart diseases. Infant Neonate Clinic streamlined preoperative management of sick infants with congenital heart diseases. The focus shifted to comprehensive rehabilitation of children with critical congenital heart diseases with the launch of a pilot study to evaluate the cardiac and neurodevelopmental outcomes of children who underwent arterial switch operation for transposition of the great arteries.

Pediatric Cardiology procedures during the year:

Procedure	No.
Device closure of Atrial Septal Defect (ASD DC)	168
Device closure of Ventricular Septal Defect (VSD DC)	7
Device closure of Patent Ductus Arteriosus (PDA DC)	115
Balloon Pulmonary Valvotomy (BPV)	33
Balloon Aortic Valvotomy (BAV)	10
Balloon Atrial Septostomy (BAS)	29
Balloon dilatation of Coarctation of Aorta (BCoA)	6
Patent Ductus Arteriosus stenting (PDA stenting)	11
Balloon Mitral Valvotomy (juvenile BMV)	2
Coarctation stenting	5
Pulmonary artery angioplasty (balloon/stent)	6
Coiling of aorto-pulmonary collateral	2
Pulmonary vein interventions	2
BT shunt stenting	1
Abernethy malformation intervention	1
PFO device closure	1
AP window device closure	1
Cardiac catheterization	134
Total	534



New Initiatives

1. TAVR Programme

The Department started the latest addition to percutaneous interventions – Transcatheter Aortic Valve Replacement (TAVR). Five proctored cases of TAVR were done during 2017-18. We were also part of the indigenous percutaneous valve development, Myval by an Indian firm and a trial was underway.

2. Percutaneous Pulmonary Valve Replacement Programme

The Programme was started and two implantations were carried out during the year.

3. Training in Balloon Mitral Valvotomy for overseas faculty

Dr Darwin Jeyaraj, Interventional Cardiologist, Freeman Hospitals, Joplin, USA, visited the Department and got training in Balloon Mitral Valvotomy for a period of two weeks.

4. Instantaneous Wave-Free Ratio

The use of next-generation coronary physiology assessment tool was started. This technique uses unique software to calculate the instantaneous wave-free ratio. This precludes the use of adenosine in coronary physiology assessment.

5. Training in Pediatric Cardiology for Nurses

The Department provided three months of observership training in pediatric cardiac catheterization and interventions in the Cath Lab to three cardiac nurses from SAT Hospital, Government Medical College, Thiruvananthapuram.

6. 3D Ventricular Tachycardia Ablation Programme

The ablation of ischemia-related VT was been established. It is done under 3D mapping with the Ensite, Carto mapping systems. The Department started performing VT ablation by epicardial approach in select cases.

7. Tachy/Brady Device Implantation

Newer versions of the LV epicardial screw-in leads were evaluated and found successful.

Events organized

1. “Back to Basics” - A simulator-based coronary intervention training programme was conducted on 20-21 January 2018 at SCTIMST.
2. A Continuing Nursing Education Programme in Acute Heart Failure was held on 20 January 2018 at SCTIMST.
3. A Pediatric Cardiology and Cardiac Surgery Workshop was jointly organized by the Departments of Cardiology and Cardiac Surgery, SCTIMST, in association with Children’s Heart Link between 22- 27 January 2018.

Awards and Honours

1. Dr Ajitkumar V K continued to serve as a Member of Biotechnology Industry Research Council, Ministry of Science & Technology, Government of India
2. Dr Ajitkumar V K was elected President Elect, Society for Coronary Imaging
3. Dr Ajitkumar V K was selected as Editorial Board Member for the journals, The Cardiologist, Jomard Publishers, Germany, and Madridge Journal of Cardiology
4. Dr Ajitkumar V K continued as Editorial Board Member of Indian Pacing & Electrophysiology Journal
5. Dr Ajitkumar V K was selected as Member of the Academic Committee, Technology Transfer Committee, and Technology Research Committee, SCTIMST
6. Dr Sivasankaran S was invited as Member of the expert committee for developing algorithm for guideline-based management of hypertension for the State of Kerala
7. Dr Sivasankaran S was invited by the Department of Health, Government of Kerala to be a Member of the expert committee to provide the recommendations to set targets for non-communicable disease control as a part of the United Nations Sustainable Development Goal 2030



8. Dr Harikrishnan S delivered the Prof J P Das Heart Failure Oration of the Indian College of Cardiology, 'Heart Failure in India: Problems and Prospects' on 15 September 2017 at Bhubaneswar
9. Dr Harikrishnan S was selected as the Chief Co-ordinator of the Committee to prepare the Cardiological Society of India Position Statement for the Management of Heart Failure in India
10. Dr Narayanan Namboodiri continued to serve as Honorary Editor-in-Chief of the Indian Pacing and Electrophysiology journal
11. Dr Narayanan Namboodiri continued to serve as Subcommittee Member of the Guidelines and Writing Group, Asia Pacific Heart Rhythm Society
12. Dr Narayanan Namboodiri was invited to be a Member of Scientific Publications and Document Writing Committee for the Clinical Practice Document on Catheter Ablation of Ventricular Arrhythmias by the Heart Rhythm Society, the International Organization for Cardiac Electrophysiology
13. Dr Narayanan Namboodiri was invited to be a Member of Scientific Publications and Document Writing Committee for 'Arrhythmic risk in neuromuscular disorders' by the Heart Rhythm Society, the International Organization for Cardiac Electrophysiology
14. Dr Narayanan Namboodiri continued as Vice-president of the Kerala Heart Rhythm Society
15. Dr Bijulal S was Invited Member of DSMB of the European Clinical Trial "Thin Strut Sirolimus-eluting Stent in All Comers Population vs. Everolimus-eluting Stent (TALENT trial)" conducted by Cardialysis
16. Dr Abhilash S P was elected Chief Editor of Kerala Journal of Cardiology, the official publication of the Indian College of Cardiology, Kerala Chapter

Faculty

- Dr Ajit Kumar V K, Professor and Head of the Department
- Dr Sivasankaran S, Professor
- Dr Krishna Moorthy K M, Professor
- Dr Harikrishnan S, Professor
- Dr Narayanan Namboodiri K K, Professor
- Dr Bijulal S, Additional Professor
- Dr Sanjay G, Additional Professor
- Dr Abhilash S P, Associate Professor
- Dr Krishna Kumar M, Assistant Professor
- Dr Deepa S Kumar, Assistant Professor
- Dr Arun Gopalakrishnan, Assistant Professor

Technical

- Mr Suji K, Scientific Officer
- Mr Subrahmoniam H R, Junior Technical Officer
- Ms Resmy P V, Technical Assistant - B
- Ms Sheeja S, Technical Assistant - A
- Ms Sethu Parvathy, Technical Assistant - A
- Ms Rasmi Mohan, Technical Assistant - A
- Mr Midhun S V, Technical Assistant - A
- Ms Princy, Technical Assistant - A



DEPARTMENT OF CARDIOVASCULAR & THORACIC SURGERY

The Department functions as three Divisions – Adult Cardiac, Paediatric Cardiac and Thoracic–Vascular. The Adult Cardiac Surgical Division performed complex cardiac surgeries along with minimally-invasive procedures and complex valve repair procedures. The Division of Pediatric Cardiac Surgery continued its neonatal and infant complex surgical programmes. The quality of treatment offered by the Division was highlighted by the successful correction of complex congenital heart disease in an infant from Bangladesh. As part of the prestigious Heart Link Initiative, the Heart Team from Children’s Hospital Kansas, USA, visited the Unit and spent a week with the Heart Team of our Institute (Figure 9). The Extra Corporeal Membrane Oxygenation (ECMO) system was successfully used in a patient. Nitric oxide delivery system (Figure 10) was also introduced and successfully used in one neonate with obstructed total anomalous pulmonary venous connection. The endovascular aneurysm programme with 13 cases continues to be one of the largest in the country.

Activities

During the year, 2166 cardiovascular and thoracic operations were performed, of which 1485 were open-heart procedures. The details are furnished below:

I. Adult Cardiac Operations:

Open Heart - 1085

They included:

1. Coronary artery bypass surgery – On pump and Off pump
2. Mitral valve repair surgery – Simple and Complex
3. Valve replacement surgery – Mitral , Aortic and Double
4. Ascending aortic and root aneurysm repair operation
5. Adult congenital heart disease

II. Thoracic and Vascular Procedures:

1. Total Major Vascular Procedures: 202
2. Thoracic procedures: 32
3. AV Access procedures: 195
4. Emergency surgeries: 25

III. Congenital Heart Surgeries:

Major procedures: 599

They included:

1. TGA operations - Switch and Sennings
2. Norwood operation for HLHS including hybrid Norwood
3. Surgeries for TOF
4. VSD, ASD closures
5. ICR for AV Canal Defects
6. Rastelli operation
7. Single ventricular repair procedures like Glenn and Fontan
8. Neonatal Arch Repair
9. Truncus repair
10. Hybrid procedures - Hybrid VSD closure, Hybrid PA stenting
11. Half Turn Truncal Switch

Minor procedures: 164

Awards and Honours

1. Dr Vivek V Pillai received the AATS Foundation Travel Award
2. The article, ‘Still ticking successfully - Bentall operation with handmade conduit using TTK-Chitra valve–Mid term analysis,’ by S Veerbhadrhan, V T Panicker, V V Pillai, J Karunakaran in the Indian Journal of Thoracic and Cardiovascular Surgery in February 2017 received the best original article award in IJTCS for 2017



Events organized

The Department conducted a CME on Congenital Heart Disease on 26 January 2018.

Faculty

Dr K Jayakumar, Professor (Senior Grade) and Head of the Department

Dr Baiju S Dharan, Professor

Dr Vivek V Pillai, Additional Professor

Dr Varghese T Panicker, Additional Professor

Dr Sreekumar R C, Additional Professor

Dr Sabarinath Menon, Associate Professor

Dr Bineesh K R, Assistant Professor

Dr Sudip Dutta Barua, Assistant Professor

Dr Sowmya Remanan, Assistant Professor

Technical

Ms Beegum Thaslim

Ms Maya L

Mr Sujith V M

Mr Don Sebastian

Mr Shanu P S

Mr Rijesh

Mr Sujesh S

Transplant Co-ordinator

Ms Beena B Pillai



Figure 9. Heart Link initiative and visit by “Heart Team” from Children’s Heart Hospital, Kansas, USA

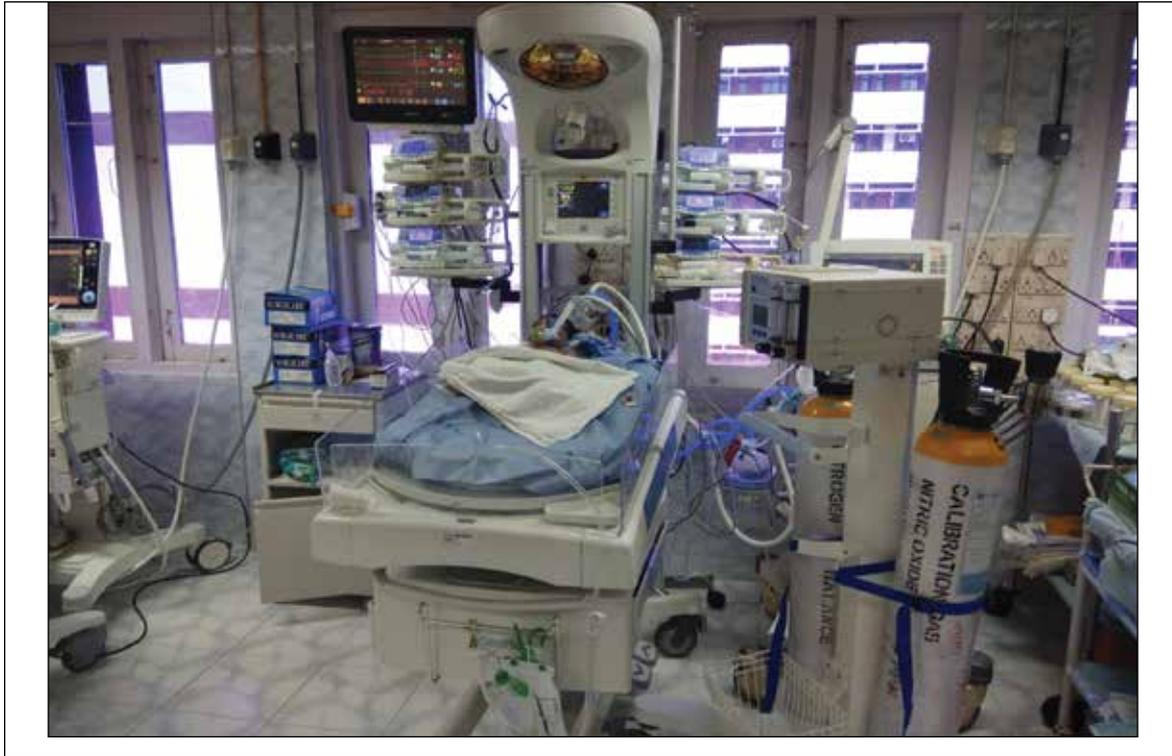


Figure 10. Nitric oxide delivery system successfully used in a neonate following obstructed TAPVC repair



DIVISION OF CLINICAL ENGINEERING

The Mission of the Division is to provide timely and cost-effective quality service to clinicians by supporting all aspects of patient care-related technology in a professional and responsible manner. Our dedicated engineering team ensures smooth functioning of the electrical, electronic and mechanical equipment of the Institute. The Division is also involved in technology assessment and acquisition, equipment life cycle cost analysis, upgrades and replacement planning, and resource optimization.

Activities

The Division ensured proper equipment management by promoting the use of standard-based approach for safer, more efficient and high quality management of all medical equipment. To ensure safe and effective treatment of patients, DCE took part in selecting suitable equipment to support the services of the Institute and organized teaching and training programmes on medical equipment to Staff. The Division also assessed the need for regular technical support for medical equipment and devised strategies for appropriate calibration, inspection, maintenance and repair services to ensure the safety and reliability of medical equipment.

Clinical Engineers in the role of medical technology experts performed many activities that were directly involved in the various stages of equipment lifecycle such as pre-purchase evaluation, equipment recommendation, purchase assistance service, equipment inspection and servicing, contract management, user training, regular maintenance, performance testing and calibration.

Major installations

The Division was responsible for ensuring proper installation of equipment and accessories worth more than 8 Crores. Some of the major equipment installed during the year were:

- 35 TR VRV system
- 3 LED operating lights at cardiac and new operation theatre
- Accessories for the DSA Cath Lab
- Operating theatre table
- Nitric oxide delivery system for pediatric surgery
- Blood cell separators
- 3 ICU ventilators
- Sophisticated anaesthesia work station
- 60 computers and associated software for a Public Health project
- Tissue embedding station
- C-Mac video laryngoscope system
- Two plasma sterilizers
- PCR thermal cyclers

Events organized

“HEATS” (Hospital Equipment Awareness Training Series) for imparting advanced technical training on various medical equipment is ongoing since 2013. This year DCE organized 7 Workshops as summarized below:

HEATS-23	Esaote Portable Ultrasound System - Mylab Alpha With eHD Technologies	17 May 2017
HEATS-24	Intra-Operative Doppler	13 September 2017
HEATS-25	Computerized Maintenance Management System	27 September 2017
HEATS-26	Esaote, Portable Echo Machine	4 December 2017
HEATS-27	MASIMO, Rad 5v Pulse Oximeter	5 December 2017



HEATS-28	SLE 3600 INOSYS, Inhaled Nitric Oxide System, Calibration	5 March 2018
HEATS-29	Drager Ventilator, Device Check procedure	9 March 2018

Staff

Mr Koruthu P Varughese, Engineer G and Acting Head of the Division (till 30.11.2017)

Manoj G S, Engineer C and Head of the Division, In-charge (from 01.12.2017)

Mr Anoop Jose, Engineer C

Mr Vishal V P, Engineer B

Mr Ganesh P, Junior Engineer (Electrical)



DIVISION OF CELLULAR AND MOLECULAR CARDIOLOGY

The Division aims at carrying out basic and translational research in the domain of cardiovascular biology. Currently, the focus is on molecular mechanisms of pathological myocardial remodelling. The long-term goal is to identify strategies to prevent or delay the initiation and progression of heart failure. A combination of cell culture and animal models of human disease is employed to achieve these clinically-relevant goals.

Guiding students for PhD is a major academic activity here. One student was awarded PhD and another submitted the PhD thesis. Extramural grants from different central funding agencies provided support for sustaining the research activities.

Research Programmes

1. Molecular mechanisms in cardiac fibroblast growth

In response to myocardial injury, quiescent cardiac fibroblasts phenotypically transform into myofibroblasts that proliferate, produce collagen and promote tissue repair and remodelling. However, active myofibroblasts resist apoptosis and persist in the scar indefinitely, promoting excessive collagen deposition, myocardial stiffness and reduced ventricular compliance. Delineation of mechanisms that regulate these aspects of cardiac fibroblast growth – phenotypic transformation, cell proliferation, collagen production and apoptosis resistance is therefore important for understanding the mechanistic basis of myocardial fibrosis and left ventricular dysfunction associated with many disease states. This laboratory has, over the years, been engaged with these aspects of cardiac fibroblast biology.

Extending our past work, investigations during the year generated conclusive evidence of the centrality of Discoidin Domain Receptor 2 (DDR2), a fibroblast-specific collagen receptor tyrosine kinase, in regulating these key aspects of cardiac fibroblast growth – phenotypic transformation, cell

proliferation, collagen production and apoptosis resistance. Using gene knockdown and knock-in approaches, it was demonstrated for the first time that a cross-talk between DDR2 and Integrin-1, the two major collagen receptors, is a key determinant of cardiac fibroblast activation and activity. The involvement of DDR2 in cell survival under conditions of ambient stress and cell cycle progression, and delineation of the underlying mechanisms, were other substantial achievements during the year. Together, the findings indicate that DDR2 is a critical determinant of cardiac fibroblast function and, hence, cardiac fibrosis following myocardial injury.

Further, in collaboration with the NIH, we demonstrated the obligate role of DDR2 in collagen gene expression in vascular cells and, importantly, in arterial fibrosis and remodelling in a non-human primate model of metabolic syndrome. The observations underscore the critical role of DDR2 in arterial stiffness associated with conditions such as hypertension and atherosclerosis and, obviously, are of immense clinical relevance.

The specific localization of DDR2 on cells of mesenchymal origin, such as cardiac and vascular fibroblasts and vascular smooth muscle cells, and its regulatory role in collagen gene expression in these cells, identify it as a potential drug target in the control of cardiovascular fibrosis.

Gratifyingly, in a Report in Circulation Research, a prestigious journal of the American Heart Association, our work on DDR2 was placed at the top of a list of 10 cardiovascular research projects with translational value being carried out in India.

2. Anti-oxidant, tempol, prevents cardiac remodelling in Spontaneously Hypertensive Rat along with prevention of cardiac remodelling

Cardiac remodelling in chronic pressure overload hypertrophy is accompanied by oxidative stress. Myocardial oxidative stress was observed



in Spontaneously Hypertensive Rat (SHR). Assessment of stem cell attributes in SHR showed deterioration in stem cell number and function along with enhanced redox status. Considerable increase in the ROS levels of cardiac stem cells (CSCs) is possibly the consequence of the adverse microenvironment associated with hypertensive heart disease. Proportion of senescent cells was also higher in SHR along with enhanced expression of senescent proteins, p16INK4a and p21. Comet assay established severe DNA damage in CSCs from SHR. Telomere length correlates with cellular longevity. Loss of TERT mRNA was concordant with decreased telomerase activity in SHR.

As cardiac remodelling is associated with oxidative stress, the effect of antioxidant supplementation on stem cell attributes was examined. Tempol, a superoxide dismutase mimetic, was administered to 6-month old male SHR to evaluate the modulation of stem cell characteristics on reduction of oxidative stress. Reduction of oxidative stress was observed on treatment with Tempol. The treatment caused reduction in blood pressure and left ventricular mass along with improved left ventricular function (Figure 11). The treatment also improved the migration potential, proliferative capacity, TERT expression, telomerase activity, cellular senescence and proportion of c-kit⁺ cells in SHR. Considering the vital role of CSCs in maintaining a healthy myocardium, the decrease in functionally-efficient CSCs appears to be a precipitating factor in the transition from adaptive remodelling to cardiac decompensation in SHR. Restoration of stem cell efficiency by reduction of oxidative stress highlights the importance of maintaining a healthy microenvironment and preservation of stem cell homeostasis for prevention of progressive cardiac remodelling leading to cardiac failure.

3. Modulation of cardiac stem cell characteristics by metoprolol in hypertensive heart disease

Cardiac stem cells play a vital role in cardiac remodelling. Maintenance of a healthy stem cell population is essential for prevention of progressive cardiac remodelling. All anti-hypertensive drugs do not have a positive effect on the heart. Some of

the anti-hypertensive drugs are cardioprotective. However, their effect on CSCs has not been investigated. Metoprolol is a cardioprotective anti-hypertensive agent. To examine whether metoprolol can prevent deterioration in the efficiency of CSCs, SHR were treated with the drug and its effect on stem cell function was evaluated.

Six-month-old male SHR were treated with metoprolol for 2 months. The effectiveness of the treatment in reduction of blood pressure and regression of hypertrophy was ensured and the animals were sacrificed. Cardiac stem cells were isolated from the atrial tissue and the effect of metoprolol on stem cell migration, proliferation, differentiation and survival was evaluated by comparison with untreated SHR and normotensive Wistar rats. Treatment with metoprolol reduced cellular senescence and increased cell migration and proliferation potential, along with retention of stemness of CSCs in SHR. Oxidative stress in CSCs was also reduced. Stem cell attributes were comparable to Wistar rat on treatment with metoprolol. Restoration of stem cell efficiency, possibly mediated by reduction of oxidative stress, may prevent hypertension-induced progressive cardiac remodelling.

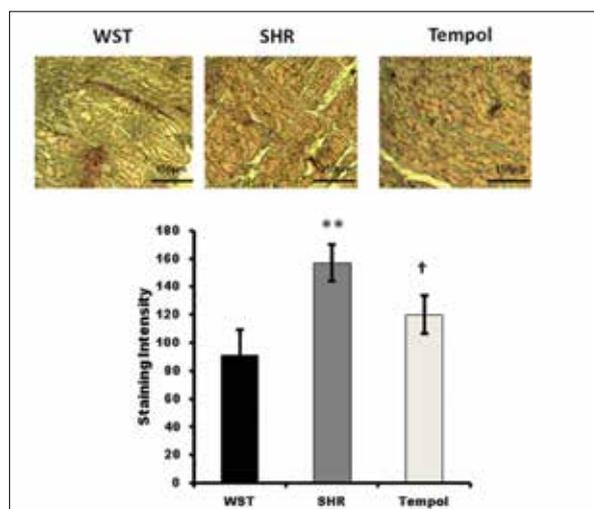


Figure 11. Effect of Tempol (20mg/kg/day for 2 weeks) on myocardial 3-nitrotyrosine levels in SHR determined by immunohistochemistry.

Data presented are mean ± SD of staining intensity. Variation was analyzed by ANOVA followed by t-test. **p<0.01 SHR Vs WST; † p<0.01 SHR Vs Tempol. One way ANOVA p<0.01 (n=6).



Faculty

Dr R Renuka Nair, Scientist G (Senior Grade) and Head of the Division (till 30.08.2017)

Dr K Shivakumar, Scientist G and Head of the Division (from 01.09.2017)

Dr Neethu Mohan, Scientist D (from 01.09.2017)

Technical

Ms Remani K. Junior Technical Officer (Laboratory)

Ms Hima V M, Technical Assistant Lab - A (since 12.07.2017)



COMPUTER DIVISION

Activities

1. Software maintenance, updations and new forms, and report development
2. Website (Intranet, Internet) maintenance, site updates and new development
3. Network management, maintenance and new cabling work
4. Tuning, backup and maintenance of high-end Servers (18)
5. Tender publishing and online recruitment of staff and students
6. Updation and maintenance of all Portals (Blood Donor, Vendor, Pension, CSC, patient), DSpace, e-learning etc.
7. OMR evaluation, form changes for staff recruitment and academic admissions
8. Report generation for Auditors, IT Committee, DST etc.
9. Hardware and software maintenance of servers, storage, PCs, routers, switches, scanners, printers etc. with a remarkable uptime of 99.98% (Total 1370 devices)
10. Data backup, maintenance of data and network security
11. Monitoring e-payment status
12. Monitoring of medical equipment integrated to Electronic Medical Records (EMR)
13. Training for staff and students
14. General help to staff and students on IT-related issues

Major equipment purchased during the year:

Sl. No	Equipment	Approximate cost
1	Business PC HP 280 SFF - 60	USD 46200
2	Licenses for Microsoft Windows 10, Microsoft Project, Server 2016	Rs 1191578
3	Oracle Appliance and Oracle 12c License	Rs 18544943

New Initiatives

1. Project implementation related to the Grant received from the Union Ministry of Electronics and Information Technology for infrastructure upgradation
2. Electronic Medical Records for new and review patients in Radiology OPD
3. Module for 7th pay fixation and arrears calculation for non-academic staff and pensioners
4. SMS encryption service, sign and verify for XML files
5. Online applications for Science Fete with data upload
6. Online applications for SCTIMST Compendium with document upload and view option for DST
7. Governing Body/Institute Body online meeting software and mobile app to view agenda, meeting approval, minutes preparation, view of old minutes etc.
8. e-Gate pass system for BMT Wing
9. New websites created for IPC and TRC
10. Installation of: new PC (60) in all patient care areas, dual side laser printers (12), ID card printers (2), thermal printers (3), document scanners (3), Oracle Appliance and upgradation of Oracle database to 12c, Gateway Security Appliance under high availability and SPSS software version 25



11. Tender processing, order placement and work initiated for building a Mini Data Centre
12. Tender processing and order placement were completed for purchase of servers, storage and networking
13. Reconfiguration of Telemedicine set-up for video conferencing and patient e-consultation
14. Tenders prepared and floated for PACS upgradation for Radiology and Cardiology, Mobile Clinical Assistant, and Payment Kiosk and Surveillance

Staff

Dr Geetha G, Scientist G and Head of the Division

Mr Suresh Kumar B, Engineer E

Mr Rejith L R, Programmer - B

Mr Saji K S, Programmer - A

Mr Manoj M, Technical Assistant (Computer Programmer) - B

Mr Anish R, Technical Assistant (Computer Programmer) - B

Mr Sakilnag P S, Technical Assistant (Computer Programmer) - B

Ms Haseena L, Technical Assistant (Computer Programmer) - A



DEPARTMENT OF IMAGING SCIENCES AND INTERVENTIONAL RADIOLOGY

The Interventional Radiology Facility of the Department is involved in the management of peripheral and neurovascular minimally-invasive procedures. Neuro Intervention Centre (NIC) and the associated Biplane Catheterization Laboratory actively manage the neurovascular disorders. The newly-started Single Plane Catheterization Laboratory is used for diagnostic neuro-angiogram and peripheral interventional procedures. The quality management practices coupled with strong multidisciplinary co-operative directions have contributed significantly to achieving less than 1% morbidity and mortality. NIC, which was started 5 years back, has contributed significantly to improving patient outcome, postgraduate training and research activities. NIC got incorporated into the hospital services after successful completion of the project in 2016.

Activities

The activities of the Department during the year are depicted in Figures 12-15.

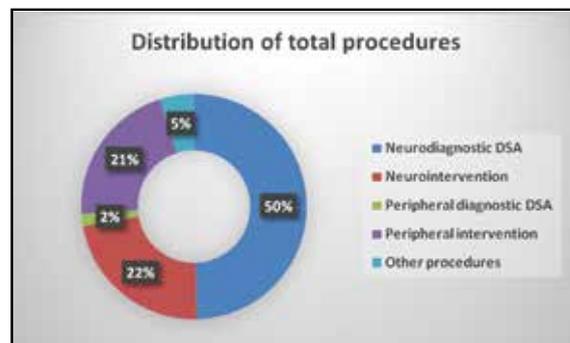


Figure 12. Distribution of total procedures in Interventional Radiology in 2017-18

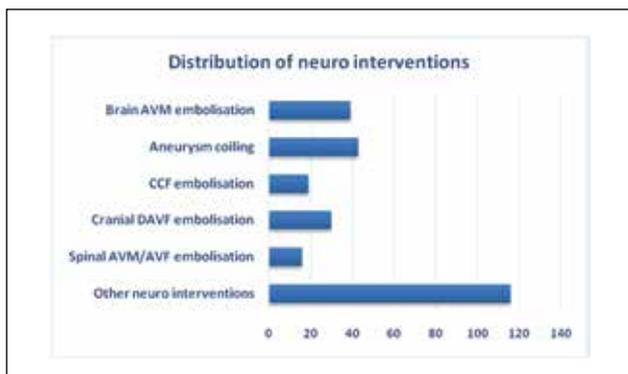


Figure 13. Distribution of neuro-intervention procedures in 2017-18

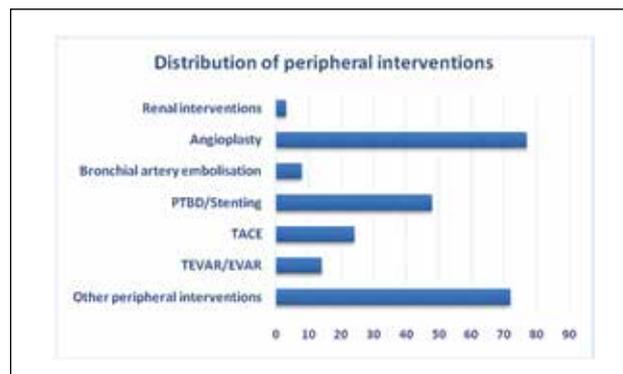


Figure 14. Distribution of peripheral intervention procedures in 2017-18

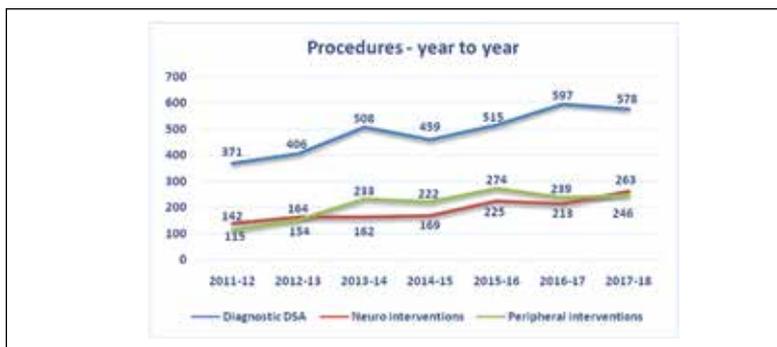


Figure 15. Comparison of number of intervention procedures in the last 7 years



The statistics for the Imaging Complex in 2017-18 are summarized in the Table below:

Imaging modality	No.
MRI	6116
CT	7297
Ultrasound	4133
X-ray	33843

The NIC recorded mortality and morbidity rate of less than 1% in 2017-18 with a hospital-acquired infection rate of less than 1%. The average length of hospital stay was 5 days and bed occupancy rate was 98%.

Research Programmes

Dr Bejoy Thomas, Professor, was the Principal Investigator of the Chitra Vein Viewer Technology that was transferred to M/s. Agappe Diagnostics Pvt. Ltd. on 14 October 2017. This is a portable device based on a method for locating superficial veins for intravenous puncture and for tracing the route of the vein with peripheral scanning. An Indian patent application was filed for the device.

A DST/SERB-funded project, 'Biochemical and functional investigation of dorsolateral prefrontal cortex in mild cognitive impairment using functional magnetic resonance spectroscopy and functional magnetic resonance imaging', was initiated during year by Dr Anupa V, Research Fellow.

OPTOSIS: Portable Optical Brain-Computer-Interface and Orthosis for Movement Restoration after Stroke, a three-year project funded by DBT, was completed.

The Department also had several ongoing extramural, intramural and industry- funded projects.

The ongoing medical device development projects in collaboration with the BMT Wing were:

1. Development of a prototype Flow Diversion Intracranial Stent for the treatment of complex intracranial aneurysms, funded by Technology Development Fund, SCTIMST
2. Development of novel prototype mechanical clot retriever for the treatment of acute cerebral

ischemic stroke, funded by the Department of Biotechnology

3. Radiopaque liquid embolization device by chemical grafting of iodinated compounds onto the ethylene vinyl alcohol co-polymer, funded by Technical Research Centre, SCTIMST
4. Development of Aortic Stent Graft for treatment of thoracic aortic aneurysms, funded by Technical Research Centre, SCTIMST

Dr C Kesavadas, Professor, had research collaboration with the following academic institutions:

1. Indian Institute of Technology Madras
Collaborator: Prof Manivannan Topics: 1. Developing virtual reality tools for stroke rehabilitation and validating the tool. 2. Developing Near infra-red spectroscopy system and validating the tool for human use
2. Indian Institute of Technology Madras
Collaborator: Dr Ganapathy Krishnamurthy
Topic: Machine learning for brain tumor segmentation
3. Pontificia Universidad Católica de Chile.
Collaborator: Dr Sitaram Ranganatha Topic: Brain-Computer Interface (fMRI & fNIRS-based) for neurofeedback
4. Indian Institute of Information Technology, Hyderabad. Collaborator: Prof Jayanthi Sivaswamy Topic: Development of an Indian brain template for elderly population
5. National Institute of Technology, Surathkal, Karnataka. Collaborator: Dr Jeny Rajan Topics: 1. Carotid plaque segmentation in MRI images 2. Machine learning for cortical dysplasia
6. Advisor for the project 'Testing and validation of MRI raw data processing and image reconstruction and visualization algorithms using the data acquired from the clinical scanner (1.5T)' as part of the development of indigenous 1.5 T MRI scanner system initiated by the Ministry of Electronics and Communication, Government of India, under Digital India Initiative Collaboration with CDAC, Trivandrum, and CDAC, Kolkata
7. Advisor and Co-PI for Project at TIMed: Project title: Real-time acute stroke analysis of CT scans using artificial intelligence. Company: Ignitarium, Bangalore



New Initiatives

A new Single Plane Catheterization Laboratory was inaugurated in the Medical Block on 22 November 2017 (Figure 16). This laboratory will decrease the patient waiting period and will also help start new interventional radiological procedures. A new Digital Subtraction Angiography (DSA) System (PHILIPS ALLURA Xper FD 20C) costing, approximately, 4 Crore rupees was purchased during the year.

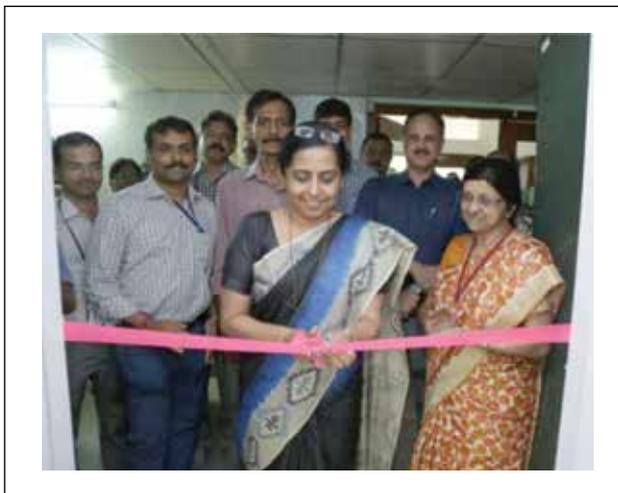


Figure 16. Director, Prof Asha Kishore, inaugurating the new Single Plane Catheterization Laboratory

New procedures started in Interventional Radiology included:

1. Low profile stent-supported endovascular aneurysmal coiling
2. Aneurysmal coiling using neck bridging device (Pconus)
3. Direct aspiration first pass technique (ADAPT) for acute large vessel occlusive stroke
4. Radiofrequency ablation of liver tumors
5. Transarterial chemoembolisation of liver tumors using newer chemotherapeutic agents

New procedures started in Diagnostic Radiology were:

1. Resting state fMRI in epilepsy, dementia and movement disorders
2. Intracranial vessel wall imaging in the work-up of stroke
3. LC model MR spectroscopy quantification of metabolites
4. Functional near infra-red spectroscopy for language lateralization

Events organized

The following events were organized during the year:

1. 'Insights into Cardiovascular Imaging in CT and MRI' was conducted on 12 November 2017 at the AMC auditorium, SCTIMST (Figure 17)
2. 'One-day CME and Master Series in Neuroradiology' was conducted on 26 September 2017 at the AMC auditorium, SCTIMST (Figures 18 & 19)
3. A two-day CME 'FLAIR-2017' (Focussed Learning Advanced Imaging in Radiology) was conducted on 22-23 April 2018



Figure 17. Insights into Cardio Vascular Imaging in CT and MRI – Series II with International Faculty, Dr Binukrishnan, MBBS, MRCP (UK), FRCR (UK), Clinical Lead in Cardiac Radiology, Liverpool Heart & Chest Hospital and other National faculty



Figure 18. Renowned neuroradiologist Prof Scott Atlas delivering a lecture at the institute

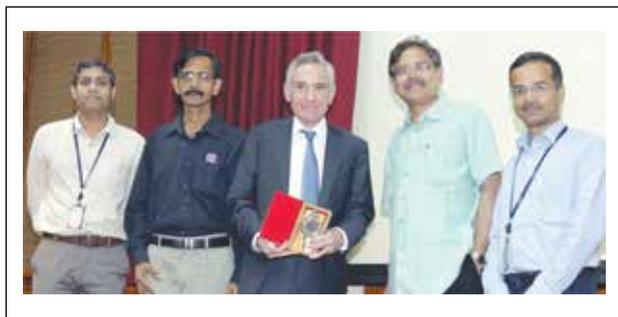


Figure 19. Prof Scott Atlas with Radiology Faculty

Awards and Honours

1. Dr Adhithyan R, Resident, received “Cum Laude” Award for the exhibit- “Dedicated 3D high resolution 3T vessel wall MR imaging for cerebrovascular disorders” at the Radiological Society of North America (RSNA) Conference held at Chicago, USA, from 26 November to 1 December 2017
2. Dr Adhithyan R received the RSNA Travel Fellowship Award and the CSIR International Conference Travel Fellowship for the paper titled “Volumetric T2 MR imaging versus conventional T2 MRI in spinal vascular malformations” presented at the Radiological Society of North America (RSNA) Conference held at Chicago, USA, from 26 November to 1 December 2017
3. Dr Vinayagamani, Resident, secured the 1st Prize for the poster ‘Diffuse leptomeningeal glioneuronal tumors: frequently masquerading entity’ at STAR Neuroradiology in August 2017 held at Pune, Maharashtra

4. Dr Vinayagamani won the 1st Prize in Quiz competition at STAR Neuroradiology in August 2017 held at Pune, Maharashtra.
5. Dr Kesavadas C, Professor, was selected VAJRA faculty by SERB, DST, Government of India

Faculty

Dr C Kesavadas, Professor and Head of the Department

Dr T R Kapilamoorthy, Professor (Adhoc)

Dr Bejoy Thomas, Professor

Dr E R Jayadevan, Additional Professor

Dr Santhosh Kannath, Associate Professor

Dr A Anoop, Assistant Professor

Dr Jineesh V, Assistant Professor

Technical

Ms Githakumari V, Junior Scientific Officer

Mr Alex Jose, Senior Technical Assistant

Ms Sheebakumari R, Senior Technical Assistant

Mr Johnson C, Senior Technical Assistant

Mr Krishna Kumar, Technical Assistant - B

Mr Vikas N, Technical Assistant - B

Mr Mahesh P S, Technical Assistant - B

Mr Joyi K, Technical Assistant - B

Ms Sandhya V, Technical Assistant - B

Mr Babunath B, Technical Assistant - B



DEPARTMENT OF MICROBIOLOGY

The Department provided accurate and quick reports on all specimens sent to the Laboratory and gave consultant clinical microbiology service, one component of which is antibiotic stewardship. The Department carried out outbreak investigation and containment using microbiological methods, maintained the viral culture facility, and trained MD and MSc Microbiology students as observers and as Apprentice trainees, respectively. The Department liaised with Hospital Infection Control Unit, and enhanced and supported research activities of all Wings of the Institute.

Activities

Clinical Services

1. Bacteriology and Mycology

There were 10 cases of infective endocarditis. The important causative agents identified were: a) *Corynebacterium* species - *C. jeikeium* and *C. striatum* b) Nutritionally-variant streptococci like *Granulicatella elegans* c) *Pseudomonas aeruginosa* d) *Brucella melitensis*, e) different species of *Candida* such as, *C. albicans*, *C. parapsilosis*, *C. tropicalis*, *C. krusei*, *C. famata*, *C. glabrata*, *C. haemolunii* and *Kodamaea ohmeri*.

Mycobacterial culture was performed with conventional Lowenstein-Jensen medium. The culture yielded three positive cases for *Mycobacterium* species.

2. Serology

Nephelometer (Agappe Diagnostics) installed in 2016, was used for ASO, CRP, RF, C3 and C4 estimation.

3. Viral Serology

Automated VIDAS (Enzyme Linked Immunofluorescent Assay) and ARCHITECT (Chemiluminescence-Linked Immuno Assay) were used for HIV, HBsAg, HCV, TFT and procalcitonin. Hepatitis B antibody titres were measured for health care personnel to assess their

immune protection levels post-vaccination and after health care accidents like needle stick injuries. Various rapid card tests like Tridot were also used for confirmation and emergency purposes.

The total number of serology samples tested during the year is summarized in the Table below:

Test	No.
RF	963
ASO	305
CRP	1953
TPHA	300
RPR	89
TFT	8187
Procalcitonin	1809
HIV	10006
HBsAg	9998
HCV	9998

4. Molecular Diagnostics

Standardised Real-time PCR was performed for detection of encephalitis viruses and tropical fever pathogens panel. 65 samples, including 8 from outside hospitals, were processed. 55 samples were done under Neuro9, and 15 samples were done under tropical fever core category.

Screening for antimicrobial resistance genes was performed, focussing mainly on Gram-negative bacilli (mainly ESBL). The procedure was standardised using RT-PCR. The genes screened were: Metallo-beta lactamase - PCM (NDM), Carbapenemase - KPC, CTX - CTX M 914, CTX M1, CTX M825 and TOHO1, Amp C - MOX, FOX, CMY2, DHA, ACT and ACC. These genes were screened in isolates from our patients and also isolates received from other hospitals.

RT-PCR using SYBR chemistry was also standardised for *Brucella* and *Mycobacterium tuberculosis*.



Research

A Project on fungal infective endocarditis was approved by IEC and data collection was completed in January 2018.

New Initiatives

Institutionalisation of Homograft Project was completed. Transplant co-ordinator and Technical Assistant were appointed.

Events organized

The Department organized “Hand Hygiene Day” activities with Hospital Infection Control Unit.

Awards and Honours

Dr Kavita Raja was elected Vice-President of the Academy of Clinical Microbiologists in August 2017 at the Triennial Conference in Calicut.

Faculty

Dr Kavita Raja, Professor and Head of the Department
Dr Molly Antony, Scientist G

Technical

Ms Sujatha B, Scientific Officer (Lab)
Ms Reeja Rani D C, Technical Assistant (Lab) - B
Ms Smitha M, Technical Assistant (Lab) - A
Ms Soja Rani G S, Technical Assistant (Lab) - A
Ms Sudha Chandran R, Technical Assistant (Lab) - A



DEPARTMENT OF NEUROLOGY

The Department of Neurology comprises multiple subsections that provide specialized and comprehensive care to patients with various neurological disorders. The Department conducts general neurology outpatient clinics from Monday to Friday and weekly speciality clinics.

Activities

A total of 53938 routine outpatients were seen in general neurology, including 47354 reviews and 6584

new registrations during the year. There were 3624 inpatient admissions (Figure 20). The average length of inpatient stay was 5 days with a bed occupancy rate of 98% and bed turnover of 60, the bed strength in neurology being 60. The mortality was 0.99 % during this period. A two-fold increase in the number of admissions was noted in 2017-18, compared to the preceding year. ICU mortality recorded a fall from 6.89% to 2.4%.



Figure 20. Outpatient and inpatient care in Neurology Department in 2017-18

The patient details in the Neuromedicine Intensive Care Unit during the year are summarized in the Table below:

Neurological condition	No.
Status epilepticus	44
Super refractory status epilepticus	6
Myasthenia gravis	18
Meningitis	24
Chronic Tubercular	11
Pyogenic	3
Aseptic	3
Carcinomatous	3
Chronic non-infective	4
Acute strokes	22

Cerebral venous sinus thrombosis	2
CNS Demyelination	25
Motor neuron disease	3
Guillain-Barre syndrome	15
Chronic inflammatory demyelinating polyneuropathy	4
Viral encephalitis	8
Autoimmune encephalitis	13
Rasmussen's encephalitis	2
Cruetzfeldt-Jakob disease	3
Metabolic Encephalopathy	25
Others	77
Total	291



The special treatments and procedures carried out in Neuromedicine ICU were as below:

Special Treatments/Procedures	No.
Plasma exchange	30
Continuous EEG monitoring	45
Intravenous immunoglobulin therapy	21
Rituximab administration	8

The faculty and students of the Department participated in many national and international conferences and received several prestigious awards. The Department continued to pursue major research projects and produce notable publications. Patient outreach programmes were conducted, including the Athiyanoor Clinic outreach programme, which is being attended every two weeks by the consultants and residents from the Department. During the year, 21 postgraduate students, 11 speech and language pathologists and 3 foreign faculty from Sri Lanka visited for a brief observership in the Department.

New Initiatives

The 'Comprehensive Care Centre for Neurodevelopmental Disorders' was officially inaugurated on 8 August 2018 by Shri Harish Engineer, Head, CSR Wing of Federal Bank.

Events organized

In 2017-18, the Department of Neurology hosted many major conferences.

1. The second Dr P K Mohan Oration and Alumni CME was conducted on 7 April 2017 at the Achutha Menon Centre Auditorium (Figure 21). The Memorial Oration was delivered by Dr Cynthia Harden, eminent epileptologist and Professor of Neurology, Mount Sinai Hospital, New York, USA. The oration was preceded by a CME by the alumni of the Department of Neurology of SCTIMST.
2. The 'Super EMG India 2018', an International Workshop and Neuromuscular Symposium on basic and advanced techniques of EMG was organized by the Department of Neurology from 23-25 March 2018. The 3-day Congress was inaugurated by Shri Justice P Sathasivam, the Hon'ble Governor of Kerala. The Hon'ble Governor awarded the Lifetime Achievement Award to the veteran Neurologist, Dr M Gourie Devi, in the inaugural function.



Figure 21. Dr Cynthia Harden receiving the Award for Oration from Dr Muralidharan Nair, Head of Department of Neurology, on the occasion of the 2nd Dr P K Mohan Oration



Awards and Honours

1. Dr Paul J Alapatt and Dr Saraf Udit Umesh, Residents, won 1st and 2nd Prizes, respectively, for the Stroke Quiz at the 4th National Stroke Summer School organized by the Indian Stroke Association from 18-20 August 2017 at Mahabalipuram, Tamil Nadu
2. Dr Keni Ravish, Resident, was the first runner-up in the South Zone for the Torrent Young Scholar Award
3. Dr Satyan Nanda, Resident, was awarded travel bursary to attend the prestigious World Congress of Neurology to present the study titled 'A pilot study on mapping structural and functional connectivity in early Alzheimer's disease (AD) in comparison to stable mild cognitive impairment (MCI) and healthy controls' in October 2017
4. Dr Gopikrishnan U, Resident, secured 2nd Prize for the poster 'Electroclinical profile of Miller-Fisher syndrome in a tertiary care centre' at the 6th Asian-Oceanian Congress of Clinical Neurophysiology from 9-12 November 2017 at Bengaluru
5. Ms Manju Mohan P and Ms Vipina V P, Speech Therapists, received the Best Paper Award for the paper titled 'An appraisal on the speech, language, cognitive and neuroimaging correlates of Primary Progressive Apraxia of Speech' at the 10th Kerala State Branch - Indian Speech and Hearing Association Conference on 13-14 January 2018 at Kollam
6. Drs Saraf Udit Umesh and Soumya V C, Residents, secured 2nd Prize in the Neuroexchange Pediatric Neurology Quiz on 3-5 March 2018 at Trivandrum

The activities of the various subsections of Neurology in 2017-18 are enumerated below:



COGNITION AND BEHAVIOURAL NEUROLOGY SECTION

The Section provides clinical services to patients with cognitive problems and dementia. It also provides advice and technical support to the Alzheimer's and Related Disorders Society of India (ARDSI), a voluntary organization that helps dementia patients and caregivers. The Section also carries out clinical and basic science research in the fields of Dementia, Cognition and Behaviour.

The Section conducts a Memory and Neurobehavioural Clinic every week, provides comprehensive assessment of patients with cognitive problems, counsels caregivers of patients with dementia, conducts cognitive retraining sessions for patients and carries out research activities on structural and functional neuroimaging in dementias as well as development and validation of neuropsychological batteries.

Activities

The activities of the Section during the year are summarized in the Table below:

Activity	No.
Memory and Neurobehavioral Clinic attendance	602
Neuropsychological testing	1536
IQ assessment	158
Counseling sessions	396
Cognitive retraining	237
Speech and Language evaluation	2408
Speech therapy	626
Audiometry evaluations	237
Videofluoroscopic testing	20

Research Programmes

Dr Ramsekhar N Menon was Principal Investigator of two ongoing DST-funded projects: 'The human brain mapping project- a resting state fMRI study of healthy controls and patients with mild cognitive dysfunction' and 'Effect of yoga on neuropsychological functions and brain connectivity networks in mild cognitive

impairment and cognitively normal subjects'.

Ms Manju Mohan P led a study on videofluoroscopic measures of neurogenic dysphagia in patients with stroke and motor neuron disease and received the ARF fund of Rs. 4.3 Lakhs in collaboration with All India Institute of Speech and Hearing.

New Initiatives

Standardization of cognitive retraining protocol in mild cognitive impairment and early dementia patients was done. New equipment procured during the year included an Impedance Audiometer costing Rs 8,30,000.

Events organized

A public contact programme was conducted in collaboration with ARDSI, Trivandrum Chapter, related to World Alzheimer's Day on 21 September 2017. The Chief Guest for the event was Hon'ble Health Minister of Kerala, Smt K K Shailaja Teacher. It was attended by over 50 participants, including patients and caregivers. Ms Vipina V P presented an overview on "Augmentative and Alternative Communication in Dementia" and Ms Nandini, Ms Vipina, and Ms Sushama presented papers on care giver support.

Awards and Honours

Dr Ramshekhar N Menon was awarded the ILAE travel bursary to attend the prestigious 32nd International Epilepsy Congress in September 2017 at Barcelona, Spain, to present a study 'Imaging memory in temporal lobe epilepsy – validation of 'within-scanner' material specific encoding-recall paradigms during memory task-based functional magnetic resonance imaging' which was conducted by CBNS along with R Madhavan Nayar Centre for Comprehensive Epilepsy Care, and, funded by DST-SERB.



COMPREHENSIVE CARE CENTRE FOR MOVEMENT DISORDERS

The Comprehensive Care Centre for Movement Disorders (CCCMD) at SCTIMST deals with a group of neurological ailments manifesting as involuntary movements or disturbances in voluntary movement, without true weakness or muscle paralysis. Such neurological conditions are together designated as 'Movement Disorders' and generally result from disease processes affecting structures deeply seated in the brain, called 'basal ganglia' and their connections to other areas of brain. The CCCMD provides comprehensive medical and surgical care to patients afflicted with various movement disorders, trains neurologists from various parts of India in state-of-

the-art management of movement disorders, conducts PhD and Post-doctoral Fellowship programmes and engages in basic science, and clinical and biomedical engineering research. During the year, the Centre provided comprehensive clinical services to patients who come from all over the country. The Centre was involved in several externally-funded research projects (including those with international collaboration) and a R&D project in collaboration with the Biomedical Technology Wing of the Institute. One of the research fellows successfully completed her course and was awarded PhD for the work done on the interaction between autophagy and alpha-synuclein. A new research project funded by the Department of Biotechnology, Government of India, was initiated. Six articles were published in scientific journals and



Figure 22. Dr Cecile Galea, researcher from Pitié-Salpêtrière Hospital, Paris, France delivering a scientific lecture to the faculty and research scholars of the Institute on principles of analysis of resting state functional MRI during her visit to the Institute

invited lectures were delivered in one international and several national scientific conferences by the faculty of the Centre. Dr Sabine Meunier and Dr Cecile Galea, Faculty from Pitié-Salpêtrière Hospital, Paris, France, visited the Centre as part of the ongoing collaborative research projects (Figure 22).

Activities

The clinical activities of CCCMD include the weekly Movement Disorders Review Clinic,

Botulinum Toxin Injection Clinic and the Movement Disorders Surgical Programme. The Motor Physiology Laboratory under the CCCMD conducts electrophysiological investigations in patients with movement disorders. Around 575 new patients with various movement disorders were referred to the CCCMD from all over India during the year. The Movement Disorders Review Clinic had 2755 review consultation visits by patients. 436 botulinum toxin injection sessions were undertaken in the fortnightly



Figure 23. Electromyography-guided Botulinum toxin injection for dystonia

Botulinum Toxin Injection Clinic (Figure 23). 32 Deep Brain Stimulation and replacement procedures were performed. Around 65 deep brain stimulation programming sessions were performed for patients on DBS. The Motor Physiology Laboratory conducted around 215 sessions of electrophysiological studies.

Research Programmes

The CCCMD is involved in research pertaining to the basic science, clinical and genetic aspects of movement disorders. One of the projects completed during the year addressed the pathogenetic mechanisms underlying the condition called Writer's Cramp, which is a 'task-specific' dystonia. In this condition, muscles that are unrelated to the task of writing also get activated, resulting in abnormal posturing and tremors of the hand while writing. In the Transcranial Magnetic Resonance Imaging-based study funded by the Dystonia Medical Research Foundation, USA, in patients with different types of this condition (those with and without a phenomenon called mirror dystonia), the already known pathogenetic mechanisms of the condition were integrated to a concept of altered motor preparation to demonstrate that the condition is more severe in those with more severe abnormalities of motor preparation. In another study, which addressed the pathophysiology

of dystonia affecting the neck (cervical dystonia), the role of proprioceptive information (ascending sensory information pertaining to the position of the body parts in space) was addressed. Yet another research project explored interaction between alpha-synuclein (a protein with pivotal role in the pathogenesis of Parkinson's Disease) and autophagy (a cellular mechanism for clearing defective proteins). It was found that the protein has a regulatory role in autophagy and defined an alternate physiological role for the same in non-neural cells. An internally-funded study explored the effects of DBS surgery on impulsivity and decision-making capabilities (which is a matter of debate in the scientific circles) of patients undergoing this procedure and found that the surgery most likely doesn't have any direct adverse effects on impulsivity or decision-making powers.

A new research project, funded by the Department of Biotechnology, Government of India, was initiated this year. This project aims at quantitatively estimating the abnormal deposition of iron in basal ganglia and related structures in the brains of patients with Parkinson's Disease and other conditions mimicking PD ('Atypical Parkinsonism'), using advanced Magnetic Resonance Imaging techniques. Iron deposition occurs in brain regions undergoing neurodegeneration and topographical mapping of iron



levels could have a diagnostic value in differentiating these conditions, as the pattern of neurodegeneration and its progression are different in different disorders causing Parkinsonism.

The CCCMD, collaborating with the Biomedical Technology Wing of the Institute and the Bhabha Atomic Research Centre, is engaged in the

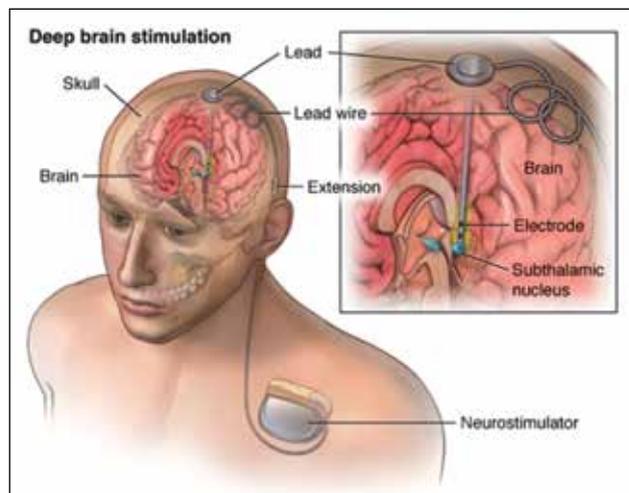


Figure 24. Diagram showing the pulse generator and leads of Deep Brain Stimulator system implanted in the patient

Lead Body Flexion Test System, Conductor Flex Test System and Terminal Connection Endurance Test System were developed as per international standards.

Among several other ongoing projects, one funded by the SATYAM Programme of DST explored the physiological basis of the salutary effects of Yoga on the neural control of movements. Another research project, funded by the ICMR, aimed at a longitudinal follow-up of the cognitive functions in patients with PD to detect how it declines over time. Other ongoing research projects include: a collaborative one with the University of Tubingen, Germany (Funded by the Michael J Fox Foundation, USA) aimed at elucidating the genetic perturbations underlying Parkinson's Disease in the Indian population, the Transcranial Magnetic Stimulation-based study examining the relationship between cerebellum and loss of depotentiation of motor cortex synapses that occur in dyskinetic PD patients and the functional MRI (fMRI)- based study exploring the connections between cerebellum and basal ganglia structures (Figure 25). Apart from these major research projects,

development of a low cost and efficient Deep Brain Stimulation system for movement disorders. The preliminary design of the hardware was finalised for this Technical Research Centre-funded project and the implantable electrode and the implantable pulse generator development were ongoing (Figure 24). Test systems for fatigue testing of the leads, including

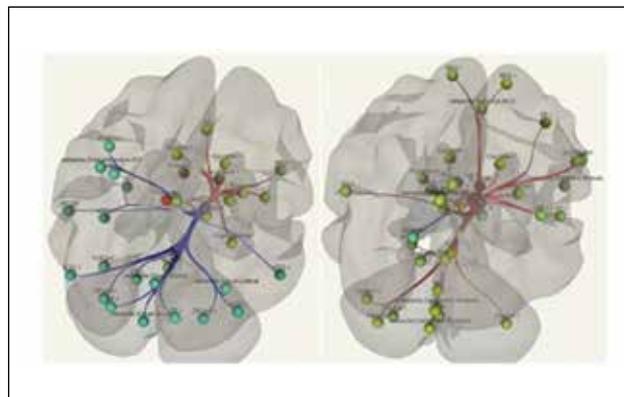


Figure 25. One of the ongoing research projects aim to delineate the connections between cerebellum and basal ganglia in healthy people and the differences which occur in Parkinson's disease, using resting state functional MRI. The first image (right sided panel) is a representative image from the patient group and the second, from healthy volunteers

there were several student projects exploring various clinical aspects of movement disorders such as the effects of subthalamic nucleus DBS on non-motor fluctuations in Parkinson's Disease and relationship between apraxia of eye lid opening and DBS.

New Initiatives

Tele-consultation Facility

Many patients with movement disorders have great difficulty in travelling owing to their physical disability, and bringing the patients from remote places in the state and other states of India for clinical follow-up is strenuous for the caregivers. The CCCMD, in collaboration with the Computer Division and the Biomedical Technology Wing, developed a Tele-consultation Facility incorporated in the patient portal of the Institute website and was approved by the Governing Body of the Institute for use in patients. This will enable patients already registered in the Clinic to access the treating clinician through videoconferencing and get medical advice and prescription.



Events organized

An awareness programme for patients and caregivers was conducted in connection with the World Parkinson's Day on 11 April 2017 (Figure 26).



Figure 26. Awareness session conducted on World Parkinson's Day

COMPREHENSIVE CARE CENTRE FOR NEURODEVELOPMENTAL DISORDERS

The Comprehensive Care Centre for Neurodevelopmental Disorders (CCCND) was formally inaugurated in August 2017. The Centre provides diagnostic and rehabilitative services to children with various neurodevelopmental disorders, particularly autism.

Activities

During the year, 175 pediatric neurology cases were admitted and 542 new cases were registered at the CCCND. The distribution of the cases is given in the Table below:

Entity	No.
Autism Spectrum Disorder	96
Intellectual Developmental Disorder	257
Social Communication Disorder	5
Cerebral Palsy	159
Learning Disorder	25

New Initiatives

1. A Scientific Advisory Committee (SAC) was constituted with experts in neurodevelopmental disorders, including a neurologist, neuropsychiatrist, geneticist and speech therapist. The 1st SAC meeting was organized on 5 October 2017 and was presided over by the Hon'ble President of the Institute, Shri K M Chandrasekhar. Several important suggestions on the rehabilitation of children with various developmental disorders of the brain, promoting academics and research in the field to enable the Centre to become a state-of-the-art facility, were put forward by the committee members.
2. On 8 August 2017, the 'Comprehensive Care Centre for Neurodevelopmental Disorders' was formally inaugurated by Shri Harish H Engineer, Head, CSR Committee, Federal Bank, in the presence of Shri Shyam Srinivasan, Managing Director and Chief Executive Officer of The Federal Bank Ltd., Shri K M Chandrasekhar, Hon'ble President, SCTIMST and Dr Asha Kishore, Director, SCTIMST (Figure 27). The aim of the Centre is to provide comprehensive rehabilitation for children with various developmental disorders of brain such as autism, dyslexia, learning disabilities and ADHD. The Centre has a Sensory Integration Unit and Pediatric Physiotherapy Unit to cater to children with neurological disabilities (Figure 28).



Figure 27. Inauguration of the 'Comprehensive Care Centre for Neurodevelopmental disorders' by Shri Harish H Engineer



Figure 28. Sensory Integration Unit and Pediatric Physiotherapy Unit

Events organized

Dr Valsamma Eapen, Professor and Chair of Infant, Child and Adolescent Psychiatry, University of New South Wales, visited the Centre on 29 January 2018. She discussed management of children with autism and attention-deficit/hyperactivity disorder and delivered a talk on 'Early intervention program in autism'.

COMPREHENSIVE CENTRE FOR SLEEP DISORDERS

Comprehensive Centre for Sleep Disorders conducts weekly Sleep Clinic on Thursdays for diagnosis of patients with sleep disorders and follow-up of patients on Continuous Positive Airway Pressure (CPAP) therapy. In addition, the programme has a two-bedded Sleep Laboratory where an average of 14-15 sleep studies are conducted per month, including diagnostic polysomnography and CPAP titrations. A patient educational programme is conducted before the Sleep Clinic for 30 minutes and is chaired by a medical social worker who educates patients on sleep disorders and their management.

Activities

The number of services provided during the year is given in the Table below:

Activity	No.
Sleep Clinic attendance	591
Polysomnography	124
CPAP titrations	47
Multiple sleep latency test	8

New Initiatives

An Insomnia Care Plan was started for patients with chronic insomnia in collaboration with the Neuropsychologist who does psychological evaluation of patients and administers cognitive behavioural therapy.

Research Programmes

'Do cardiovascular patients with obstructive sleep apnea have adverse perioperative outcomes – a prospective study', a two-year study, funded by ResMed Foundation, California, and conducted in collaboration with the Departments of Anaesthesia and CVTS, was initiated in August 2017

COMPREHENSIVE STROKE CARE PROGRAMME

The Comprehensive Stroke Care Programme of SCTIMST is committed to providing comprehensive care for patients with stroke. It is staffed by a multidisciplinary team with specialized knowledge in stroke care. Apart from the regular stroke clinics and multidisciplinary stroke meetings, the stroke programme organized a number of activities during the year. The Unit was successful in initiating five new research projects in areas of stroke care with funding from the Indian Council of Medical Research, Neuroscience Foundation, Australia, and The Wellcome Trust-DBT. With the support of the Department of Health and Family Welfare, Government of Kerala, the Unit initiated a large-scale community-based health worker training programme on stroke care. To mark the occasion of World Stroke Day, a state level Nursing Conference on stroke management was organized on 29 October 2017. The research work also led to 13 publications during the year.

Activities

The Unit conducted a Stroke Clinic every Friday. After discharge, all stroke patients were carefully followed up and medications/ rehabilitative strategies were reviewed/ optimized periodically. Stroke meetings held on Fridays discussed the clinical scenarios of patients to decide upon the best strategy for their management by the multidisciplinary stroke care team.



Areas / Procedures	No.
Stroke Clinic Attendance	2918
ICU Admissions	510
Carotid Endarterectomy	42
Carotid Stenting	14
IV tPA	41
Mechanical Thrombectomy	31
Moyamoya Revascularization	11
Decompressive Hemicraniectomy	13

Research Programmes

Indian Stroke Clinical Trial Network

The INSTRuCT Network was created under the Indian Council of Medical Research to conduct small and large clinical trials and research studies to advance acute stroke treatment, stroke prevention and recovery and rehabilitation following a stroke. This network involves 27 hospitals across India that are committed to enhancing stroke care through research and development. SCTIMST is the South Indian regional coordinating Centre for the INSTRuCT Network, which coordinates and monitors 13 Centres under the network.

SPRINT INDIA Study

Secondary Prevention By Structured Semi-Interactive Stroke Prevention Package in INDIA (SPRINT INDIA) is a trial designed to assess the role of a structured semi-interactive stroke prevention package in reducing the risk of recurrent strokes in patients with sub-acute stroke. The study was conducted across 27 Centres in India. SCTIMST validated the Malayalam intervention and data collection forms of SPRINT study.

Monitoring early neurological fluctuation in hyperacute stroke

Neuroscience Foundation Australia-funded project, 'Monitoring early neurological fluctuation in hyperacute stroke' is a prospective pilot observational

study that monitors acute stroke patients by direct examination and through a wrist-worn, watch-like device to assess improvement and deterioration of stroke symptoms.

Improvement of secondary prevention in stroke survivors by a primary healthcare approach

The Programme, with the support of the Department of Health and Family Welfare, Government of Kerala, undertook a large-scale, community-based study on Secondary Prevention of Stroke. As a part of this study, regular training programmes were conducted for primary care physicians, community health nurses, ASHA workers, palliative care nurses and junior public health nurses from 8 rural blocks of Thiruvananthapuram. The programme comprised initial intensive training followed by refresher sessions.

New Initiatives

The existing Memorandum of Understanding was revised with John Hunters Hospital, Australia, for the study titled 'International Stroke Perfusion Imaging Registry (INSPIRE)', a study on CT perfusion in acute stroke in April 2017

An MoU was signed between Royal Melbourne Hospital, Australia, CMC Ludhiana, India, and the Institute, for a study titled 'Monitoring Early Neurological Fluctuation in Hyper Acute Stroke' in September 2017

Events organized

Conference on Nursing Management of Stroke

As part of World Stroke Day, a state level conference on Nursing Management of Stroke was organized on 29 October 2017 by the Unit, the Nursing Division of SCTIMST and the Non-Communicable Diseases Division of the Kerala State Health Services. Around 340 nurses from district hospitals, taluk hospitals, medical colleges, and private hospitals attended the conference.

Training programme for community health workers

As part of the Government-funded study, 'Improvement of secondary prevention in stroke survivors



by a primary healthcare approach', training was given to community health workers from 8 rural Panchayats of Trivandrum. The training was conducted on 23, 25 and 30 of January 2018 at three Centres (Poovar, Kesavapuram, Manampur). The training programme covered topics such as early diagnosis, warning signs, risk-factor control and secondary prevention of stroke. The training emphasized the necessity of secondary stroke prevention and role of community health workers in attaining the same. The programme was attended by 270 participants.

Training programme for primary care physicians

A training programme for primary care physicians on stroke care was organized on 22 February 2018 as part of the community-based secondary prevention of stroke study. The programme was co-organized by AMCHSS and was sponsored by the Directorate of Health Services. Dr Saritha R L, Director of Health Services, Government of Kerala, inaugurated the event. Primary care physicians from 8 rural health blocks of Trivandrum District attended the programme.

Others

Two guest lectures were also organized during the year. Dr Pooja Khatri, Professor of Neurology and Director of the Stroke Programme, University of Cincinnati, US, delivered a lecture on 'Endovascular trials in acute ischemic stroke' on 13 July 2017. Prof Craig Anderson, Professor of Neurology and Epidemiology, University of New South Wales, delivered two talks on 'Future Directions in Management of Stroke' and 'How to write a scientific paper and get it published' on 13 March 2018.

Awards and Honours

1. Dr P N Sylaja was selected Commissioner representing India in the Lancet Neurology Commission on Stroke in low and middle-income countries
2. Dr P N Sylaja was selected Expert Member of the Technical Evaluation Committee for Mental Disorders, Stroke and Neurological Disorders under the Department of Health Research, Ministry of Health and Family Welfare, Government of India
3. Dr P N Sylaja was selected Member of the Educational Committee of the World Stroke Organization
4. Dr P N Sylaja was elected President of the Indian Stroke Association (2018-2019)
5. Dr P N Sylaja was Member of the Academic Council of Kerala University of Health Sciences during 2017- 2019
6. Dr Arun K, Wellcome-DBT Fellow in the Stroke Programme, received the 2nd Prize for platform presentation for the study titled "Prevalence of aortic plaques in cryptogenic ischemic stroke and predictors of outcome" at the 12th Indian National Stroke Conference in New Delhi on 16-18 March 2018
7. Dr Sapna Erat Sreedharan received the 3rd Prize for the poster titled "Malignant middle cerebral artery stroke management in developing world outcome predictors" at the 12th Indian National Stroke Conference in New Delhi on 16-18 March 2018

NEUROMUSCULAR DIVISION

The Neuromuscular Division caters to two broad groups of disorders: (a) the Neuromuscular disorders that include anterior horn cell diseases, neuropathies, myopathies and neuromuscular junction disorders, and (b) Acquired central nervous system demyelinating disorders like multiple sclerosis and neuromyelitis optica spectrum disorders. The patient care services included a weekly Neuromuscular Clinic and a neurorehabilitation meeting in addition to the routine management of patients admitted in the neurology wards and intensive care unit. Academic activities included training of Postdoctoral Fellows and Diploma in Neurotechnology students. The Consultants and Fellows participated in various national and international conferences as faculty and delegates.

Activities

The Neuromuscular Clinic functioned on Tuesday of every Week. During the year, the Clinic recorded 1848 patient visits. A patient management conference focussing on rehabilitation of patients with significant



physical disability held every Tuesday was attended by neurology consultants, physiatrist, speech therapist, occupational therapist, medical social worker, postdoctoral fellow and neurology residents.

The Multiple Sclerosis (MS) Clinic functioned on the second Tuesday of every month. The Clinic specifically addressed the disease-modifying therapy, rehabilitation needs and social problems in multiple sclerosis. In addition, other central nervous system demyelinating disorders like neuromyelitis optica were also reviewed in the Clinic. 97 patient visits were made to the MS Clinic during the year.

The routine studies conducted in the Electrophysiology Laboratory during the year are summarized in the Table below:

Study	No.
Nerve conduction studies	1221
Electromyography	755
Repetitive nerve stimulation	150
Blink reflex studies	10
Single fibre EMG	33
Visual evoked potential	392
Brainstem auditory evoked potential	200
Somatosensory evoked potential	101

The procedures performed during the year are listed below:

Procedure	No.
Therapeutic plasma exchange	30
IV immunoglobulin	78
Muscle biopsy	40
Nerve biopsy	10
Skin biopsy	19
Thymectomy (for myasthenia gravis)	5

Research Programmes

1. A project titled 'Structural and functional correlates of cognitive dysfunction in multiple sclerosis' funded by the Cognitive Science Research Initiative of the Department of Science and Technology, was initiated in June 2017. This study aimed to do neuropsychological testing and multimodality MRI in 50 patients with relapsing remitting multiple sclerosis (RRMS) and matched controls to identify the networks of cognition that may be affected in RRMS patients with mild motor disability.
2. The extension phase for the Daclizumab High Yield process in RRMS continued. The drug trial was the Extension Phase of the Phase III trial of Daclizumab for relapse prevention in RRMS.
3. The in-house projects continued during the year included: A comparative study on voluntary and axonal stimulation techniques of single fibre electromyography and comparison of mandibular nerve repetitive nerve conduction test in myasthenia gravis and motor neuron disease patients. Two student projects on the utility of muscle biopsy in the diagnosis of neuromuscular disorders and predictive role of serum albumin in Guillain-Barre syndrome were also initiated.

Events organized

The Neuromuscular Division spearheaded the organization of 3 events in 2017-18

1. Super EMG India 2018

Super EMG India 2018 was an International Workshop in Advanced Electromyography and Neuromuscular Symposium held in the Achutha Menon Centre Auditorium from 23-25 March 2018 (Figure 29). Dr Muralidharan Nair was the Organizing Chairman and Dr Abraham Kuruvilla was the Organizing Secretary for this event which was attended by 350 delegates from India and abroad. The lectures and demonstration Workshops were conducted by international faculty renowned in electromyoneurography – Dr Jun Kimura, Dr Janice Massey, Dr Bjorn Falck and Dr Sanjeev Nandedkar.

The inaugural ceremony on the 1st day was chaired by Shri Justice P Sathasivam, the Hon'ble Governor of Kerala, who conferred the 'Lifetime Achievement Award' upon eminent Neurologist and Neurophysiologist, Dr M Gourie-Devi during the event.



Figure 29. Group photo of faculty and delegates of Super EMG India 2018

2. Multiple Sclerosis Symposium South

This one-day update on multiple sclerosis was organized on 15 April 2017 under the aegis of the Department of Neurology, SCTIMST. The speakers included senior neurologists with experience in the diagnosis and management of multiple sclerosis from South and West India.

3. World Multiple Sclerosis Day 2017

A patient outreach programme was held on the occasion of the World Multiple Sclerosis Day on

31 May 2017. The programme was inaugurated by the Director, Dr Asha Kishore, and was attended by 20 patients and 23 caretakers. Renowned social activist and voice artist, Ms Bhagyalakshmi, was Guest of Honour at the event. Sessions included talks on clinical features, treatment, rehabilitation and psychological problems in multiple sclerosis (Figure 30). The event also marked the formative meeting of Multiple Sclerosis Society of India (MSSI), Trivandrum Support Group.



Figure 30. The Guest of Honour Ms Bhagyalakshmi addressing the audience at World Multiple Sclerosis Day 2017 meeting



Awards and Honours

Dr Vineetha V S, PDF, Neuromuscular Disorders, was awarded the International Federation of Clinical Neurophysiology Fellowship award at the 64th Annual Meeting of the American Academy of Neuromuscular and Electrodagnostic Medicine (AANEM) for the poster 'Clinical and electrophysiological correlation in chronic inflammatory demyelinating polyradiculoneuropathy'.

R MADHAVAN NAYAR CENTRE FOR COMPREHENSIVE EPILEPSY CARE

R Madhavan Nayar Centre for Comprehensive Epilepsy Care (RMNC) provides comprehensive care for all types of adult and paediatric epilepsies to patients from all parts of India and the neighbouring countries. It is the main Centre for epilepsy surgery in India and South-East Asia and offers world-class, yet, affordable comprehensive epilepsy care, comparable to any other Centre in the world. The Mission of RMNC is: (1) to provide comprehensive medical, surgical, psychosocial and occupational care for patients with epilepsy with emphasis on the surgical treatment of medically-refractory epilepsies, (2) to undertake advanced clinical and basic science research in various areas of epilepsy, (3) to enhance epilepsy awareness among the primary care physicians and general public, and (4) to address issues pertaining to women with epilepsy under the Kerala Registry for Epilepsy in Pregnancy (KREP).

Activities

The activities during the year are summarized in the Table below:

Activity	No.
Video EEG monitoring	1465
Intracranial monitoring	7
Epilepsy Surgery	112
Intraoperative electrocorticogram	92
WADA test	15
Cortical Stimulation and Mapping	2

Epilepsy Clinic attendance	7570
Epilepsy Ward admissions	310
EEG (outpatient)	4846

In 2017-18, RMNC reached the milestone of completing 2000 epilepsy surgeries. Two video EEG machines and one portable EEG machine were donated to RMNC during the year.

In addition to the routine activities, the following special activities were undertaken:

- 12 clinics were conducted at PHC Changaramkulam in collaboration with Alamcode Panchayat Committee
- Epilepsy Camp organized at Palakkad in April 2017 attended by 98 patients was supervised by Dr Ramshekhar N Menon
- Monthly special clinics for women with epilepsy were conducted at the Women and Children Hospital, Thycaud, Trivandrum

New Initiatives

Stereo EEG-based intracranial monitoring and resection in MRI-negative extratemporal epilepsy was initiated.

Events organized

International Epilepsy Day was celebrated in RMNC on 28 February 2018, which was attended by more than 150 people with epilepsy, their parents, doctors of the institute and various health care providers from the hospital. In connection with this, a drawing competition was organized for children with epilepsy on 24 February 2018 and children with epilepsy participated in cultural programmes on the occasion. Dr Sriram Venkatraman IAS (Director of Employment and Training, Kerala State) graced the occasion along with Dr M D Nair and Dr Sanjeev V Thomas.

**Faculty**

Dr Muralidharan Nair, Professor (Senior Grade) and Head of the Department

Dr Sanjeev V Thomas, Professor (Senior Grade)

Dr Asha Kishore, Professor (Senior Grade)

Dr Abraham Kuruvilla, Professor

Dr Sylaja P N, Professor

Dr Ashalatha R, Professor

Dr Sajith S, Additional Professor

Dr Syam K, Additional Professor

Dr Ramsekhar N Menon, Additional Professor

Dr Sapna Erat Sreedharan, Associate Professor

Dr Ajith Cherian, Assistant Professor

Dr Sruthi S Nair, Assistant Professor

Dr Soumya Sundaram, Assistant Professor

Dr Divya K P, Assistant Professor

Mr Praveen James, Engineer - B

Technical

Ms Nandini V S, Senior Scientific Assistant

Ms Preetha Govind G, Senior Technical Assistant

Ms Salini K R, Technical Assistant - B

Mr Pradeep M J, Technical Assistant - B

Ms Shana N Nair, Technical Assistant - B

Mr Anees C A, Technical Assistant - B

Ms Deepa Paul Miranda, Technical Assistant - A

Medico-social Worker

Mr Unnikrishnan J P, Junior Social Worker - A

Therapists

Ms Aley Alexander, Senior Psychologist

Mr Gangadhara Sarma, Psychologist - B

Ms Lincy Phillip, Occupational Therapist - B

Ms Manju Mohan, Speech Therapist - A

Ms Vipina V P, Speech Therapist - A

Ms Sushama S R, Psychologist - A



DEPARTMENT OF NEUROSURGERY

The Department seeks to provide world-class neurosurgical care, advance neurosurgical knowledge through research and innovation, and ensure the best academic environment for neurosurgical education. Regular teaching activities and seminars promote the involvement of trainee residents in the discussion of current issues with emphasis on recent advances and management protocols. Journal discussions in a new format and neuro-radiology sessions also contribute to solidification of patient management strategies.

Dr Mathew Abraham took over as the Head of the Department following superannuation of Prof Suresh Nair on 30 June 2017.

Activities

During the year, the Department expanded its repertoire of cerebrovascular and skull base surgeries by performing an increasing number of complex neurovascular procedures, including microvascular anastomosis for cerebral perfusion. A total of 1382 surgeries were performed during the period.

Research

Two extramural-funded projects were initiated by Dr Mathew Abraham, both funded by CAERF for a period of 2 years. The projects are prospective observational studies of patients undergoing microneurosurgical procedures through interhemispheric transcallosal approach and surgeries by different transcranial approaches for craniopharyngiomas.

New Initiatives

1. The Neurosurgical equipment was upgraded in 2017-18 with the procurement of a new operating microscope and Cavitron Ultrasonic Surgical Aspirator (CUSA)
2. Stereo EEG-guided resection for MRI-negative epilepsy was initiated in June 2017

Events organized

Prof Kazuhiro Hongo, a renowned neurosurgeon and Chairman of the Department of Neurosurgery

at Shinshu University, Matsumoto, Japan, visited the Department on 28 February 2018 and spoke on surgery for complex aneurysms and arteriovenous malformations. He also shared operative nuances and videos during the Symposium - Chitra Masterclass conducted by the Department on 28 February 2018. The other faculty for the symposium included: Prof Mathew Abraham, Prof Suresh Nair and Prof Anil P.

The Sree Chitra Neurosurgery Conclave 2017 was organized on 10 June 2017 by Dr Mathew Abraham, Dr Easwer H V and Dr Krishnakumar K.

Awards and Honours

1. Dr Easwer H V received the Dr Ramdas Pisharody Memorial Award from the Government of Kerala on 27 November 2017 for his contributions toward raising awareness on Organ Donation following Brain Death
2. Dr Easwer H V received appreciation from the Hon'ble High Court of Kerala for his deposition on behalf of the Government of Kerala in response to a Public Interest Litigation filed at the High Court
3. Dr George C Vilanilam received the FRCS in Neurosurgery from the Royal College of Surgeons, Edinburgh, in February 2018
4. Dr George C Vilanilam, received the 'Minimally Invasive Endoscopic Brain and Skull Base Fellowship' at Weill Cornell Medicine from April-June 2017
5. Dr Jayanand Sudhir received the Award for Best Presentation for the paper: 'Blasting Brain Tumours: The effect of shock waves on meningiomas' at the 5th National Symposium on Shock Waves, NSSW 2018
6. Dr Amjad Jalaluddin, Resident, received the Award for the Best Paper titled 'Can we preoperatively prognosticate vision in patients undergoing surgery for diaphragm sella meningioma?' at SKULLBASECON 2017 on 29 October 2017



Faculty

Dr Suresh Nair, Professor (Senior Grade) and Head of the Department (till 30 June 2017)

Dr Mathew Abraham, Professor and Head of the Department (from 01 July 2017)

Dr Easwer H V, Professor

Dr Krishnakumar K, Professor

Dr George C Vilanilam, Additional Professor

Dr Jayanand Sudhir, Assistant Professor

Dr Prakash Nair, Assistant Professor



DEPARTMENT OF PATHOLOGY

The Department provides round-the-clock laboratory and autopsy services, participates in academic activities and carries out research on cardiovascular and neurological diseases.

Activities

The Department provided surgical and autopsy services and immunology tests pertaining to cardiovascular, thoracic and neuropathology to the clinical Departments. The clinical services provided by the Department during the year are summarized in the Table below:

Category	No.
Neurosurgical biopsies	931
Cardiovascular & thoracic biopsies	367
Frozen sections	363
Cytology	17
Paraffin blocks	4252
Immunohistochemistry	3417
Immunopathology	4774
Autopsy	2

Research Programme

Rheumatic heart disease

The study on rheumatic disease by Dr Deepa Surendran, PhD Scholar, under the guidance of Dr S Sandhyamani, was completed. The presence of Group A Streptococcus in several excised valves was confirmed using immunohistochemistry and PCR techniques on formalin-fixed, paraffin-embedded tissue biopsies.

Awards and Honours

1. Dr Deepa Surendran, PhD Scholar, received 3rd Prize for the paper "Detection of Group A Streptococci in rheumatic valves by immunohistochemical analysis" at the Annual Conference of the Cardiological Society of India - Kerala Chapter, at Alappuzha on 5 November 2017
2. Dr S Sandhyamani was awarded a special Certificate of Appreciation for her paper "Unique findings in idiopathic pulmonary haemorrhage: lipofuscinosis and platelet dysfunction, a new observed entity" at APCON 2017 in Bhopal on 8-10 December 2017

Events organized

The CME, 'Cardio-Vascular Pathology Update 2018', was conducted on 11-12 March 2018 at SCTIMST (Figures 31 & 32).



Faculty

Dr S Sandhyamani, Professor & Head of the Department

Dr Deepti A N, Associate Professor

Dr Rajalakshmi P, Assistant Professor

Technical

Ms Sushama Kumari P, Scientific Officer (Lab)

Mr James T, Junior Scientific Officer

Ms Neena Issac, Technical Assistant (Lab) - A

Ms Resmi S R, Technical Assistant (Lab) - A



Figure 31. Professor Jaya Deshpande delivering a lecture at Cardio-Vascular Pathology Update 2018



Figure 32. Cardio-Vascular Pathology Update 2018



PAIN CLINIC

Patient-management decisions at the Comprehensive Multidisciplinary Pain Clinic are taken based on consensus arrived at by various departments of the institute. The services provided in the Clinic (Figure 33) include Outpatient Clinic on Fridays and the following interventional procedures:

1. Transforaminal fluoroscopy-guided injections
2. Trigger point injections
3. Musculoskeletal infiltrations
4. Ultrasound-guided sacro-iliac joint interventions
5. Selective dorsal root ganglia radiofrequency ablation (ultrasound-guided)
6. Facet joint interventions (fluoroscopy-guided)
7. Epidural steroid and anaesthetic injections
8. Radiofrequency ablation in trigeminal neuralgia (fluoroscopy-guided) and CT confirmation of ablator tip
9. Radiofrequency ablation of stellate ganglion in chronic regional pain syndromes (ultrasound-guided)
10. Ultrasound-guided stellate ganglion block
11. Regenerative Prolotherapy: Platelet-Rich Plasma (PRP) therapy using the patient's own blood component for regenerative and healing therapy

Activities

During the year, 767 patients were catered to in the Clinic and Intervention suites, the details of which are provided in the Table below:

Procedure	No.
Review patients	605
Second opinion referrals	56
Direct referrals	8
Minor interventions (epidural injections, nerve blocks)	45
Major interventions (Gasserian ganglion radiofrequency ablation)	9

Trigger point injections	22
Musculoskeletal anaesthetic with steroids	2
Regenerative Prolotherapy	20
Total	767

New Initiatives

Prolotherapy (in collaboration with the Department of Transfusion Medicine) was performed with the patients' own platelet rich plasma in chronic pain conditions, including osteoarthritis, rheumatoid arthritis and bursitis.

Awards and Honours

Dr Subin Sukesan, Associate Professor, won the Best Free Paper/Poster Presentation Session Award for – 'Percutaneous Radio-Frequency Trigeminal Rhizotomy - Combining Bi-plane Fluoroscopy with integrated 3D Tomography - 5 Year Experience with 118 patients' at the International Conference for Recent Advances in Pain 2017 (ICRA) in Pune (Figure 34)

Faculty

Dr Rupa Sreedhar, Professor, Anaesthesiology

Dr Nandakumaran Nair U, Visiting Professor, Physical Medicine and Rehabilitation

Dr Easwar H V, Professor, Neurosurgery

Dr Subin Sukesan, Associate Professor, Anaesthesiology



Figure 33. Procedures performed in Pain Clinic

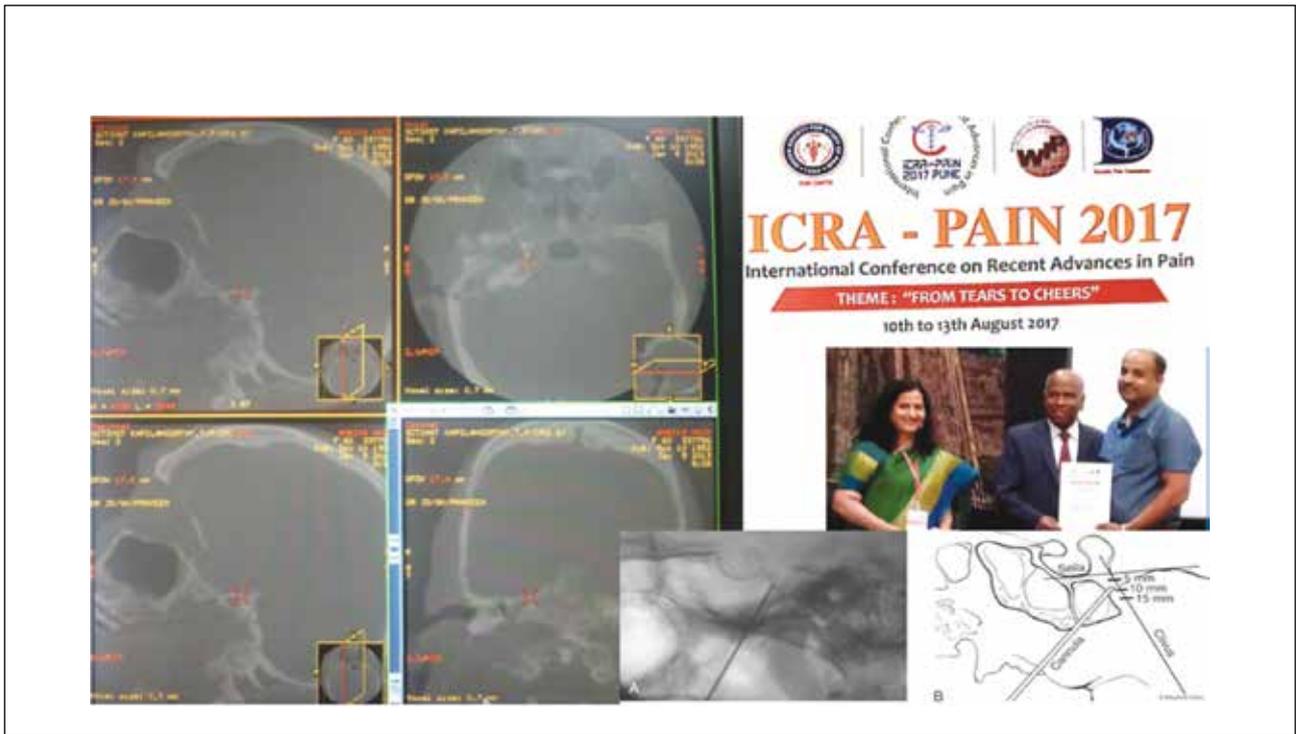


Figure 34. Bi-Plane Fluoroscopic Images and integrated 3D Tomography to trace the needle track along foramen ovale and confirming needle tip at desired target of petrous-clival junction for accessing retrogasserian fibres (Presented at International Conference on Recent Advances in Pain)



DEPARTMENT OF TRANSFUSION MEDICINE

The Department improved its service and academic activities during 2017-18. There was an increase in the work output of the Department in terms of increasing blood collection, component preparation and patient support.

Activities

Service

During the year, 7768 units of blood were collected, all from voluntary blood donors, and 19850 units of blood components were prepared for an increase of 15% over the previous year. 12644 units were issued to the in-house patients. Transfusion support was provided to 1346 cardiac surgery, 1115 neurosurgery and 1087 paediatric cardiac surgery patients. 3818 units of blood components were issued to outside hospitals. 1566 plasma units were issued for plasma fractionation in exchange for albumin and immunoglobulin for in-house patients. 1123 units of fresh frozen plasma were issued to BMT Wing for blood-derived product development. The Department also supported Regional Cancer Centre patients with 546 units of platelets.

Academic

The first batch of MD Transfusion Medicine graduated from the Department in December 2017.

Research Projects

A study, "Autologous platelet-rich plasma for regenerative prolotherapy in chronic musculoskeletal pain" by Dr Vinu Rajendran, funded by the Technology Development Fund, SCTIMST, was ongoing. "Preoperative Disseminated Intravascular Coagulopathy associated with aortic aneurysms: A prospective study" by Dr Debasish Gupta and "Prevalence of unexpected red cell antibodies in healthy donor population in a tertiary care centre in South Kerala" by Dr Gayathri were two other ongoing projects.

Two projects: "Effectiveness of therapeutic plasma exchange in patients with Guillain-Barre Syndrome" by Dr Revathy Nair and "To study the awareness on

blood donation and blood donation practices among the gymnasium goers in Thiruvananthapuram" by Dr Debasish Gupta were successfully completed.

New Initiatives

1. The Department established 'Therapeutic Regenerative Medicine' at the Institute in association with the Pain Clinic by the end of September 2017. This was started with the intention of making Platelet-Rich Plasma (PRP) therapy cost-effective. Autologous PRP prolotherapy was offered to patients with acute and chronic musculoskeletal pain attending the Pain Clinic. A curative approach rather than symptomatic relief and lack of side effects made this therapy superior to conventional therapies. Twenty-five patients received PRP therapy and more than 90 percent of them benefitted.
2. An Apheresis Machine - Spectra Optia was procured this year

Events organized

National Blood Donation Day was celebrated on 27 October 2017. A meeting was conducted by blood donation organizers and blood donors. Thiruvananthapuram Sub-Collector, Dr Divya S Iyer, was the Chief Guest (Figure 35).

Public Awareness Programme

Continuous effort was made to increase public awareness about voluntary blood donation. A flash Mob was organized by the students on the concept of safe voluntary blood donation. Marches were conducted by NSS volunteers at different places in Thiruvananthapuram to create awareness and motivate people on the importance of blood donation.

Awards and Honors

The Indian Pharmacopoeia Commission, Ministry of Health and Family Welfare, Government of India, entrusted Prof Debasish Gupta with preparation of Monographs, of all blood components to be published in Indian Pharmacopoeia.



Faculty

Dr P V Sulochana, Scientist G and
Head of the Department

Dr Sathyabhama S, Scientist G

Dr Debasish Gupta, Professor

Technical

Ms Sheeladevi S, Scientific Officer

Ms Sindhu P N, Junior Scientific Officer



Figure 35. National Blood Donation Day celebration. Dr Divya S Iyer, Thiruvananthapuram Sub-Collector was the Chief Guest.

BIOMEDICAL TECHNOLOGY WING





DEPARTMENT OF APPLIED BIOLOGY

The Department plays a major role in providing biological testing services that form the backbone of all product development activities of the Institute. Many of the tests performed by the Department are accredited by COFRAC of France and are essential for technology transfer of the specialized medical products of the Institute. The accredited tests are also extended to external customers from Indian and international industry and academia. In addition, the Department offers several non-accredited tests, which are useful for product development activities. The faculty, research students and Fellows of the Department are engaged in research on various aspects of Applied Biology, which are broadly sub-classified as development of novel biomaterials, tissue engineering using a variety of scaffolds and fabrication techniques, stem cells and regeneration, thrombosis, molecular medicine, microbial technologies, toxicology of biomaterials, sleep research, and disease biology and pathology.

The Department of Applied Biology comprises the Divisions of:

1. Experimental Pathology (including Histopathology Laboratory)
2. Laboratory Animal Science
3. Microbial Technology
4. Molecular Medicine
5. Sleep Research
6. Tissue Culture
7. Tissue Engineering and Regeneration Technologies
8. Thrombosis Research
9. Toxicology

DIVISION OF EXPERIMENTAL PATHOLOGY AND HISTOPATHOLOGY

The Laboratory is unique in the country as a COFRAC-accredited histopathology laboratory with facilities to undertake routine and a wide range of specialized techniques for evaluation of biocompatibility of various materials as per international standards and pre-clinical evaluation of medical devices as per approved protocols. The Division is engaged in the histological evaluation of samples from internal and external customers.

The Division developed an innovative non-detergent/enzymatic method for preparing biomaterial-grade scaffolds from porcine cholecyst (gall bladder). Research is ongoing to prepare various formulations of cholecyst scaffold and evaluate the potential for various applications. Evaluation of Laser Rapid Manufactured (LRM) porous titanium structures for implants is underway.

Product Development

The Division developed an innovative non-detergent/enzymatic method for preparing biomaterial-grade scaffolds from porcine cholecyst (gall bladder), which can be used as wound healing matrix in different types of wounds like excision, burns and diabetic wounds. The technology was transferred to M/s. Optimus Life Science in May 2017.

Research Programmes

1. Various applications of cholecyst-derived scaffold

Research is progressing in the preparation of various formulations of cholecyst-derived scaffold such as powder, hydrogel etc. Preparation of curcumin-incorporated Cholecystic Extracellular Matrix Hydrogel (CEMH) formulations is ongoing.

2. Biological evaluation of LRM Ti-porous structures

In vivo biocompatibility evaluation was initiated



in rabbit model and work is in progress. At short term (one month) post-implantation, no gross abnormalities were found at implant site in both test and control groups. Histologically, necrosis and degeneration were absent, and no intervening soft tissue was noted at implant-bone interface. New bone formation was observed at the interface (Figure 1). New woven bone arising from periosteum and endosteum of bone was observed, which was found filling the interface. Upregulation of Runx2, Collagen I and SPARC were observed at one-month post-implantation in the test group.

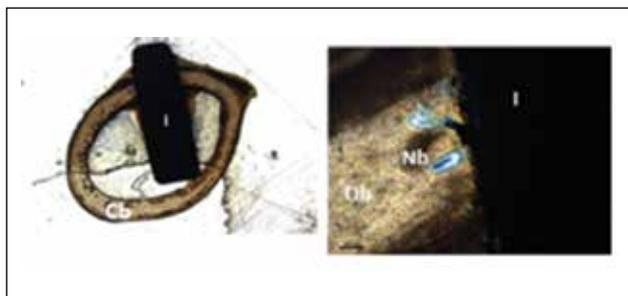


Figure 1. Cross section of rabbit femur cortical bone (Cb) is seen all around with implant (I). Implant interface shows new bone (Nb) formation.

Testing and Evaluation

A total of 454 tissue specimens were received, which included muscle, subcutaneous tissue with implant, penile and vaginal tissue and bone with implant for biocompatibility evaluation as per ISO 10993-6,10. Preclinical evaluation specimens such as small diameter vascular grafts, aortic patch, calvarial defects with drug-eluting beads, corneal graft tissues, dental sockets, rabbit knee joint tissues and skin wound tissues were also received. 19 test reports including accredited and non-accredited reports were issued during the year. COFRAC External audit was completed successfully in February 2018. The Laboratory has maintained quality system for the past 15 years and retained COFRAC Accreditation successfully for intramuscular, subcutaneous and bone implantation tests and mucosal irritation tests.

The Division also performed autopsy with histopathology of laboratory animals as part of sentinel health-monitoring programme for the Division of Laboratory Animal Science.

DIVISION OF LABORATORY ANIMAL SCIENCE

The Division of Laboratory Animal Science (DLAS) facilitates research and testing using small laboratory animals by catering to the care, welfare and management of small laboratory rodents and rabbits. The care and welfare are effected as per ISO 10993 Part-II for the testing facility of which quality system is based on ISO/IEC 17025; 2005. The Division underwent a CPCSEA audit and a COFRAC audit and succeeded in complying with the stipulations thereof. The primary mandate of DLAS is to breed, stock and supply good quality small laboratory animals for testing and research. The Division is under surveillance of COFRAC for the quality system. The Division is CPCSEA-registered and has to its credit many work procedures maintained as per international guidelines applicable to the field. DLAS has set up a state-of-the-art experimental animal facility with Individually-Ventilated Cages (IVC) System and changing stations. The Division is part of several research projects including 5 TRC projects and delivers animal models to elucidate proof-of-concept studies. Apart from these activities, the Division also carried out a training session for budding researchers in small laboratory animal handling, ethics and technicalities of small laboratory animal welfare assessments which was attended by MSc and PhD scholars from across the country. The Division has put up the plans for upgradation of animal facility and worked toward upgrading its CPCSEA licence to that of trading to adhere to the 3Rs in biomedical research.

Research Programmes

DLAS is registered under the CPCSEA guidelines and supplies quality laboratory animals that are cared for and managed as per ISO 17025 to aid testing and research activities. Periodic quality assurance and compliance to ISO 10993 Part II guidelines were ensured.

The Division collaborated with other departments for ongoing projects and research activities including:

1. Evaluation of biodegradable PLGC-fibrin hemostatic graft for skin regeneration



2. Raising antibodies in rabbit model against specific hormones
3. Mitochondrial metabolism and function in type-2 diabetic heart
4. Efficacy evaluation of insulin-loaded microneedles in diabetic animals
5. Efficacy of evaluation of oral insulin nanoparticles in rat model
6. Investigation of semiconductor-based quantum dots and their alloys for whole animal in vivo fluorescence bioimaging and therapeutic application
7. Mitochondrial remodelling for prevention of chronic pressure overload-induced cardiac hypertrophy
8. Alginate scaffold with recombinant growth factors for enhanced wound healing
9. Chitosan/Alginate-based antioxidant polymeric wound dressings for controlled antibiotic delivery
10. An optical peripheral nerve stimulator
11. Bioresorbable nanoporous bioceramic matrices for drug delivery in osteoporosis management

Animals bred and supplied for testing and research during 2017-18 included: Rabbits (NZW:Sctb) 179; Rats (Wi:Sctb/SD:Sctb/SHR) 337; Mice (BALB/c / SA:Sctb) 940; Guinea Pigs (HA:Sctb) 196

Testing and Evaluation

The Division is a part of several research projects including 5 TRC projects and delivers animal models to elucidate proof-of-concept studies.

1. Tissue-generated ceramic for promoting osteointegration in osteoporotic animal models with relevance to clinical problem in women
2. Regeneration of Intervertebral Discs - a tissue-engineering approach
3. Evaluation of electrospun polycaprolactone-based scaffolds in a rat osteoporotic model for bone repair
4. Oxidative stress-mediated stem cell modification in cardiac failure associated with hypertrophic remodelling
5. Anti-hyperglycaemic activity of Aglaia extract in

Swiss albino mice

6. In vivo efficacy of differentiated mesenchymal stem cells
7. Study of carbamazepine embryotoxicity in relation to MDR1 polymorphisms and Pgp expression

DIVISION OF MICROBIAL TECHNOLOGY

The Division has multiple spheres of activity, covering medical device evaluation, research and teaching. Medical device evaluation is conducted on the quality platform accredited by COFRAC of France. Research activities in the Division are application-oriented or basic research with translational value.

Product Development

'Rapid UTI diagnostic kit with antibiotic sensitivity' developed by the Division was transferred to M/s. Agappe Diagnostics for commercialisation and an MoU was signed.

Research Programmes

The research activities focussed on addressing medical device-related infections. This was undertaken by studying the trigonal interactions between material/device, bacteria and the cell or tissue. The tendency of bacteria to form biofilms on devices and in tissues leads to chronic infections, which is recalcitrant to therapy. The bacterial behaviour in biofilms was investigated to understand the mechanism of evasion of the host immune system.

1. Characterisation of *Bacillus* species producing antimicrobial molecule against Methicillin-Resistant *S.aureus* (MRSA)

In this era of rising antibiotic resistance, there is an urgent need to develop new antibiotics. From among thousands of microorganisms screened, we identified an antibiotic-producing bacillus strain, *Bacillus pumilis*. Efforts were underway to purify the antibiotic for characterisation.

2. Biofilm formation and immunomodulation by *Acinetobacter baumannii* on endotracheal tubes: in vitro study



DIVISION OF MOLECULAR MEDICINE

Product Development

1. Growth factor-incorporated biological scaffold for wound healing application

The programme aims to develop enhanced wound healing scaffold with growth factors for chronic skin wounds. Growth factors allow the wounds to heal faster and the major objective of the programme is to develop cost-effective bandages with growth factors which will be affordable to the general population.

TGF-alpha and VEGF are two growth factors that have a critical role in wound healing. We have incorporated these growth factors in a bio-scaffold to augment the healing process. These growth factors were expressed as functional peptides to increase the stability and bioactivity. This process also helped in reducing the cost of development of these growth factors. Preclinical results showed that a combination of the two growth factors had a significant effect on the healing of chronic skin wounds.

2. Point-of-care diagnosis for pulmonary tuberculosis using loop-mediated amplification of DNA

The Division developed a modified LAMP reaction for faster detection of pulmonary tuberculosis. The assay is cost-effective and can be carried out within an hour in 20 patient samples at a time. A field trial has been planned and will be carried out in collaboration with Medical College, Trivandrum.

Research Programmes

1. Interactome and connectome alterations in the brain during physiological and pathological conditions

Learning and memory are two of the fundamental functions of the brain. Though it is known that neuronal plasticity has a role in this pathway, the exact mechanism by which neuronal cells receive

and recall memory is not clear. *Caenorhabditis elegans*, a nematode model with limited but well-defined nervous system, was used to elucidate the neuronal connectome involved in conditional learning paradigm. One of the critical observations was that the base levels of neurotransmitters, especially dopamine, tyramine, insulin and glutamate, are critical in the development of behaviour patterns in this organism. A series of genetic mutants were analysed to further confirm how alterations in the receptor levels of these neurotransmitters affect the learning paradigm. Furthermore, the studies on insulin pathway as well as imprinting suggested that learning deficiency could be linked to epigenetic factors that are critical for the development of proper circuits during early development. This led to the assumption that there are incidences of consolidation of synapses during early development stages in the brain. In addition, neural circuits involving interneurons such as AIY, CEP and RIM are critical in learning and memory pathway. In olfactory learning pathway, a series of receptors including *str-2*, *sra-11*, *glc-3*, *tdc-1*, *lgc-55*, *daf-2* and *ins-1* receptors have a critical role at various stages. Besides, dopamine neuron degeneration was found to have a significant impact on learning in this model system.

To further probe how neurodegenerative diseases like Alzheimer's and Parkinson's disease (PD) affect the memory pathway, mutant worms expressing human alpha-synuclein and beta-amyloid in nerve cells were used. As in PD patients, worms expressing human alpha-synuclein in their dopamine neurons showed neurodegeneration as the organism aged. Dopamine neurons were more sensitive to metallic salts and developed degeneration.

A series of glutamate receptors like *glr-1* and *-2*, *glc-3*, *nmr-1* and *-2* mutants were used to see how the memory formation and synaptic plasticity are interlinked. Besides, epileptogenesis and role of NMDA receptor subtypes in hippocampal neurons and astrocytes were probed using electrophysiology. Blocking NMDA receptors was found to alter the signal spikes in the brain slices.



2. Mechanism of epileptogenesis in young and adult brain – role of NMDA receptor subtypes in hippocampal neurons and astrocytes

NMDA receptors (NMDAR) are the critical molecules involved in memory formation, synaptic plasticity and excitotoxicity. In this project, the role of NMDAR in epileptogenesis was dissected. The role of NMDAR in epileptic seizure in living brain slices was studied with electrophysiology techniques. Pilocarpine rat models (in epilepsy) were created to study the pathological changes in rat brain due to epileptic seizures.

DIVISION OF SLEEP RESEARCH

The Division of Sleep Research investigates the unresolved questions related to sleep and its functions. This Division aims to explore the neural mechanisms involved in sleep regulation and conducts translational research in the emerging aspects of sleep medicine for improving human health. The laboratory is equipped with the latest instruments and technology to conduct sleep research. One of the current studies explored the role of sleep in developmental programming for cognition and neural dynamics in brain using insomnia model. Sleep deprivation-induced changes in neural dynamics were studied using multiplexer system. Further, the role of prenatal sleep in modulating cognitive behavior in offspring was examined. Sleep was monitored electrophysiologically by means of stereotaxically-implanted EEG (for electrical activity of brain) and EMG (for muscle activity) electrodes. Active principles of the medicinal plants were tested for regulation of sleep as part of translational research. The laboratory also aims to research inflammatory markers after acute and chronic sleep deprivation.

The Division of Sleep Research received a grant from the Cognitive Science Research Initiative Programme of the DST. Research findings from the Division were published in international journals and presented in various international meetings and forums. The Division trained students in techniques to learn sleep and cognition in free-moving animals.

Research Programmes

1. Role of prenatal sleep deprivation in rat models

The Division conducted studies to explore the role of sleep in developmental programming for cognition. Sleep deprivation during pregnancy is an emerging concern as it can adversely affect the development of the brain of the offspring. Sleep deprivation studies in human subjects during pregnancy are difficult to perform due to ethical issues. Investigations were carried out in an animal model (Wistar rat) to study the effects of deprivation of Rapid Eye Movement (REM) component of sleep during the third term of pregnancy on the sleep-wake profiles of neonates. Sleep-wake patterns were assessed through electrophysiological measures and behavioural observations, during postnatal days 1 to 21, on pups born to REM sleep-deprived dams and control rats. Pups of REM sleep-deprived dams had active sleep that was not only markedly higher in percentage during all the studied days, but also had reduced latency during later postnatal days 15 to 21. Quiet sleep and wake periods were lower. These factors, along with less frequent but longer sleep-wake cycles, indicated maturational delay in the sleep-wake neural networks. Disruption of time-bound growth of sleep-wake neural networks indicated the need for extended care of pups. Examination of altered sleep-wake patterns during early development may provide crucial information about deranged neural development in the offspring. This study showed that maternal sleep deprivation during pregnancy can delay and impair the development of sleep-wake profile in the offspring.

2. Alpha-asarone therapy for insomnia

The management of insomnia and anxiety is a challenge as commonly used hypnotics have undesirable side effects, especially with continuous usage. The Division evaluated the hypnotic potential of alpha-asarone, an active principle of herb, *Acorus calamus*, as a relatively safe substitute drug for insomnia. After identifying the optimal dose of alpha-asarone for improving sleep, the effect of repeated administration of this optimal dose (10 mg/kg body weight) for five days was evaluated on sleep-deprived rats (Figure 3). Alpha-asarone at 10 mg/kg improved the quality



of sleep, as indicated by increased Non-rapid Eye Movement (NREM) sleep bout duration, reduced arousal index, and decreased bout frequencies of NREM sleep and wakefulness. A marginal decrease in the hypothalamic and body temperatures was also observed. Higher doses (80-120 mg/kg body weight) on the other hand, not only reduced the quantity and quality of sleep, but also produced hypothermia. In sleep-deprived rats, administration of 10 mg/kg alpha-asarone for five consecutive days improved the quality of sleep in contrast to the vehicle and a known hypnotic, midazolam. Improvement in NREM sleep quality was observed when the difference between the

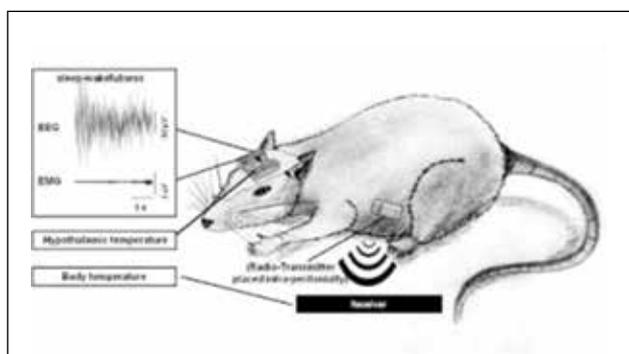


Figure 3. Diagram showing the experimental setup for acquisition of biological signals (sleep-wakefulness, body and brain temperature) in free moving animal for drug bioassay

hypothalamic and the body temperature was minimum. An enhanced association between NREM sleep bout duration and hypothalamic temperature was also observed after administration of 10 mg/kg alpha-asarone. This is the first study on the hypnotic property of alpha-asarone, suggestive of its potential in the treatment of insomnia.

The Division also reported the importance of sleep in maintenance of appropriate synchrony among various neuronal networks during REM sleep, based on several experiments that established deficits in learning and memory after sleep loss.

DIVISION OF TISSUE CULTURE

The Division offers in vitro cell culture tests and studies to internal and external customers under the quality platform. It provides technical support

for product development, participates in research and development activities and other academic programmes of the Institute. Research areas include cell-material interaction, stem cells, scaffolds for tissue engineering, 3D bioprinting and in vitro tissue models.

Research Programmes

1. Biofabrication of liver constructs by 3D bioprinting

As a part of institute's TRC programme on developing liver constructs for toxicity evaluation, 3D Bioprinting Facility was initiated at the Division of Tissue Culture. The main component required in 3D bioprinting is the hydrogel system that would serve as bioink when mixed with live cells. A novel polymeric formulation was developed for cell encapsulation, tissue engineering and 3D bioprinting. The multi-component extrudable hydrogel system contains a functionalized biopolymer, a photo-initiator and a cocktail of antioxidant free radical scavengers to be used as an ultraviolet light-safe bioink for 3D bioprinting. A locally procured 3D bioprinter was customized to suit the printing requirement of liver tissues. Primary rat hepatocytes bioprinted using the novel bioink showed viability and liver-specific functions such as synthesis of albumin and urea. The functionally active 3D bioprinted construct also showed stability over 14 days in culture confirming its suitability as an in vitro toxicity system (Figure 4).

Biofabrication of tissues in vitro requires organization of tissue structures for expected tissue functionality. A gelatin-based hydrogel was evaluated as scaffold for hepatocytes and hepatocyte spheroids.



Figure 4. (A) Customised 3D Bioprinter, (B) liver construct printed using in house developed bioink with rat hepatocytes and (C) the construct after 14 days of in vitro culture



2. Alternate adult stem cells for ocular surface regeneration

The three-year study to identify alternate cell sources to limbal stem cells for use in corneal regeneration or in limbal stem cell deficiency was completed. Stem cells from adult rabbit tissues other than the eye were evaluated for the feasibility of differentiating to corneal epithelial lineage. Stem cells from tissues with (a) epithelial origin (epidermis, hair follicle, oral mucosal epithelium), (b) mesenchymal origin (bone marrow and adipose-derived mesenchymal stem cells (MSC)), and (c) peripheral blood mononuclear cells (PBMNC) from circulating blood were studied. Isolated stem cells were differentiated into corneal lineage using rabbit limbal explant culture conditioned medium. Differentiated cells expressed corneal epithelial marker CK 3/12 after 14 days of induction. The differentiation capability varied among different

sources as per the CK3/12 expression of 76% in oral mucosal cells, and 30-40% in adipose MSCs, bone marrow MSCs and PBMNCs. Using a thermoresponsive culture surface prepared by modifying tissue culture dishes with poly N-Isopropylacrylamide co-glycidylmethacrylate (NGMA), the transdifferentiated cells were retrieved as cell sheets as an alternate to corneal graft. The transdifferentiated adipose cells sheets were transplanted to limbal stem cell deficient-rabbit models. Results showed ocular surface regeneration with improved corneal clarity compared to sham models (Figure 5).

3. Mechano-biology of muscle regeneration

The study investigates the cellular mechanism involved in the inhibition of the molecular chaperon Hsp70 in cardiac and skeletal muscle cells. Fundamental features of heterogeneity



Figure 5. Transplantation of adipose mesenchymal stem cell-derived corneal cell sheet after one month: (A) control eye (B) Sham model (C) cell sheet transplanted eye

among muscle cells and other cells are their differences in self-renewing potential and the differences in response to activation for proliferation and differentiation. The reason and the mechanisms that control the adoption of this difference in response remain unclear. Since cardiac and muscle cells function under stressful conditions, heat shock proteins play a major role in regulation of protein expression in them. 70-kDa heat shock proteins (Hsp70s) assist a wide range of folding processes, including the folding and assembly of newly synthesized proteins, refolding of misfolded and aggregated proteins, membrane translocation of organellar and secretory proteins,

and control of the activity of regulatory protein. Specifically, the study focussed on the role of Hsp70 in differentiation of cardiac and skeletal muscles. The present study revealed that Hsp70 has a prominent role in myoblast differentiation.

4. Periodontal ligament regeneration

Human periodontal ligament (HPDL) cells have been identified as a potential cell source with stem cell property. The osteogenic differentiation potential of HPDL cells was evaluated in the presence of modified bioactive calcium cements - calcium sulfate, calcium phosphate and bioactive calcium sulfate cements. The results showed



that HPDL cells exhibited differentiation and mineralization potential with mineralized nodules, without external osteogenic supplements in the presence of Bioactive Calcium Sulphate material. This material could find enduring application as a 'barrier graft' material for periodontal regeneration.

5. Cell sheet engineering of myocardial tissues

Human umbilical cord-derived mesenchymal stem cells (hUCMSC), PDL cells and rat mesenchymal stem cells (MSC) were differentiated using the cytidine analogue, 5-azacytidine. The differentiated cells were grown on thermo-responsive culture surface modified with NGMA and were retrieved as intact cell sheets.

Cell sheet with enormously large cell number is required for soft tissue engineering avoiding external scaffold materials. A novel method for generating thick cell-dense construct was prepared using cytocompatible soft, transparent polymer mould cast on tissue culture dishes spin-coated with NGMA. Rat MSCs differentiated to cardiomyocyte lineage, seeded on customized plates, were retrieved as 62 μm thick cell dense construct.

Testing and Evaluation

The Division is a cytotoxicity testing facility of the Institute, concentrating on cell-biomaterial interaction. The tests for in vitro cytotoxicity testing of medical devices are done as per ISO10993-5 and are accredited by the COFRAC, France. Apart from these established testing procedures, the Division also accepted customized in vitro evaluation tests as study plans as per specific requirements of the customers. The Division completed 68 test requests for cytotoxicity evaluation of various biomaterials and devices that included nasopharyngeal tubes, ceramic articles such as hydroxyapatite bone grafts, metallic articles such as teeth alignment brackets, and composite materials.

DIVISION OF TISSUE ENGINEERING AND REGENERATION TECHNOLOGIES

Major area of research in the Division is the designing of suitable biological substitutes/tissue-engineered constructs through the principles of tissue engineering. Current major research programmes of the Division are directed to: (a) develop novel, biodegradable and biomimetic "designer" scaffolds, (b) understand the regeneration process using adult cells and directed stem cell differentiation, and (c) delineate the molecular pathways that regulate the growth factors and other molecules or drugs to promote regeneration. The Division also deals with usage of bioreactors, wherein the in vivo environment is recapitulated and monitored in vitro, while exerting physiologically relevant mechanical and biochemical stimuli to guide neo-tissue development and the use of bioprinting technology to generate cell-incorporated tissue constructs for various applications.

The Division also contributes to other laboratory and institutional programmes, national and international, with indigenously developed innovative scaffolds and biomaterials. Scaffolds made by conventional techniques, electrospinning, 3D printing, 3D bioprinting as well as regulator combinations generated by the Division find additional medical applications as products for drug delivery, wound healing and haemostats. Wound dressing and injectable gels for cartilage repair are the other promising products of this Division.

Product Development

1. An injectable hydrogel for repair of cartilage injury and growth plate defects

The incidence of cartilage injury or damage is quite high and the etiology is traumatic or degenerative. Most of the trauma-related injuries to the cartilage result from sports or accident-related trauma. This technology is a Class III injectable hydrogel to be used during arthroscopic microfracture surgery for focal lesions and can function as a 'microfracture plus' therapy with added clinical effectiveness. Further, the gel may also be used as a delivery vehicle or a spacer for encapsulation of growth

plate chondrocytes for the repair of growth plate defects.

Screening of raw materials and validation of test procedures for preparation and characterisation of the final gel was completed. An applicator system was designed and patented for delivering the gel system (Figure 6).



Figure 6. Applicator system designed for delivering the gel system for cartilage repair

2. Lint-free absorbent dressing for surgical and highly exudating chronic wounds

The present project at the proof-of-concept phase focussed on the development of a medical dressing with controlled pore size that is expandable, biocompatible, lint-free, soft, has fast wicking, and has a high liquid holding capacity. The uniqueness of this wound dressing is that it would present a pliable and foldable dressing as gauze roll. Instantaneous wicking and high liquid holding capacity was attained by controlling processing procedure. The project investigated a blend formulation of polyvinyl acetate (PVA) with a polysaccharide to enhance moisture retention and ease of removal. The uniqueness of this external dressing is that this dressing can be tailored to meet several size requirements that would also further expand the scope of its use (Figure 7).



Figure 7. Lint-free absorbent dressing

Research Programmes

1. Enhancing insulin production of islets-like clusters derived from mesenchymal stem cells by tranfecting microRNAs

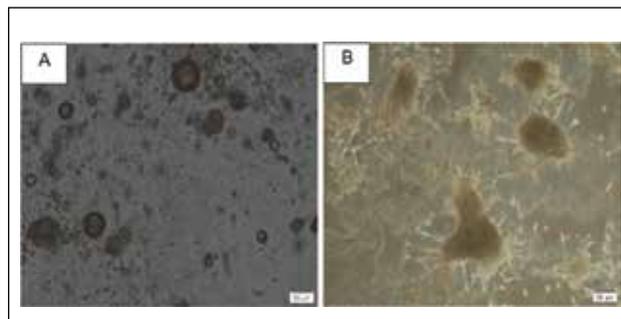


Figure 8. (A) Dithizone stained rat islet cells and (B) stem cell differentiated islet-like clusters

For islet tissue engineering application, DEXGEL scaffold was prepared by cross-linking gelatin with dextran dialdehyde. Physicochemical characterisation and cytocompatibility studies of the scaffold were carried out. Adult mesenchymal stem cells (MSCs) were found to be viable post-seeding on the scaffolds even after one month. For construct preparation, MSCs were isolated from rat, checked for stem cell property and trilineage differentiation potential as well as cell surface protein specific for the MSCs and cytoskeleton arrangement. MSCs were differentiated into islet-like clusters using specific induction media (Figure 8).

2. Tracheal tissue engineering

The scaffold for the trachea was attempted through electrospinning. Even though electrospinning is a well-established technique, the lack of cell infiltration into the porous structure is still a major disadvantage. Here the technique was modified to generate a 3D construct with uniform cell distribution throughout the scaffold. The modification involved electrospinning of cells simultaneously with electrospinning solution to have the cells seeded. A blend of polycaprolactone (PCL) and graphene oxide (GO) was electrospun simultaneously with electrospinning cells from the other side of the collector (Figure 9).

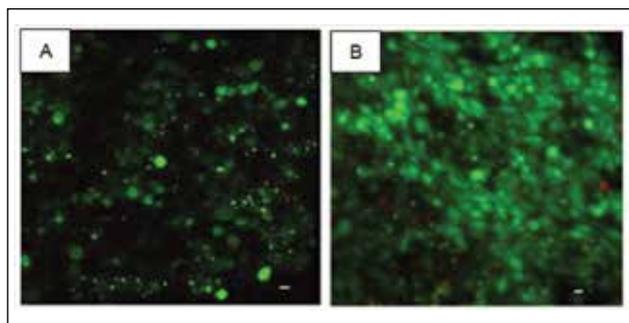


Figure 9. Live/Dead staining after 3 days culture (A) polycaprolactone (PCL), (B) polycaprolactone and graphene oxide (PCL-GO)

3. Differentiation of MSCs into chondrocytes by sustained delivery of miRNAs using chitosan hydrogel

The major objective of this PhD project is to design and develop scaffold for capturing distinct layers of osteochondral tissues for repair of critical size defects and to engineer this scaffold for controlled, localized and sustained delivery of specific signalling molecules from these MSC-laden scaffolds. Chitosan nanoparticles were prepared for transfecting oligomers into the cells by ionic gelation method using tripolyphosphate. Oligomer-transfecting agent complexes of different concentrations were prepared and cellular internalization was studied. The results showed enhanced transfection with nanoparticles of concentration 700 $\mu\text{g/ml}$. A 21 day siRNA release study from CHDA gel (2:1) loaded with 700 microgram of chitosan nanoparticles conjugated with 45 nm siRNA was also performed. At 48 hours, the concentration of siRNA released from the gel was 9.955 nanomolar. siRNA entrapment and determination of entrapment efficiency of Cs-TPP nanoparticles were studied. The entrapment efficiency was 76.1 %.

4. Tissue-engineered small diameter small vascular graft

Cell and scaffold-based blood vessel engineering has gained considerable relevance over the past years. A range of polymers, both synthetic and natural, are used as scaffold material to make vessel replacement in terms of endothelisation

and patency. Similarly, autologous cell source in which patient-specific cells can be used to make graft capable of being replaced is the major feature of patient-specific tissue engineering. On the basis of this, adipose-derived stem cell-based tissue engineering strategy has been adapted on acrylate-based material that was previously proved to be endothelial binding and blood compatible. The polymer was synthesised and electrospinning of the same was standardised to make tubular scaffold. The graft was characterised for its mechanical robustness, media uptake ability and morphological characteristics. The human adipose-derived perivascular cells, adventitial cells and pericytes were isolated and co-cultured with endothelial cells in order to analyse effect of extracellular matrix - collagen I, collagen IV, elastin - deposition by cells and maintenance of

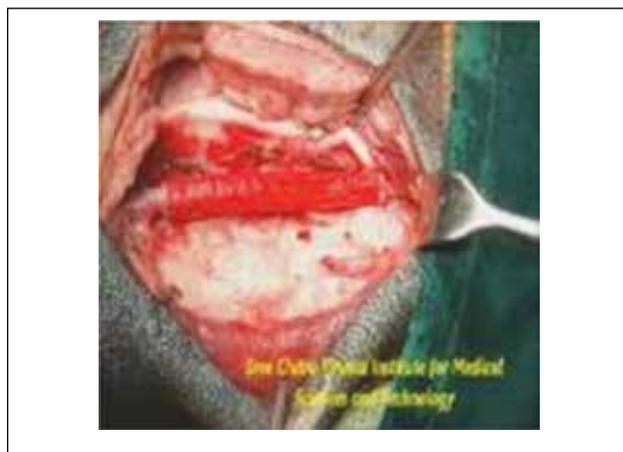


Figure 10. Gelatine vinyl acetate – poly caprolactone co-electrospun scaffold with adipose-derived mesenchymal stem cell differentiated to smooth muscle cells implanted in ovine model

vessel stability by increased or decreased expression of genes and secretion of protein factors, PDGFB, VEGF and eNOS.

As a different strategy, the in vivo endothelial progenitor cell homing property of adipose-derived mesenchymal stem cell differentiated to smooth muscle cells on gelatine vinyl acetate – poly caprolactone co-electrospun scaffold was analysed in ovine model (Figure 10). A patency of 67% was achieved. Histological analysis and scanning



electron microscopy (SEM) analysis showed neointima formation of both proximal and distal anastomosis while neointima with non-uniform thickness was noted in the mid-graft region.

5. 3D-printed narrowed pore membrane bags for encapsulating islet clusters for enhanced islet viability and functionality in pancreatic islet transplantation

This study was an attempt at a combined approach of micro and macroencapsulation for effective islet transplantation, which could serve as an alternate modality of treatment for diabetes mellitus. Microencapsulation was done using alginate beads prepared using 5% alginate solution. The application of 3D printing for making macro immune-isolation bags is a novel strategy wherein the diffusion property can be controlled. Polyurethane membrane was 3D printed and characterised. Glucose challenge assay was done to confirm insulin release from encapsulated rabbit islets. The main benefit in using the 3D printing was that narrowed pore channels could be generated with a pore size $556.98 \pm 50.11 \mu\text{m}$ x $543.5 \pm 29.86 \mu\text{m}$ when two layers were drawn. At the end of 10 layers, the pore size narrowed rapidly, and pore size could not be determined from the SEM images. The encapsulated islet cells released insulin at a rate of $9.72 \pm 0.65 \text{mU/L}$ when treated with 20mM glucose on day 7 and thus functionality was confirmed. The cells were found to be functionally active when live/dead cell assay was done after 21 days. Hence this study is a promising starting point for exploring the potential advantages of 3D printing in developing narrow pored channel membranes or bags for islet encapsulation and the use of combined micro and macro encapsulation strategy for further scale up technologies in the area of pancreatic islet transplantation (Figure 11).

6. Creating microfluidic channels on paper using 3D printer for use as point-of-care analytical device

Paper-based analytical devices (PAD) are successfully being used as point-of-care devices in modern healthcare technology mainly because

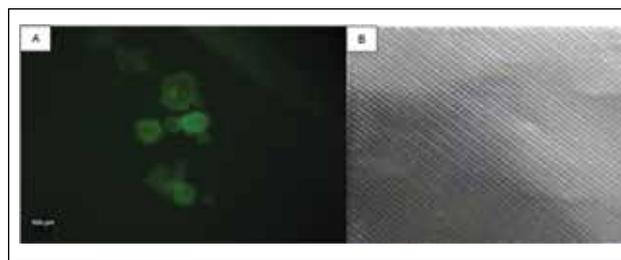


Figure 11. (A) Fluorescent images of live and dead staining of islet cells. (B) Photograph of the 3D printed 10 layered polyurethane membrane

they are easy to fabricate and inexpensive, giving accurate results at the same time. 3D printing is another emerging area that is successfully being implemented for fabrication of materials, and has some promising features such as easy fabrication and programmable flow speed. In this study, it was attempted to create hydrophobic channels on Whatman Grade 1 filter paper by 3D printing using polycaprolactone (5%w/v in chloroform) as the ink, which allows its deep penetration and narrow channel formation. Two, three and four channel systems were attempted. The width of the hydrophobic channel barrier could be manipulated by adjusting the diameter of the nozzle used and the number of layers being printed. To add to the mechanical stability and to prevent the vertical fluid spread, a polycaprolactone backing support was provided. Characterisation of the printing technique was done to assess the printing resolution (minimum width of the hydrophilic channel and effective hydrophobic barrier). A simulation study of the fluid flow was also carried out in order to assess the change in fluid flow with fluids of varying viscosity to optimise the device design. Compared to the widely used fabrication methods of μPADs and wax printing, this method using 3D printed PCL microfluidic channels had less lateral spread of the hydrophobic barrier after compression, for example, $0.339 \pm .0032 \text{mm}$ for a printed width of $2.73 \pm .067 \text{mm}$. Hence, this method will prove to be a more convenient, fast and low-cost alternative method to meet different application requirements.



DIVISION OF THROMBOSIS RESEARCH

The Division focuses on the development of biological products for various therapeutic applications. This year, collaboration with Rajiv Gandhi Centre for Biotechnology, Trivandrum (RGCB) was established for transfection of adipose-derived stem cells with two angiogenic genes, vascular endothelial growth factor and hypoxia inducible factor-1 with promising results. An image-based high-throughput method for detecting caspase activation using stable cells expressing FRET-based genetically-encoded sensor technology developed in RGCB was carried out to test apoptotic effect of human serum albumin-curcumin (HSA-Curc) and promising results were achieved. For testing anticancer effect of HSA-Curc conjugate in lung cancer model in SCID mice using RGCB animal facility, RGCB-IAEC approval was obtained

Product Development

1. Blood product component production

The fibrin sealant production technology was scaled up and shelf-life study assured product integrity till 9 months when stored at 4°C. The study will continue till 24 months using stored samples from the same batch. A project funded by TRC was initiated for standardization of purification of factor VIII out of cryoprecipitate of pooled fresh frozen plasma (FFP), and albumin and intravenous immunoglobulin from cryopoor plasma. Once completed, a minimum of 3 products can be isolated from the same pool of plasma.

2. Point-of-care sensing device for PT/INR monitoring

In this TRC funded project, a new prototype of sensing device for PT/INR monitoring was fabricated and different parameters were validated. Strips were modified and checked under different conditions. Patient and control sample INR values were compared with Clinical Central Laboratory instruments and results were found promising with good repeatability and reproducibility.

3. Development of skin substitute

A biodegradable hemostatic hybrid matrix of

synthetic terpolymer (poly lactide-glycolide- ϵ -caprolactone) and fibrin sealant with added hyaluronic acid (PLGC-F-HA) was evaluated in burns wound (4x4cm²) rabbit model (Figure 12). Its hemostatic potential, suture-less application on the debrided wound and wound regeneration potential in 28 hours were established. Product dossier with essential information for further approval of the product for preclinical and limited clinical trial was ready.



Figure 12. PLGC-F-HA immediately on application to burnt and debrided skin tissue

4. Anticancer effect of human serum albumin-curcumin

Progress was made by validating conjugation efficiency of HSA to curcumin as part of a TDF-funded project. Endocytosis of the HSA-Curc conjugates by both lung cancer cells (A549) and endothelial cells (EC) was demonstrated. Optimum concentration for inhibition of inflammatory response in EC was identified. Pharmacokinetics study of HSA-Curc was initiated in rabbit model to establish absorption, distribution, metabolism and elimination (ADME).

Research Programmes

Research programmes of the Division focus on development of regenerative potential of hADMSCs. Adipose tissue collected from subcutaneous tissue either surgically from patients under surgery (SCTIMST-IEC approved) and by lipoaspiration in a local hospital (KIMS-IEC approved) was processed. The ADMSC differentiation into cardiomyocytes, oligodendrocytes and neurons, endothelial cells, smooth muscle cells, chondrocytes, skin and cardiac fibroblasts

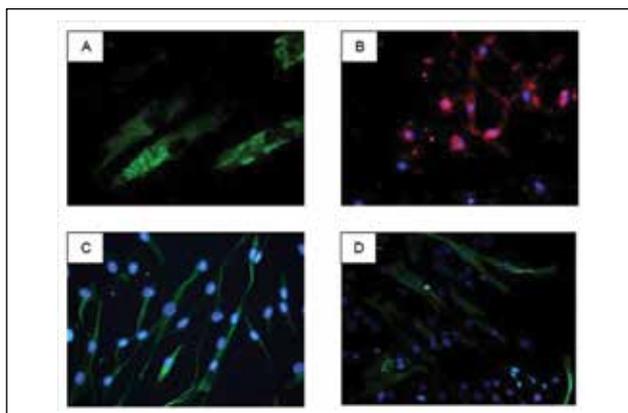


Figure 13. ADMSC differentiation to (A) cardiomyocyte, stained with Troponin T, (B) oligodendrocyte stained with myelin basic protein, (C) neurons stained with beta-tubulin 3, (D) smooth muscle cells stained with smooth muscle actin

and keratinocytes (Figure 13) were achieved with in-house developed cell-specific protocols using combination of growth factors in the medium and fibrin-coated dishes. Differentiation into different lineages were confirmed by analysing up-regulation of markers at transcriptional and translational levels. In the WoS-A project on “Effect of vascular endothelial growth factor transfected in promoting angiogenesis for chronic wound healing”, it was demonstrated that electroporation is an effective approach for overexpression of angiogenic genes. Human umbilical vein endothelial cells were used as an in vitro model to study angiogenesis. Five different studies in animal models were in progress to test regeneration of spinal cord post-injury, wound angiogenesis, myocardial infarction and knee joint inflammation.

Testing and Evaluation

Various COFRAC accredited tests were offered to test materials/components used for blood-contacting devices undertaken by various investigators as part of TRC programmes. Several samples were tested for platelet function, submitted by internal and external patients as part of special service. The testing laboratory supported quality control programme of the Institute’s Blood Bank by testing components such as cryoprecipitate for factor VIII, fibrinogen and platelet-rich plasma for aggregatory response.

DIVISION OF TOXICOLOGY

The main aim of the Division is the toxicity/biocompatibility evaluation of materials, medical devices, and tissue engineered products intended for the fabrication of medical products and investigation of potential safety/biological hazards of nanomaterials used for health care applications. The Division is accredited by COFRAC France as per ISO 17025 and has full-fledged facility for the pre-clinical safety and toxicity evaluation of various materials and medical devices as per International Standards such as ISO, USP and ASTM.

Product Development

Development of kit for testing pyrogenicity of whole blood

The proof-of-concept for the development of an in vitro pyrogen test kit for the evaluation of pyrogenicity using human whole blood was completed. The validation process under different environmental conditions was in progress.

Research Programmes

1. Integration of nanographene with Rat neonate cerebellar granule neurons and associated toxicity : an in vitro and in vivo approach (ICMR Support)
2. Interaction of brain astrocytes with Zinc Oxide nanoparticles and related inflammatory and neurotoxicological response using rat model (UGC Support)
3. Interfacing of nanographene with mouse bone marrow mesenchymal stem cells and its allied molecular toxicity using in vitro and in vivo methods (ICMR support)

Testing and Evaluation

The following toxicity assays were done during the year:

Total materials received for toxicity studies: 36

Total number of reports released: 43

(Maximization test for delayed hypersensitivity – 6; Intracutaneous Test – 8; Acute systemic toxicity test – 16; Pyrogen Test – 1; Bone Implantation – 2 and Animal skin irritation Test – 3)

Physico-chemical analysis of potable water for various Divisions: 15.



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DEPARTMENT OF BIOMATERIALS SCIENCE AND TECHNOLOGY

The Department focuses on the development of novel biomaterials and the translation of these technologies into viable and affordable products. It comprises the Divisions of:

1. Dental Products
2. Bioceramics
3. Biophotonics and Imaging
4. Biosurface Technology

DIVISION OF DENTAL PRODUCTS

A new project for development of bioinks for 3D bioprinting using click gels commenced this year. The bioink development process for liver constructs was optimized in the 3D bioprinting project. A simple approach for the development of multifunctional oligomers for fast in situ step growth photopolymerization for medical application was developed. In vitro evaluation of polymeric microneedles was completed. A project entitled “Development of bioactive bone cement based on novel inorganic-organic hybrid resins” supported by KSCSTE was initiated.

Product Development

1. Development of multifunctional oligomers for dental applications

A simple and elegant approach for the development of multifunctional oligomers for fast in situ step growth photopolymerization for medical application was the desired outcome of the project. The new composite showed good physico-mechanical properties and polymerisation shrinkage values. Remineralisation studies, water sorption solubility, radiopacity measurement (using standard aluminium wedge), in vitro cytotoxicity, in vitro cell adhesion and cell proliferation studies and in vivo biocompatibility evaluation were completed. The optimised formulations were found to be radiopaque, with bioactivity, biocompatibility and no cytotoxicity. One patent application was filed for this product.

2. Development of bioactive bone cement

The project entitled “Development of bioactive bone cement based on novel inorganic-organic hybrid resins” supported by KSCSTE was initiated. A novel inorganic-organic hybrid resin containing alkoxide of calcium/magnesium/zinc with polymerizable dimethacrylate groups was synthesized using a simple single-pot modified sol-gel method using 3-trimethoxysilyl propyl methacrylate as the precursor. The composites were developed by masticating the newly synthesized resin with quartz and radiopaque glass (70:30) in an agate mortar and subjecting the paste to photo-polymerization reaction. The composite exhibited good mechanical properties with low polymerization shrinkage, enhanced bioactivity, radiopacity and biocompatibility. The composite material was successfully filled in the cavity of tooth without using a bonding agent and showed excellent bonding of tooth structure with the composite (Figure 14).

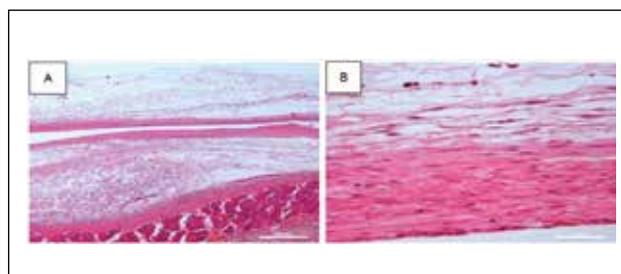


Figure 14. Histological images of CMZRQG at 4 weeks post-implantation showing (A) fibrous capsule around implant site 500 μm and (B) absence of inflammatory cells at the implant site 50 μm

Research Programmes

Optimization of 3D bioink formulation

The bioink formulation for printing liver construct was optimized. Gelatin-based bioink was found suitable for printing liver construct. Liver cells (HepG2 and primary rat hepatocytes) were mixed with gelatine methacrylamide (GelMa) and the



construct bioprinted. The bioprinted construct was then evaluated for liver function tests such as albumin and urea synthesis. Both small (1 mm thick) and large (5 mm thick) constructs were produced and evaluated. Activities of encapsulated cells in both these constructs were evaluated. It was confirmed that the cells were functional and viable for over a period of 14 days in vitro.

Testing and Evaluation

The testing facilities including micro CT, FTIR, FT Raman and UV-visible spectrophotometer, universal testing machine and particle size analysis were extended to external and internal customers.

DIVISION OF BIOCERAMICS

The Division is engaged in developing bioceramics-based tissue repair materials for orthopaedics and dentistry. The most significant achievement of the Division during the period was the transfer of the know-how for two bioceramic graft products (beta tricalcium phosphate ceramic and hydroxyapatite-tricalcium phosphate biphasic ceramic) to M/s. Onyx Medicals Pvt. Ltd., Meerut, Uttar Pradesh. The Director of SCTIMST, Prof Asha Kishore and Mr Harshvardhan of Onyx Medicals Pvt. Ltd., signed the MoU on 17 November 2017.

Product Development

1. Development of bioceramic coating over dental implant

The longevity of dental implants is determined by the strength of attachment with bone, as it faces high cyclic load of mastication. The osseointegration of implants made with titanium (Ti) metal could be enhanced by providing appropriate coating on the interface. Indigenous Ti-based dental implants were designed and fabricated as part of the DBT Programme Support on 'Translational Research on Biomaterials for Orthopaedic and Dental Applications'. Bioceramic materials were coated on the surface of titanium implants through pulsed laser deposition (PLD) technique. Multi-phase bioactive ceramic coating with excellent uniformity and microstructure was obtained at optimised conditions. The in vitro cell

compatibility studies were done on the samples using human osteosarcoma cells. The cells showed adhesion and proliferation in scanning electron microscopy and confocal microscopy (Figure 15). The coating was bioactive and effective for osseointegration of the implants.

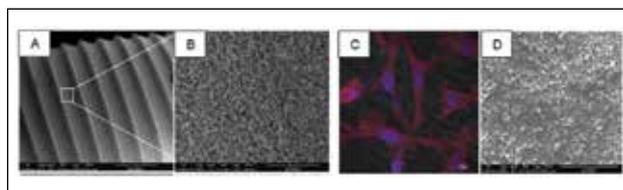


Figure 15. SEM images of bioceramic material coated over dental implant (screw) using PLD technique (A) low magnification and (B) high magnification. Images of cLSM (C) and SEM (D) showing morphology of HOS cells over the coated Ti samples

2. Drug-eluting bioactive calcium sulfate cement

Osteomyelitis can occur through wounds and lead to serious complications, including the loss of the limb. This could be effectively managed through local drug delivery only. Bioactive bone cements are projected as an ideal medium for delivering antibiotics for bone infections as the material integrates with the host site after drug elution. The new composition of bioactive calcium sulfate cement was used to study the potential of osteomyelitis management by incorporating antibiotics. Gentamicin and vancomycin were incorporated in the cement before setting and the elution was quantified with time in vitro.

Initial burst release was observed in both cases, after which a sustained release was observed. The diffusion mechanism for gentamicin release followed the Higuchi model and that for vancomycin obeyed quasi-fickian nature. The time taken for gentamicin to reach the minimum inhibitory concentration was 17 days, and for vancomycin, it was 47 days.



Research Programmes

1. Functionalised chitosan composite membranes for guided tissue regeneration in dentistry

Guided tissue regeneration is a technique used for reviving periodontal tissues lost in disease, wherein a bioactive resorbable membrane is needed to isolate the wound from epithelial cells. Chitosan has been suggested as a suitable material due to its biocompatibility, affordability and processability. But it has the limitations of low resorbability and lack of bioactivity. A novel membrane was made using 'quaternised' chitosan (QC) compositing with strontium-doped apatite (SA) particles.

Properties of the QC-SA membranes were assessed in terms of: morphology, chemical structure and mechanical properties, and in-vitro tests on degradation, bioactivity and cytocompatibility. The results proved the QC-SA membranes to be ideal for guided tissue regeneration.

2. Self-assembling polymeric dendritic peptides for the regeneration of periodontium

Periodontal disease is a challenging issue in dentistry considering the magnitude of its incidence and the damage it creates to the tissues that anchor and maintain the teeth. Regeneration of the complex tissue structure of the damaged periodontia is very difficult with conventional technique and it demands special approaches of tissue engineering. As the underlying tissues are rich in progenitor cells, it could be hypothesized that a scaffold mimicking the extra cellular matrix (ECM) provided at the site can home the native progenitor cells, facilitate their differentiation and proliferation, and lead to the regeneration of the periodontal tissue structure.

Self-assembling polymeric dendritic peptides have been identified as a candidate ECM-mimetic material. In the present work, guanidine-appended polydiacetylene (G-PDA) was synthesized in the form of a self-assembling nano-structured matrix for potential use as scaffolds in the regeneration of periodontia. Primary human periodontal ligament (hPDL) cells were cultured in-house and the adhesion, proliferation and differentiation were evaluated in the presence of the G-PDA matrix. It

was identified that G-PDA is highly cytocompatible and supports the periodontal ligament cells and their differentiation upon induction. The osteogenic differentiation of hPDL cells on G-PDA with positive expression of enzyme and protein markers and mineralization was confirmed (Figure 16). It suggested that G-PDA may be an ideal matrix to host the cells to regenerate alveolar bone, enamel and cementum.

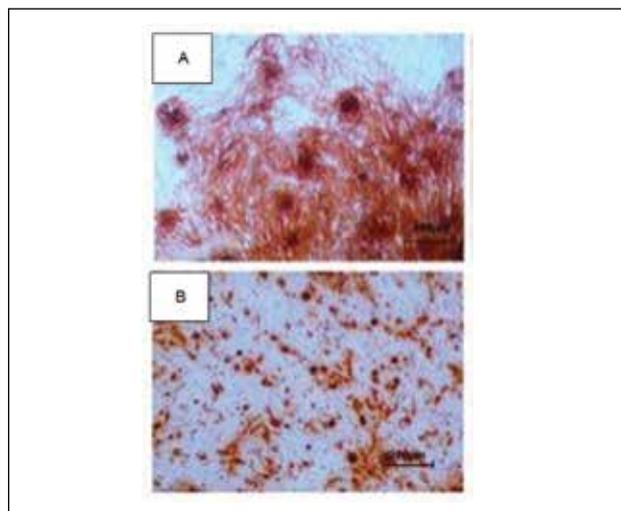


Figure 16. The osteogenic differentiation of hPDL cells evidenced through Alizarin red staining. (A) Mineral deposits by hPDL cells on G-PDA matrix at 14 days (B) Mineral deposits by hPDL cells on coverglass at 14 days

Testing and Evaluation

The Bioceramics Division has testing and characterization techniques like X-Ray powder diffraction, scanning electron microscopy, environmental scanning electron microscopy and EDS analysis and atomic emission spectroscopy with inductively coupled plasma (AES ICP) for elemental analysis. These tests were offered by the Laboratory for internal and external customers.



DIVISION OF BIOPHOTONICS AND IMAGING

The Division works mainly on the development of materials and devices for biophotonics applications in the field of sensing, imaging, diagnosis and therapy. During the year, a project on the development of optical nerve stimulation was initiated under TRC. Studies on basic biological interaction of nanomaterials in vitro and in vivo using various materials were undertaken. Development of multifunctional nanomaterials based on anisotropic systems for different analyte sensing and development of a nanocarrier-mediated stem cell delivery of cardiomyocytes were also underway.

Two major projects funded by DBT and ICMR were successfully completed during this period. One project for the development of a material to image brain by crossing the blood-brain-barrier was supported by DBT for one year. Synthesis and characterization of an all-in-one nanoplatform built on gold-graphene hybrids for multifunctional cancer theranostics was developed and the proof-of-concept was achieved. A major multi-institutional project funded by DBT on the development of gold nanorod-based targeted nanoprobe for cancer theranostics, in collaboration with NIIST, Trivandrum continued.

Product Development

1. Optical peripheral nerve stimulator

The feasibility study of optical peripheral nerve stimulation was completed successfully. A prototype of the optical peripheral nerve stimulator was developed and tested on Wistar rats. A good stimulation as represented by the EMG signal and the twitching of the leg of the animal was evident.

Research Programmes

1. Gold nanorods for targeted photodynamic therapy and fluorescence imaging

A photosensitizer (GNR-PS) based on gold nanorod (GNR), which retains its fluorescence, was developed. For retaining the fluorescence emission of the photosensitizer, GNR was considered as the donor in the system by making use of its weak fluorescence emission property. The

energy transfer from GNR to PS makes it suitable for imaging applications. Using this system, in vitro and in vivo tumour imaging and therapy were successfully performed.

2. Detection of zinc in epileptic condition using ratiometric fluorescent molecular probes

A bipyridine bridged bispyrrole (BP) probe is used for ratiometric imaging and quantification of zinc ions (Zn^{2+}) in hippocampal slices. The green fluorescence emission of BP shifts towards red in the presence of Zn^{2+} . The probe is used to detect and quantify the exogenous and endogenous Zn^{2+} in glioma cells and hippocampal slices. The dynamics of chelatable Zn^{2+} during epileptic condition was studied in the hippocampal neurons in vitro wherein the translocation of Zn^{2+} from presynaptic to postsynaptic neuronal bodies was imaged and ratiometrically quantified. Raman mapping technique was used to confirm the dynamics of Zn^{2+} under epileptic condition. Finally, the Zn^{2+} distribution was imaged in vivo in epileptic rats and the total Zn^{2+} in rat brain was quantified. The results favour the use of BP as an excellent Zn^{2+} imaging probe in biological system to understand the zinc-associated diseases and their management.

3. Spatio-temporal synchronization of photothermal therapy (PTT) and chemotherapy

Localized photothermal-chemotherapy was initiated by gold nanorod (GNR) conjugated to (i) Raman signature molecule (RSM), i.e., squaraine dye (SQ)-attached, target-specific peptide substrate susceptible to matrix metalloproteinases (MMP2 and MMP9), which are over-expressed in the extracellular matrix of cancer cells, and (ii) lipoic acid-appended doxorubicin, conjugated through acid labile hydrazone linkage (LAH-DOX). The variations in chemical environments and associated modifications of cellular components during therapy were successfully traced through SERS platform.

Photodynamic therapy (PDT) is another promising strategy that is gaining recognition as useful for treating solid tumors that are not accessible to surgery and radiation and are



resistant to chemotherapy. Methylene blue (MB), a well-known photosensitizer, was encapsulated inside cucurbituril (CB) cavity to improve the therapeutic potential of MB-mediated PDT. CB aligns GNRs for generation of precise sub-nanometer plasmonic junctions serving as SERS hot spots. CB with encapsulated MB acts as glue between GNRs that generate SERS hot spots and executes synergistic PDT and PTT in a targeted fashion along with fluorescence and SERS imaging. The combinations of targeted therapy by PDT and PTT along with simultaneous fluorescence and SERS imaging will be an excellent nanotherapeutic for the treatment of solid tumours.

DIVISION OF BIOSURFACE TECHNOLOGY

The major activity being pursued in the Division of Biosurface Technology is the research and development of polymeric biomaterials for drug delivery, wound dressing applications and gene delivery. The main focus is on translational research for product development.

Product Development

Chitosan was derivatised using various molecules, and sponges were developed for wound dressing applications. Characterisation studies on its swelling and antioxidant properties were done. The ability of these polymers to scavenge free radicals such as DPPH, ABTS cation radical and superoxide anion was established. These sponges have good swelling characteristics, ideal water vapour transmission rate and acceptable tensile strength. Porosity was evaluated using microCT technique and was observed to have good pore distribution over a range of 20 to 300 μm . The drug loading and release characteristics of the sponges were evaluated using three antimicrobial drugs – ofloxacin, gentamycin and vancomycin.

Research Programmes

Thiomers for simultaneous gene delivery and Pgp inhibition

The study mainly focused on disulphide-modified pullulan-based cationic polymer to evaluate gene delivery efficacy as well as efflux pump inhibiting property of the polymer. Redox-sensitive, cationized pullulan was synthesized by conjugating pullulan with PEI and various thiol molecules of varying acyl chain length. The polymer, upon interacting with the negatively charged DNA, formed nanosized complexes with particle size in the range of 100-150nm and zeta potential value between +15 and 20mV. This nanoplex was stable in the extracellular milieu whereas intracellularly, it released DNA, which was mimicked by increase in the particle size following exposure to DTT (>300nm) and subsequent release of DNA in agarose gel electrophoresis. All the synthesized derivatives exhibited good buffering capacity. These polymers exhibited low cytotoxicity in both C6 and L929 cell lines (more than 80% cell viability), and improved uptake and transfection efficiency. The endocytosis inhibitor studies revealed that the polymer takes multiple pathways to get access into the cells. Studies carried out with TRITC-tagged polymer revealed that the unpacking of the polyplex takes place in the cytosol and the DNA is transported to nucleus (Figure 17).

Furthermore, the ability of the polymer to inhibit efflux pump in cancer cells was also elucidated in terms of Pgp inhibition studies and drug retention kinetics using the anticancer drug, DOX. It was established that low concentration of drug can lead to high cell death in the presence of p53. The synergistic effect of the drug and gene was evaluated in C6 cells. The significance of this finding is that by delivering chemotherapeutic agent along with the p53 gene using a nanocarrier capable of inhibiting Pgp, it would be possible to reduce the drug doses markedly.

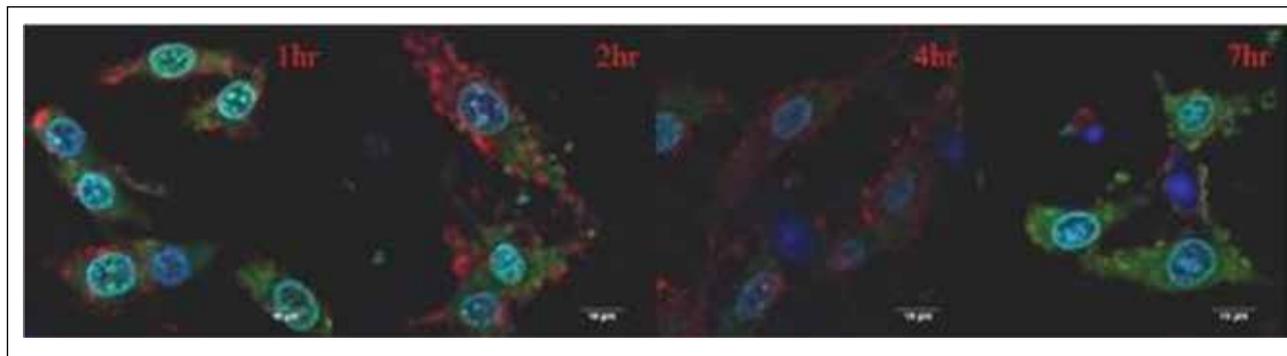


Figure 17. Cellular uptake of nanoplexes developed from rhodamine- labelled polymer and YOYO tagged DNA. The polymer is localised in cytoplasm and the DNA reaches the nucleus. Blue color indicates Hoechst stained nucleus and the red color shows rhodamine- conjugated polymer and green fluorescence indicates YOYO tagged DNA .

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DEPARTMENT OF MEDICAL DEVICE ENGINEERING

The Department is responsible for research and development of medical devices, from design to preclinical evaluation, including computer-aided design, in silico evaluation, fabrication, prototyping and functional evaluation at various stages. The Department comprises the Divisions of:

1. Artificial Internal Organs
2. Extra-corporeal Devices
3. In vivo Models and Testing
4. Medical Instrumentation
5. Polymeric Medical Devices
6. Precision Fabrication

Four Divisions in the Department focus on development of different types of medical devices while two others specialise in precision prototyping of medical devices and animal models for medical device evaluation. There are various facilities under the Department that are providing services to other internal Divisions and external customers. These facilities include: rapid prototyping, ethylene oxide sterilisation, package validation, material characterisation and design and analysis.

During the year, the technology of Vein Viewer was transferred to M/s. Agappe Diagnostics Ltd.. An MoU was signed with M/s. HLL Lifecare Ltd. for technology transfer of blood warmer and two models of infant warmers. Eight TRC projects were in various stages of development and five new projects were initiated.

DIVISION OF ARTIFICIAL INTERNAL ORGANS

The TRC projects for development of an Atrial Septal Defect (ASD) occluder and Aortic Stent Graft (ASG) were ongoing. Three TRC projects were initiated for development of the following medical devices: Annuloplasty ring for mitral valve correction (AMV), equipment for package validation (EPV) and flow diverter stents (FDS). An MoU was signed between

SITRA, Coimbatore and SCTIMST for collaborative development of textile-based medical devices.

Internal Collaboration: The TRC projects are in collaboration with the Departments of Cardiovascular and Thoracic Surgery, Imaging Sciences and Interventional Radiology, Cardiology and Neurology of SCTIMST.

External Collaboration:

1. Voice prosthesis for laryngectomy patients started in collaboration with Regional Cancer Centre, Trivandrum, funded by KSCSTE.
2. A clot retriever stent project (CRS) started in collaboration with the Department of Imaging Sciences and Interventional Radiology, SCTIMST; funded by DBT, Government of India
3. The TRC projects are in collaboration with CSIR-NAL, Bangalore for medical devices based on super-elastic NiTi and for medical textile-based devices with SITRA, Coimbatore.

Product Development

1. Bioprosthetic Heart Valve

This is a prosthetic device for replacement of diseased heart valves for both aortic and mitral position using tissues of animal origin. Leaflet design and optimization for enhanced blood flow was performed using finite element method (FEM) technique.

2. Leukocyte Filter

The process involves removal of leukocytes from whole blood and its components. Filter housing design and computational fluid dynamics (CFD) optimization studies were performed.

3. Aortic Stent Graft

This graft is a prosthetic endovascular device for treatment of thoracic aortic aneurysms. Two design patents for asymmetric stent crown and two



design patents for delivery system were applied for. Five applications for registering novel stent crown designs were made with features of improved crimpability and fixation.

4. Atrial Septal Defect occluder

This device is a prosthetic endovascular device for treatment of ASDs. Two design patents for the ASD occluder with a hub-less left atrial flange and woven/inter-twined centres were applied for.

5. Flow Diverter Stent

This is a prosthetic endovascular device for treatment of intracranial cerebral aneurysms. Braided samples using fine wires were prototyped. CFD-based design optimization was in progress.

6. Programmable Hydrocephalus Shunt

This device is used for treatment of hydrocephalus. Preliminary design and analysis of the programmable hydrocephalus shunt was in progress.

Research Programmes

Connectivity analysis of functional MRI data to analyse changes in the brain connectivity of post-stroke patients with expressive aphasia during real-time fMRI-based neurofeedback training was performed. The training improved connections in the left temporo-frontal network that had been affected by stroke.

Testing and Evaluation

Accelerated ageing studies of medical devices, medical device packaging, microhardness and scratch testing, and pin-on-wheel and sand slurry tests were regularly done for both external and internal customers as per demand.

Technology outreach programmes conducted included:

1. Mr C V Muraleedharan, Mr Sujesh S and Mr Ranjith G gave lectures on 'Advances in Biomaterials', 'Biomechanics of blood flow' and 'Biomechanics of stent devices' at TKM College of Engineering, Kollam.
2. Three faculty members from the Department, Dr P Ramesh, Mr Vinodkumar V and

Mr Sujesh S, participated in Textile India 2017 Expo at Ahmedabad, showcasing medical devices and medical textile-based devices.

DIVISION OF EXTRACORPOREAL DEVICES

The Division focusses on development of medical devices for supporting the cardiopulmonary system. The ongoing activities in the Division include developing paracorporeal left ventricular assist device, centrifugal blood pump including drive unit and magnetic flow meters, membrane oxygenators for neonatal and paediatric application, transcutaneous energy transfer system, infrared energy-based technologies for blood warmers, infant warmers and vein viewers. The Division also supported various TRC projects of the Institute.

A project for development of a technology for membrane oxygenator with active membrane vibration for enhanced gas transfer, funded under the TDF was initiated during the year. Left heart simulator facility was installed in the laboratory. This instrument mimics the pressure and flow waveform of normal as well as diseased conditions of the heart. This can be used for evaluation of medical devices like heart valves, left ventricular assist devices, etc.

As part of internal services, ethylene oxide sterilisation at low temperature, was carried out routinely. Prototype fabrication of complex designs, which are otherwise difficult to realise through other manufacturing techniques, were done using rapid prototyping system.

Technology Transfer

The technology of vein viewer was transferred to Agappe Diagnostics Ltd. An MoU was signed with M/s. HLL Lifecare Ltd. for further technology transfer of blood warmer and two models of infant warmers.

Product Development

1. Development of centrifugal blood pump along with drive unit and flow meter

The project is aimed at development of a centrifugal



blood pump for supporting heart function during extracorporeal cardiopulmonary bypass surgery. There are three major sub-systems for the device: the pump, its drive unit including motor and controller and a flow meter. Designing of all the components, prototype fabrication and evaluation in simulated environments were completed. The project reached the important milestone of in vitro evaluation using blood (Figure 18) to assess blood damage caused during device operation.



Figure 18. In vitro evaluation of centrifugal blood pump using blood

2. Development of paracorporeal left ventricular assist device

A continuous flow ventricular assist device intended for supporting the ventricle by paracorporeally placing the pump is being developed. There are three major components for the device: pump, motor and controller. Preliminary designs of the components were prepared based on the basic physics of blood flow as well as electromagnetism. Prototypes of various iterations of the design were fabricated and evaluation in simulated environments was conducted (Figure 19).



Figure 19. Paracorporeal left ventricular assist device evaluation in simulated environments

3. Development of detection system for CT contrast agent extravasation

The objective of the project is to develop a system for visualisation of CT contrast agent injected into the blood vessel and also to identify its flow outside the blood vessel (Figure 20). Primary component of the project is a vein viewer, which uses low power infrared light to illuminate the surface where vein is located. Image of the illuminated area is captured and processed for display with veins clearly visible. The technology was transferred to M/s. Agappe Diagnostics.



Figure 20. Detection system for CT contrast agent extravasation

4. Development of blood warmer

A blood warming system based on infrared radiation capable of warming the stored blood before transfusion to normal body temperature was developed (Figure 21). An MoU was signed with HLL Lifecare Ltd. for commercialisation.



Figure 21. Blood bag warmer

5. Development of baby warmer

Two types of baby warmers based on infrared technique, which are safe for use for prematurely born infants, were developed. (i) An infant warming bassinet that consumes less electrical power and can be used with less sophistication

in a primary healthcare centre and hospital, and (ii) an infant warming wrapper that is light weight, low power consuming, battery operated and transportable (Figure 22). Design and development was completed and evaluation using multiple prototypes was initiated.



Figure 22. Devices for infant warming (A) Infant Warming Bassinet (B) Battery operated Infant Warming Wrapper

DIVISION OF IN VIVO MODELS AND TESTING

The primary responsibility of the Division is to conduct medical device translational studies using physiologically normal or diseased animal models. This consists of either proof-of-concept or preclinical evaluation of medical device/ biomaterials in large animal models simulating actual clinical use in human patients to assess its performance and safety. To achieve this objective, the Division is equipped with well-qualified and trained staff, sophisticated infrastructure such as modern operation theatre, catheterisation theatre, clinical laboratory, acute care rooms, animal preparation/explantation rooms and CPCSEA-registered large animal house that provides healthy, traceable large experimental animals such as pigs and sheep.

Product Development

1. Development of bioprosthetic heart valve

During this period, a TRC project for development of bioprosthetic heart valve was sanctioned.

The project was initiated and staff recruitment was completed. Various subsets of activities such as optimization of chemical treatment of pericardium, skill development for stitching valve, design optimization of stent and valve leaflet were undertaken during this period.

2. Optimization for chemical treatment of pericardium and design of valve

Research was pursued in the Division for improving the performance and safety of processed bovine and porcine pericardium. Process of decellularisation using a non-detergent method was granted an Indian patent during this period. Glutaraldehyde-cross-linked pericardium was further made calcification-resistant by immobilizing magnesium onto its surface. An Indian patent was filed for this invention. For bioprosthetic valve fabrication, glutaraldehyde-cross-linked heparin and magnesium-immobilized bovine pericardium was being optimised because its thromboresistance, calcification resistance and better fatigue resistance properties are necessary to obtain reasonable valve durability.



Research Programmes

1. Anti-mineralization treatment of processed pericardium

Research on anti-mineralization treatment of processed pericardium was ongoing. A method to immobilize magnesium (Mg) onto processed pericardium was developed to control in vivo calcification. An application for Indian patent was made to protect this know-how. In vivo efficacy of this process was evaluated in a static animal model (juvenile rat subcutaneous implantation model) and dynamic model (pig aortic patch implantation model). The heparin-cross-linked, Mg-immobilized pericardium showed minimum calcification that was less than commercially available bovine pericardium (Figure 23).

First stage experiment in pig aortic patch model demonstrated anti-calcification effect of Mg immobilization. Further experiments are ongoing on heparin crosslinked-Mg immobilized bovine pericardium.

Testing and Evaluation

The following animal evaluations were conducted during the year:

1. Animal evaluation of Sirolimus-eluting bioresorbable polymer mesh-covered coronary stent system in adult swine coronary artery (GLP study)
2. Evaluation of Mg-immobilized, glutaraldehyde-

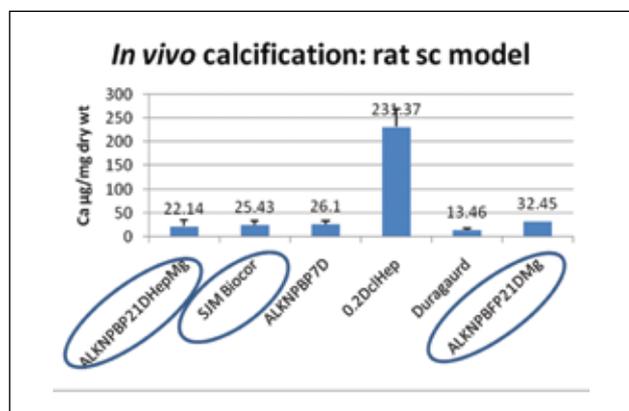


Figure 23. Magnesium immobilized pericardium tested for calcification in rats

cross-linked bovine pericardium as aortic patch in pig and subcutaneous implant in juvenile rat

3. Evaluation of Mg-immobilized, glutaraldehyde-cross-linked porcine pericardium as dura substitute in rabbit model

DIVISION OF MEDICAL INSTRUMENTATION

Division of Medical Instrumentation is equipped with basic facilities required for research and development in medical instrumentation. The Division focusses on the development of active and passive neuroprosthetic medical devices such as deep brain stimulators (DBS) and cortical electrodes, and cardiac devices such as implantable defibrillators and pacemakers.

The Division also collaborates with the Bhabha Atomic Research Centre (BARC) for the development of sophisticated medical devices like DBS for Movement Disorders, depth electrodes etc.

Product Development

1. Deep Brain Stimulator System

Deep brain stimulation involves implanting electrodes within certain areas of the brain. The stimulation is controlled by a pacemaker-like device placed under the skin in upper chest. A wire that travels under the skin connects this device to the electrodes in the brain. The project was carried out in collaboration with BARC. The prototyping stage was ongoing. Test systems for mechanical and electrical testing of the leads and

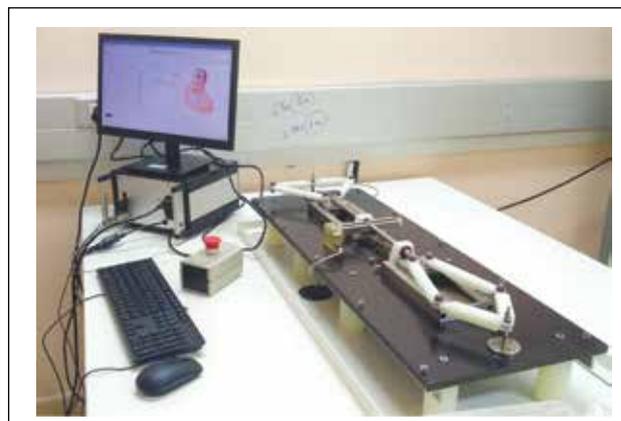


Figure 24. Test systems for mechanical testing of the leads of deep brain stimulator system



implantable pulse generator were carried out in parallel (Figure 24).

2. Development of intracranial electrodes for use in acute and chronic electrocorticography

Measurement of electrical signals from brain using subdural electrodes implanted on the surface of the brain (electrocorticography, ECoG) is employed during surgical treatment of drug-resistant epilepsy. Implanted electrodes are usually required in order to identify the seizure onset zone. The project neared its proof-of-concept phase (Figure 25).

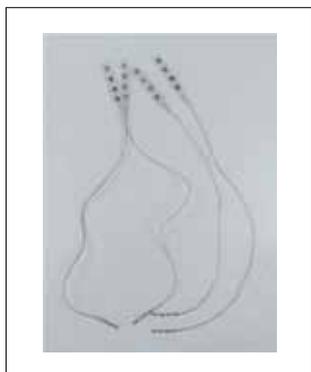


Figure 25. Intracranial electrodes for electrocorticography

DIVISION OF POLYMERIC MEDICAL DEVICES

The Division focusses on the development of polymeric medical devices. The Division also gives thrust to new research initiatives through PhD programs. Apart from the above, the Division offers mechanical testing services to internal and external customers. As part of various projects, a light-weight thyroid collar, free of the toxic element lead, was developed with a grant received from Defence Research and Development Organization. A printable bioink was developed as part of the project on 3D bioprinting. Biodegradation profile and toxicokinetic studies on gel-sealed vascular graft were completed. In another programme, enteric coating and encapsulation of the antibodies supplied by Public Health England were successfully performed.

Product Development

1. Development of liquid embolic agent

A couple of aromatic iodinated compounds were synthesized, grafted onto ethylene vinyl alcohol copolymer and evaluated for precipitation behaviour in saline. The results indicated that a radiopaque polymer that precipitates in saline could be a potential device that would be useful for embolizing abnormal arteries of the brain.

2. Development of leukodepletion filter and its evaluation

Commercially available leukodepletion filters were analysed for their physico-chemical and design characteristics. Further, a thorough study of the literature and the available standards was carried out, which helped understand the requirements of state-of-the-art leukocyte depletion filters. A set of design specifications for the filter material and the filter housing was arrived at through this exercise. Three candidate models for the housing were designed meeting these specifications. A Computational Fluid Dynamics (CFD) study was done to evaluate these designs. The criterion for evaluation was uniformity of the flow across the filter material. The filter material was first characterized using a porous domain model (Darcy model) and then simulations were done on the candidate designs to evaluate their performance for uniformity of flow. It was observed that all three candidate designs gave a uniform distribution of flow across the filter material and the difference between them was not very significant.

Testing and Evaluation

Mechanical testing and dynamic mechanical analysis facilities were extended to customers.

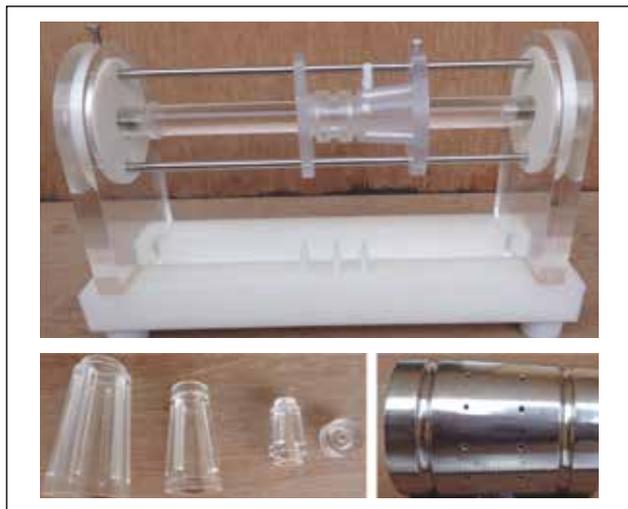
DIVISION OF PRECISION FABRICATION

The Division of Precision Fabrication facilitates technical service support activities to other scientific/technical laboratories in designing, fabricating moulds, dies, jigs, fixtures and machining of prototype components for product development and test set-up systems required for ongoing projects by utilising CNC



and conventional machines. The Division executed and delivered 70 major work orders and 30 minor work orders during the year for various precision fabrication and mould-making work required for different TRC

research projects and for other departmental R&D activities (Figure 26). The important activities carried out in the year included:



Suture fixture and crimp former parts



Setup for housing the Rapidogram, rapid diagnostic kit for Urinary Tract Infection (UTI)



Brass Die for the Annuloplasty ring



Conductor flex test setup fixture



Different size templates and valve stent



Crimping former fixture to crimp aortic stent graft prototype



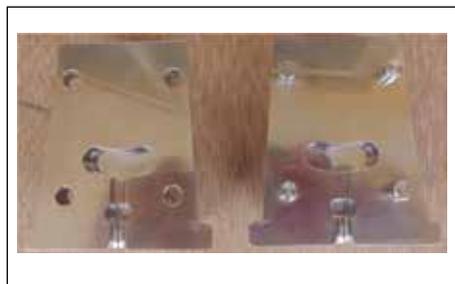
Prototype of Blood warmer casing



S.S. mould for intracranial electrode project



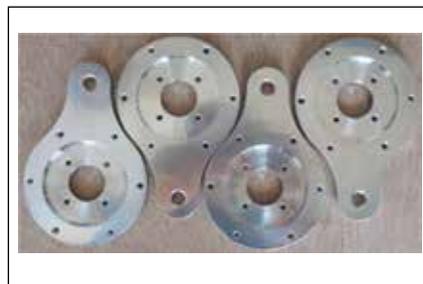
Polypropylene fixture for Pump



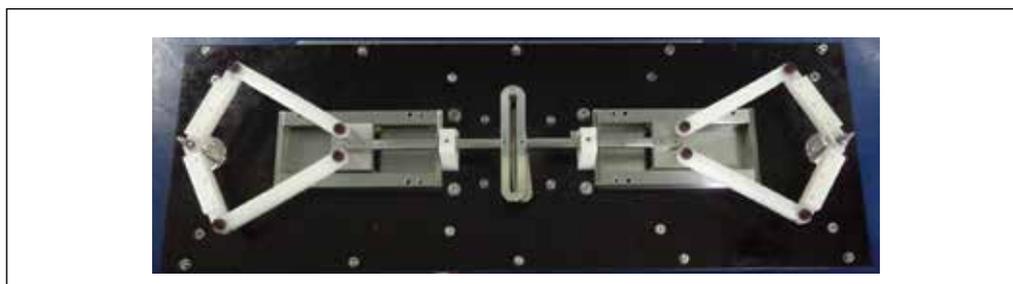
Injection mould



Shape setting fixture



S.S. Pump Motor drive casing



Fatigue testing fixture for testing implantable leads of DBS

Figure 26. Various devices, parts and accessories fabricated

Faculty

Mr Muraleedharan C V, Scientist G (Senior Grade) and Head of the Department

Mr D S Nagesh, Scientist G

Mr V Ramesh Babu, Engineer G

Dr Roy Joseph, Scientist G

Dr P Ramesh, Scientist G

Dr P R Umashankar, Scientist G

Mr Vinodkumar V, Engineer F

Mr Sujesh Sreedharan, Engineer E

Dr Sachin J Shenoy, Scientist E

Mr Ranjith G, Engineer D

Mr Sarath S Nair, Engineer D

Mr Anoop Gopinathan, Engineer C

Mr Jithin Krishnan, Scientist B

Technical

Mr Rajeev A, Scientific Assistant

Mr Prem Mohan M, Technical Assistant - B

Ms Smitha P, Technical Assistant - B

Mr Subhash Kumar M S, Technical Assistant - A

Ms Sreedevi V S, Technical Assistant - A

Mr Biju B, Technical Assistant - A

Mr Reji Kumar S, Technical Assistant - A

Mr Prathyush M, Technical Assistant - A

Mr Biju V, Laboratory Animal Caretaker - A



DEPARTMENT OF TECHNOLOGY AND QUALITY MANAGEMENT

CENTRAL ANALYTICAL FACILITY

Central Analytical Facility is equipped with a wide range of analytical equipment and provides analytical test services to internal and external customers. The analytical instruments include: Fourier transform infrared spectrophotometer, ultraviolet-vis spectrophotometer, thermogravimetric analyser, differential scanning calorimeter, high permeation liquid chromatography, gas chromatography, confocal Raman microscope, textural analysis and fluorescent microscope.

The staff of central analytical facility held demonstrations of the analytical instruments to: (a) students who attended the Science Day celebrations in the Institute, (b) delegates who attended the Workshop entitled “An Insight into Analytical Instruments in Research” held from 17-18 November 2017 and 5-16 December 2017, organized by the Industry-Institute Partnership Cell, BMT Wing.

Testing and Evaluation

Physico-chemical properties of materials used in medical devices are characterized in the analytical facility on a routine basis. About 530 samples from various external and internal customers were characterized during the year.

CALIBRATION CELL

NABL audit was completed by November 2017 in mechanical and thermal calibrations. Electrotechnical calibration was added to the scope of accreditation. Calibration Cell participated in the Inter Laboratory Comparisons (ILC) for volume parameter with M/s. Pipetemann, Coimbatore, and for mass parameter with FCRI, Palakkad. A project on system validation of medical diagnosis device used in cancer detection was completed for Research and Development Organization.

Four new calibration procedures were introduced for electro-technical parameters: (i) DC current

calibration, (ii) DC voltage calibration, (iii) resistance calibration, and (iv) frequency calibration of electro-technical devices.

Testing and Evaluation

Mechanical, thermal and electro-technical calibrations being carried out by Calibration Cell are accredited by NABL, India. Mechanical calibration includes calibration of volumetric glassware, micropipettes, electronic balances, mass sets and rotational speed. Calibration of relative humidity monitors, thermometers and temperature chambers like incubators are included in thermal calibrations. Summary of calibrations and measurements performed in 2017-18 is as follows: (i) Internal: 195 (ii) External: 316, and (iii) Surface Characterization: 55 material samples.

NETWORK SERVICE CELL (NES)

Activities

1. Collaborative project

In collaboration with Achutha Menon Centre for Health Science Studies, NES initiated a project entitled “Proactive Technology Driven Model for Tribal Healthcare in Wayanad”. This project aims to provide improved access to speciality care for tribal population through the use of new generation teleconsultation strategies. The Government of Kerala and CDAC, Thiruvananthapuram, are involved in the funding and execution of the project.

2. Upgradation of infrastructure

Upgradation of the BMT Wing Information Technology infrastructure was initiated during the year. This is to cater to the upcoming Information and Communication Technology (ICT) needs of the BMT campus. This involves upgradation of existing software platforms, migration of existing collaboration platform to new platform, and establishing a disaster recovery platform among other activities.



3. Server Migration

Two of the BMT servers were migrated to cost-effective and secure open source Linux-based platform.

QUALITY CELL

Activities of the Quality Cell include implementation, maintenance and improvement of quality management systems to ensure that the facilities, equipment, personnel, methods, practices, records and their control are in conformity with the requirements of International Standards ISO 17025.

The following were the major activities of the Quality Cell during the year:

- a. COFRAC surveillance re-assessment was conducted on 27-28 February 2018. There were 4 non-conformities identified in the assessment, and corrective actions for the same were taken and communicated to COFRAC.
- b. NABL surveillance assessment for Thermal and Mechanical Calibrations was completed in November 2017.
- c. Management reviews: Management Review Committee meeting for the year 2018 was held on 23 February 2018 and two Technical Management Committee meetings were held on 15 June 2017 and 20 December 2017.
- d. Internal audits: Two internal audits were carried out during 17-25 May 2017 and 20-29 November 2017.
- e. Documents initiated/revised:
 - (i) System procedures and work procedures revised/ issued - 158
 - (ii) Lab notebooks issued during the period - 113
 - (iii) Registers and logbooks prepared and issued to various laboratories/ sections - 95
 - (iv) Corrective actions generated by different laboratories - 21

TECHNOLOGY BUSINESS DIVISION (COMPRISING CUSTOMER SERVICE AND INTELLECTUAL PROPERTY RIGHTS CELL)

The Technology Business Division focusses on the following activities of the Institute:

1. Co-ordinating Institute-Industry interactions related to technology transfer and research project collaboration
2. Co-ordinating all the activities of Intellectual Property Rights like patent, design and trademark registration of the Institute
3. Co-ordinating testing services and specific protocol-based study requests from Industry and Academia for medical devices and biomaterials
4. Co-ordinating the internal research project funding of the Institute comprising the Technology Development Fund Scheme and the Overhead Fund Scheme
5. Preparing various reports/questions for submission to external agencies such as DST, DSIR, ICMR and the Parliament on activities of the Institute
6. Co-ordinating the visit of students from different institutions across India for exposure to development of medical devices

TECHNOLOGY CONCLAVE

The 2nd Technology Conclave and Industry Meet was held on 15-16 May 2017. Hon'ble Union Minister for Health and Family Welfare, Shri J P Nadda, inaugurated the event at the Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, in the presence of Hon'ble Minister for Health and Social Justice, Government of Kerala, Smt K K Shailaja Teacher; MP representing Trivandrum, Dr Shashi Tharoor; MLA of Nedom Constituency, Sri O Rajagopal; the President of the Institute, Sri K M Chandrasekhar and Director, Dr Asha Kishore (Figure 27).



Figure 27. 2nd Technology Conclave and Industry Meet held on 15-16 May 2017

The Hon'ble Minister also flagged off the transfer of medical technologies developed by the Institute to various companies signalling the manufacturing and marketing of these affordable medical devices and services. The technologies transferred included blood and intravenous fluid warmer, infant warmer wrapper/bassinet (HLL Lifecare Ltd.), fibrin sealant (Zum Heilen), Rapid UTI diagnostic kit (Agappe Diagnostics), cholecyst-derived scaffold (Optimus Lifesciences) and the egg yolk immunoglobulin as anti-snake venom (New Medicon Pharma Lab Pvt. Ltd.). The event also marked the release of 'Vision 2030' for Biomedical Technology, the Technology Compendium and the Technology Transfer Policy. The technology development team and the winners of various prestigious awards were also felicitated.

The Industry Meet was held on 16 May 2017 where industry representatives were provided a one day exposure at the BMT Wing.

Technology Transfers

The following technology transfer agreements were signed during the year:

1. Process for preparation of extracellular matrix scaffolds from mammalian cholecyst/jejunum/urinary-bladder to M/s. Optimus Life Sciences, Kerala
2. Blood/IV fluid warming system to M/s. HLL Lifecare Ltd., Kerala
3. Infant warmer bassinet to M/s. HLL Lifecare Ltd., Kerala
4. Infant warmer wrapper to M/s. HLL Lifecare Ltd., Kerala
5. Vein viewer to M/s. Agappe Diagnostics Ltd., Kerala
6. Beta Tricalcium phosphate to M/s. Onyx Medicals Pvt. Ltd.



7. 60% synthetic Hydroxyapatite and 40% Beta Tricalcium Phosphate to M/s. Onyx Medicals Pvt. Ltd.
8. Rapid Urinary Tract Infection (UTI) diagnostic kit with antibiotic sensitivity test to M/s. Agappe Diagnostics Ltd., Kerala (Figure 28 A)
9. Fibrin sealant to M/s. Zum Heilen Healthcare Pvt. Ltd., Bangalore in 2017 (Figure 28 B)



Figure 28. Products for which the technology was transferred (A) Rapid UTI diagnostic kit with antibiotic sensitivity (B) Fibrin sealant

Technology Transfer Committees

The Standing Internal Technology Transfer Committee meetings were held on 12 April, 26 April, 9 June, 13 July and 11 October 2017.

Technology Development Committee

Technology Development Committee met on 5 August 2017 and 19 February 2018.

Industry visits and discussions

The Division co-ordinated with the following industries to explore technology transfer and R&D collaborations:

- (i) M/s. HLL Lifecare Ltd.
- (ii) M/s. Shree Pacetronix
- (iii) M/s. Prevest Denpro
- (iv) M/s. Optimus Lifesciences
- (v) M/s. Anabond Stedmann
- (vi) M/s. Zum Helein
- (vii) M/s. Agappe Diagnostics
- (viii) M/s. Onyx Medical
- (ix) M/s. Mallelil Polymers

Intellectual Property Rights

One patent (India) was granted and 28 were filed during the year. Seven design registrations (India) were also filed.

Exhibitions

The Institute was represented in many major national exhibitions including the Exhibition organized by the scientific departments of the country at Vigyan Prasar, Noida; Youth Entrepreneurs Summit (YES

3D) 2017, Kochi; Gujarat Scientific Literacy Festival (GLF) 2017, Gujarat; 3rd India International Science Festival 2017, Chennai; Global Exhibition on Services, Greater Noida; Students Science Festival of Kerala (SSFK-2017), Trivandrum; and India Medical Devices Show 2018, Bengaluru (Figure 29).



Figure 29. Institute representation at the India Medical Devices Show 2018, Bengaluru

Student visits

The Division also co-ordinated the visits of students from different academic institutions and provided exposure to them on medical device development and other activities of the Institute.

Customer Service Cell

Customer Service Cell co-ordinated the internal and external testing services, and projects for the evaluation of medical devices and biomaterials.

The summary of the testing services is given in the Table below.



Description	External			Internal		
	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
No. of work orders	684	578	463	294	313	143
No. of test materials	1857	1355	935	865	941	435
Income (Rs)	34,650,58	3732527	44,86133	5,12,375	19,95175	11,23300

Online testing services

The Computer Division, along with the Customer Service Cell initiated a web-based testing service and the same was activated for the internal testing activities.

The system is a flow-based one that is in line with the Quality Management system of the Institute. Troubleshooting and improvements of the system were undertaken to make live services available to external customers also. The system enables the customer to make requests online, thereby have information on the status of the tests and access to online reports. The history of all test requests is available in the system.

Faculty

Mr D S Nagesh, Scientist G and Head
 Mr S Balram, Engineer G
 Dr Roy Joseph, Scientist G
 Dr Ramesh P, Scientist G
 Ms Leena Joseph, Engineer F
 Dr Anugya Bhatt, Scientist E
 Ms Sandhya C G, Engineer E,
 Mr Rajkrishna Rajan, Engineer E
 Dr Arun Anirudhan V, Engineer D
 Mr Sajithlal M K, Engineer D
 Mr Renjith S, Scientist B
 Mr Asok Kumar K R, Junior Engineer B
 Mr Binu C P, Junior Engineer A
 Mr Sabu K S, Junior Engineer A
 Ms Deepa G K, Junior Engineer

Technical

Mr Willi Paul, Scientific Officer

Mr Hari P R, Scientific Officer
 Dr Radhakumary C, Scientific Officer
 Mr Arumugham V, Senior Scientific Assistant
 Mr Rajesh R P, Senior Scientific Assistant
 Mr Vijayan C, Senior Social Worker
 Mr Sreekanth S L, Scientific Assistant
 Mr Raju A S, Technical Assistant - B
 Ms Asha Rani V, Technical Assistant - B
 Mr Krishna Prasad K, Technical Assistant - A
 Dr Sasikala T S, Technical Assistant - A
 Mr Ranjith Kumar R, Technical Assistant - A
 Mr Erlan Benanson, Technical Assistant - A
 Mr Suresh N B, Junior Technical Assistant
 Mr Binu A U, Technical Assistant - A
 Mr Saju S, Junior Technical Assistant - A
 Mr Selastin A J, Junior Technical Assistant - A
 Mr Manu M H, Junior Technical Assistant - A
 Mr Sajid A, Technical Assistant - A

Events organized

1. The 2nd Technology Conclave and Industry Meet was held on 15-16 May 2017. It was inaugurated by Hon'ble Minister for Health and Family Welfare, Shri J P Nadda.
2. The 6th Asian Biomaterials Congress was organised by the Biomedical Technology Wing in Trivandrum from 25-27 October 2017 (Figures 30 & 31). Leading researchers in biomaterials and medical devices, from various Asian countries (more than 40 speakers) and research Institutes and Universities in India (55 speakers) delivered invited lectures. There were 30 sessions in 3 parallel proceedings. More than 200 research students working in the field of advanced biomaterials, medical devices and implants, tissue



engineering, drug delivery, regenerative medicine, orthopaedics and dentistry presented papers.

3. The Annual Mentoring Committee Meeting of the 'DBT Center of Excellence' (DBT-CoE)

Programme, "Programme Support on Translational Research on Biomaterials for Orthopaedic and Dental applications" was convened at the BMT Wing on 19 December 2017. This 2nd DBT-CoE



Figure 30. Inaugural address by the Hon'ble MP Dr Shashi Tharoor at the 6th Asian Biomaterials Congress. Others on the dais – Dr Prabha D Nair (President STERMI), Prof Justin Cooper-White (President, Asian Biomaterials Federation), Dr Chandra P Sharma (founder SBAOI & STERMI), Shri K M Chandrasekhar (President, SCTIMST), Dr Asha Kishore (Director, SCTIMST), Prof Toru Mazuzawa (Secretary General, APSAO) and Dr Harikrishna Varma (Head, BMT Wing, SCTIMST)



Figure 31. Releasing of the souvenir during the inaugural session of the 6th Asian Biomaterials Congress

was organized by the Indian Institute of Science, Bangalore, and partnered by the Bioceramics Division.

4. The Division of Experimental Pathology and Histopathology organised two Modular Courses in Regulatory Toxicologic Pathology: Module II: Hepatobiliary, gastrointestinal and respiratory systems on 3-6 August 2017 and Module II: Toxicologic Pathology of lymphoid (immune), endocrine, male genital and female genital systems (including regulatory reproductive studies) from 8-10 February 2018 at the BMT Wing (Figure 32).
5. Two Animal Handling Training Programmes were conducted by the Division of Laboratory Animal Science during the year for MSc and PhD Scholars that were attended by 28 participants
6. The Division of Laboratory Animal Science

organised a one-day National Level Seminar on 16 January 2018 on "Experimental animal surgery and postoperative supervision" with the support of the Industry Institute Partnership Cell of SCTIMST. The seminar was conducted by Dr Klas S P Abelson, Associate Professor, Department of Experimental Medicine, University of Copenhagen, Denmark.

7. The World Sleep Day was organized by the Division of Sleep Research on 16 March 2018 at the Biomedical Technology Wing (Figure 33). Dr Prabha D Nair, Head, Department of Applied Biology, chaired the event. Dr Harikrishna Varma, Head, BMT Wing, delivered the inaugural address. Dr Kamallesh K Gulia, Scientist-in-charge of the Division of Sleep Research, delivered a talk on "Sleep: Revisit to an understated element of life!". Dr Gulia handed over to Dr Harikrishna Varma two copies of "Down Memory Lane" by



Figure 32. Modular Courses in Regulatory Toxicologic Pathology on 3-6 August 2017 and 8-10 February 2018 at BMT Wing

Dr V Mohan Kumar who initiated the Comprehensive Centre for Sleep Disorders at SCTIMST.

8. The National Workshop on Image Analysis in Bioscience Research (Figure 34) was organized by the Division of Tissue Culture, BMT Wing in association with the Department of Computer Science, University of Kerala, Thiruvananthapuram, from 29 November to 1 December 2017
9. A One-day Symposium on Biosafety, jointly

organized by SCTIMST and Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram, was conducted on 23 June 2018 at the M R Das Auditorium, RGCB

10. The Institute hosted the 10th The Cytometry Society-India Annual Meeting and Workshop (TCS-2017) on “Applications of Flow Cytometry in Health & Disease” from 28-31 October 2017. The event was organized in collaboration with the Regional Cancer Centre, Trivandrum, and Rajiv Gandhi Centre for Biotechnology, Trivandrum.



Figure 33. World Sleep Day celebration on 16 March 2018

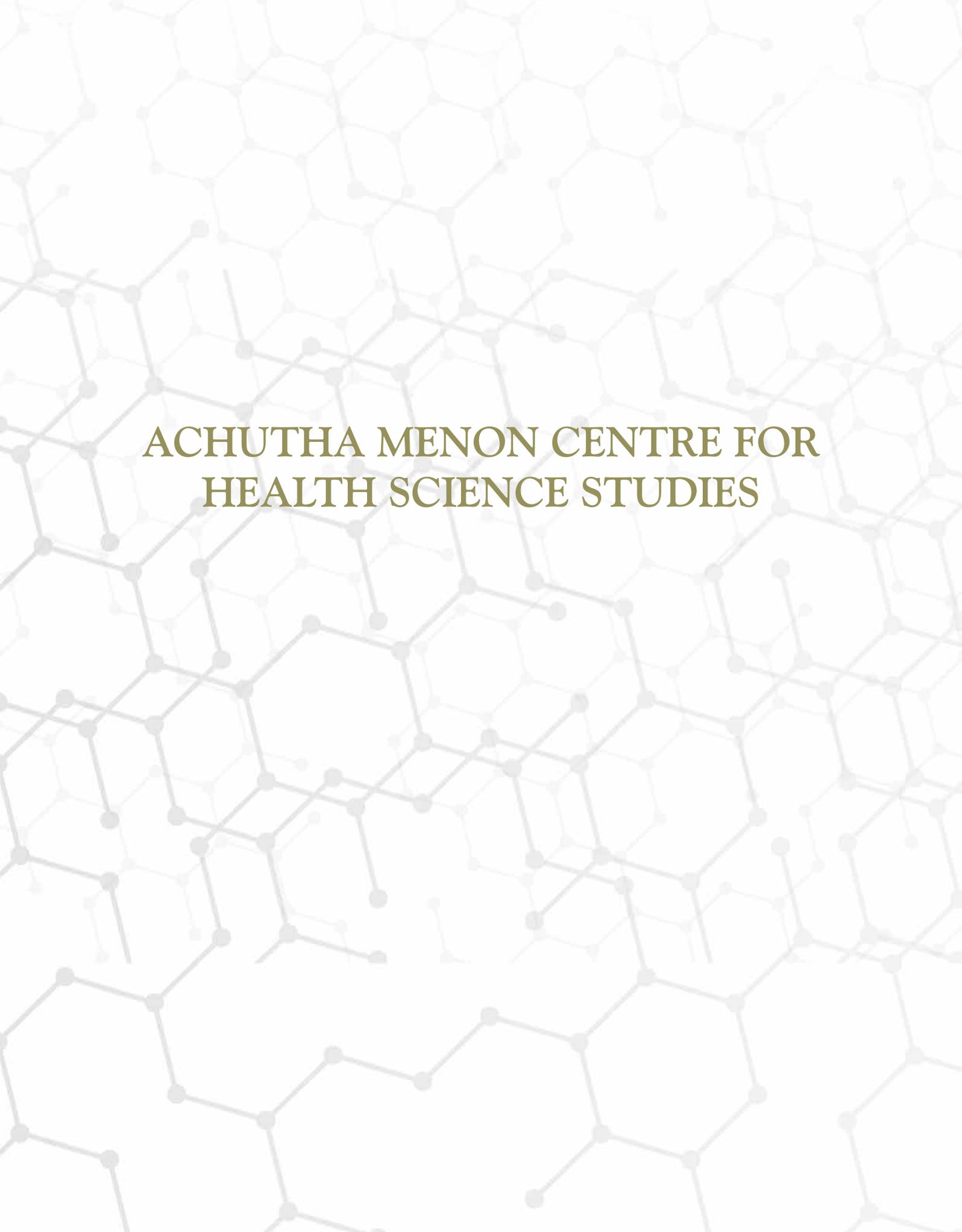


Figure 34. The National Workshop on Image Analysis in Bioscience



Awards and Honours

1. Dr Lizymol P P, was conferred the 'Nari Shakthi Puraskar', the highest civilian honour for women, for the year 2017. The award was presented by the Hon'ble President of India at the Rashtrapati Bhawan on 8 March 2018 on the occasion of International Women's Day.
2. Dr P V Mohanan received Life Time Achievement Award – 2017, in recognition of his outstanding contribution to the field of Toxicology, during the 37th Annual Conference of the Society of Toxicology, India, held on 17-19 November 2017 at PGIMER, Chandigarh
3. Dr T V Anilkumar was elected Vice-President of Tissue Engineering and Regeneration Medicine Society of India
4. Dr Kamalesh K Gulia was elected Executive Member of the Indian Academy of Neurosciences from 2018 to 2020
5. Dr Kamalesh K Gulia was elected General Secretary of the Indian Society of Sleep Research from 2018 to 2020
6. Dr Jayasree R S was nominated Member of National Science Advisory Group (NSAG) of Nanomission, DST, Government of India, for a period of two years
7. Dr Syama S received Young Scientist Award for the paper 'Organ distribution and kinetics of nanographene in biological system' at the 6th Asian Congress of Biomaterials, Trivandrum, on 25-27 October 2017
8. Ms Bridget Jeyatha W received the 2nd Prize for Poster Presentation at the 6th Asian Congress of Biomaterials, Trivandrum, on 25-27 October 2017
9. Mr Amal Wilson Varghese received the Best Poster Award at the 2nd C. elegans Conference at New Delhi on 23-26 February 2018
10. Ms Priya S S received the award for Best Paper Presentation (oral) at the Annual Technical Meeting – 2018 (MRSI-ATM-2018) of the Materials Research Society of India, Trivandrum Chapter, on 24 March 2018, at the Indian Institute of Science Education and Research, Thiruvananthapuram
11. Dr Amrita N received the CSIR Senior Research Fellowship
12. Mr Balu V Gopal received an International Travel Grant from ICMR for participation in TERMIS EU at Davos, Switzerland, on 26-30 June 2017
13. Mr D S Nagesh was Member of the Expert Committee for evaluation and appraisal on the project, "Gamma radiation plant for medical device reprocessing in hospitals", organized by the Department of Science and Technology, Government of India, at Chandigarh on 17 August 2017
14. Mr D S Nagesh was an invitee at the Conference on Draft National Medical Device Policy, organized by the Department of Pharmaceuticals, Government of India, at New Delhi, on 24 August 2017
15. Dr Prabha D Nair visited Denmark from 1-5 May 2017 as part of the Indo-Danish Collaborative Project. She delivered an invited lecture on the 'Biomaterials to enhance musculoskeletal regeneration' at the meeting
16. Dr PR Umashankar visited four GLP testing laboratories as an observer for GLP inspections for the National GLP Monitoring Authority



**ACHUTHA MENON CENTRE FOR
HEALTH SCIENCE STUDIES**



ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

The Achutha Menon Centre for Health Science Studies continued its activities in training and research in the area of Public Health. The Master of Public Health (MPH) Programme continued to train students successfully. Research activities in collaboration with major universities were very productive.

Activities

During the year, apart from the training of MPH and PhD students, the key research programmes centred around health equity, non-communicable diseases, tribal health and health technology assessment. A National Workshop on Health Technology Assessment (HTA) was organised in May 2017, with the support of the Department of Health Research and attended by participants from all over India. The faculty included national and international experts. Following this, we submitted a proposal seeking support for a 3-year initial project for a 'Regional Resource Centre for HTA', which was approved. We seek to establish HTA as a core competence of the Department in the coming years, as it is a multidisciplinary activity that befits our mandate. In January 2018, the IDRC-funded 'Closing the gaps - health equity research in India' project held a national conference on equity research that was well attended. This also incorporated the AMCCON, the Annual Public Health Conference of the Achutha Menon Centre.

The Board of Studies for Public Health proposed and the Academic Committee accepted a changeover of the academic year in AMCHSS from January-December to July-June. Accordingly, no MPH selections were made in November 2017; instead, they are being held in May 2018, so that the new batch will start in July 2018.

AMCHSS faculty represented the Institute in the selection interviews for MPH in all affiliated institutes, viz., the National Institute of Epidemiology (NIE), Christian Medical College, Vellore (CMC) and the

Indian Institute of Public Health, Delhi (IIPH-D). A team including Dr Raman Kutty visited CMC Vellore in February 2018 to review the affiliated MPH and PhD programmes.

New Initiatives

KIRAN

KIRAN is a multi-stage cross-sectional survey of random households across the state. The primary objective of KIRAN is to create a comprehensive health map of the state of Kerala with information about current prevalence of major non-communicable diseases and their related risk factors. The secondary objective is to describe the variations in morbidity and mortality profiles in relation to variations in prevalence of the identified determinants across various demographic, socio-economic and geographic strata.

Regional Technical Resource Centre for Health Technology Assessment

Health Technology Assessment (HTA) is policy research that aims to inform priority setting and resource allocation. It refers to the systematic evaluation of properties, effects, and/or impacts of health technology. It is a multidisciplinary process to evaluate the social, economic, organizational and ethical issues of a health intervention or health technology. We are establishing a Resource Centre for Health Technology Assessment with support from the Department of Health Research, Government of India.

INDIA-WORKS

It is an implementation trial to evaluate the acceptability, delivery, effectiveness and cost-effectiveness of a worksite-based lifestyle improvement package on diabetes and cardiovascular risk reduction. Participants of this programme are employees of eight diverse worksites from India.



NCD Project

The project 'Prevention of NCDs in Kerala' completed one more year, with extension of the intervention through schools and health workers into 20% more panchayats in Kerala. In activities such as health classes and sensitization, health education videos produced as part of the project were effectively used all over the state. Elected representatives of selected panchayats were also sensitized through meetings and sessions. Several districts conducted 'NCD summits', in which interesting competitions were held for school students such as posters, quiz, cooking competition and debates.

We submitted a proposal to the Government of Kerala for extending the NCD project for one more year.

Mobile Tele-medicine Project Wayanad

Mobile Tele-medicine Project in Wayanad is an initiative to improve secondary health care service coverage in the tribal areas of Wayanad District with the help of technology.

Events organized

1. Dr Sundari Ravindran organized the National Conference on 'Closing the Health Equity Gap in India: Transformational Research for Action' on 8-11 January 2018 at AMCHSS
2. Dr Ravi Prasad Varma organized a Workshop on 'Applying Research Designs to Research Questions' on 28 June 2017 at Trivandrum
3. Dr Sundari Ravindran organized a Workshop on 'Cutting Edge Research on Health Inequities: Concepts and Methods' in collaboration with Azim Premji University, Bengaluru, on 3-7 July 2017 at Bangalore
4. Dr Raman Kutty organized a Workshop on 'Analyzing Medical and Health Data using R' on 6-7 October 2017 at AMCHSS
5. Dr Srinivasan Kannan organized a Course on Project Management for Health on 27 November - 1 December 2017 at AMCHSS
6. Dr Mala Ramanathan organized a Workshop for Public Health Ethics Case Studies on 26-27 March 2018 at AMCHSS

7. Dr Sundari Ravindran organized dissemination meetings to report the findings from the multicentre study on tribal health and health inequities between 8 November-13 December 2017 at Guwahati, Ranchi, Raipur and Trivandrum
8. The launch of the book 'Health inequities in India: A Synthesis of Recent Evidence', Springer Nature Singapore Pte. Ltd., co-edited by Dr Sundari Ravindran, was held on 24 February 2017 at Bangalore

Awards and Honours

1. Prof V Raman Kutty was elected Fellow of the International Academy of Cardiovascular Sciences
2. Dr Jeemon Panniyammakal was elected Fellow of the European Society of Cardiology
3. Dr Biju Soman was visiting faculty at the School of Public Health, NITTE University, Mangalore
4. Ms Jissa V T was awarded PhD in Health Sciences (Epidemiology) by the University of Tampere, Finland, for her thesis 'Evaluation of Sociodemographic, Reproductive and Screening related Factors on Risk of and Survival from Cervical Cancer in Rural South India'.

Faculty

Dr V Raman Kutty, Professor (Senior Grade) and Head of the Department

Dr Sundari Ravindran, Professor

Dr Sankara Sarma P, Professor

Dr Mala Ramanathan, Professor

Dr Srinivasan Kannan, Additional Professor

Dr Biju Soman, Additional Professor

Dr Ravi Prasad Varma, Associate Professor

Dr Manju Nair R, Scientist C

Dr Jissa V T, Scientist B

Dr Jeemon Panniyammakal, Assistant Professor



DIVISION OF ACADEMIC AFFAIRS

The Sree Chitra Institute continues to be a much sought-after destination for super speciality courses leading to DM or MCh Degrees in Cardiac and Neurosciences. This is also one of the few institutions that offer post-doctoral fellowship programs in subspecialty areas of Cardiac and Neurosciences. In addition, the Institute offers Masters and PhD courses in Medical, Biomedical and Public Health Sciences and also, Diploma and PG Diploma courses in related areas. The nationwide response to the programmes bears testimony to their popularity.

Activities

Programmes offered during the year

Post-doctoral courses

1. DM Cardiology
2. DM Neurology
3. DM Neuroimaging and Interventional Neuroradiology
4. DM Cardiothoracic & Vascular Anaesthesia
5. DM Neuroanaesthesia
6. MCh Cardiovascular & Thoracic Surgery
7. MCh Vascular Surgery
8. MCh Neurosurgery (after M.S)
9. MCh Neurosurgery - 5-year course (after MBBS and 1 year Senior house surgency/ Residency in General Surgery)
10. Post-doctoral certificate course in Cardiothoracic and Vascular Anaesthesia
11. Post-doctoral certificate course in Neuroanaesthesia
12. Post-doctoral certificate course in Cardiovascular Imaging and Vascular Interventional Radiology
13. Post-doctoral certificate course in Diagnostic Neuroradiology
14. Post-doctoral certificate course in Vascular Surgery
15. Post-doctoral Fellowship (Post DM/MCh/DNB)

PhD/Master's

16. MD in Transfusion Medicine
17. Master of Public Health (MPH)
18. M Phil (Biomedical Technology)
19. PhD (Full Time) & (Part Time)

Diplomas

20. Diploma in Public Health
21. Diploma in Cardiovascular & Thoracic Nursing
22. Diploma in Neuro-Nursing
23. Diploma in Operation Theatre Technology
24. Diploma in Advanced Medical Imaging Technology

PG Diplomas

25. Cardiac Laboratory Technology
26. Neuro-Technology
27. Medical Records Science
28. Clinical Perfusion
29. Blood Banking Technology

Advanced Certificate

30. Advanced Certificate Programmes in Physiotherapy
 - Advanced Certificate Programme in Physiotherapy in Neurological Sciences
 - Advanced Certificate Programme in Physiotherapy in Cardiovascular Sciences

Other Programmes

Joint Programmes:

- MTech (Clinical Engineering)
- PhD (Biomedical Devices and Technology)



Affiliated Programmes with other Centres:

A. National Institute of Epidemiology, Chennai

- Master of Public Health (Epidemiology and Health Systems)

B. Christian Medical College, Vellore

- MS Bioengineering
- PhD in Bioengineering/Biomedical Sciences/Health Sciences
- Master of Public Health (MPH)

C. IITMK, Trivandrum

- PhD (For Engineering Graduates)

D. PHFI (IIPH), New Delhi

- Master of Public Health
- PhD

The annual selection process for admission to various courses was carried out in the months of November and December. A supplementary selection process was carried out to select senior residents for the CVTS Department in July 2017 along with PhD (Fellowship holders) and MPhil (Biomedical Technology) selection.

The newly-admitted students were welcomed at a function held on 6 January 2018 where the Director, Dean and various senior faculty members addressed them.

The student community attended national and international conferences, and brought laurels to the Institute by winning best oral and poster presentation awards. They actively participated in the Science Fete and organised the Students Fest, Chitrolsav.

The Orientation Programme for the senior residents was conducted during the months of April and September in two batches. They spent one week in the Biomedical Technology Wing, visiting various laboratories for exposure to areas relevant to medical device development. They also made industry visits to Terumo Penpol Ltd. and HLL Lifecare Ltd., where

medical devices are manufactured using Chitra Technologies.

Number of students enrolled from 01.04.2017 to 31.03.2018

The number of senior residents enrolled for DM/MCh/PDF and Post-doctoral Certificate courses during the year was 55. There were 13 students enrolled for PhD, 6 for MPhil programme, and a candidate for MD Transfusion Medicine. 25 students also enrolled for various Diploma/PG Diploma programmes. The candidates admitted to various programmes passed their qualifying examinations from 48 Indian Universities/Institutions/Boards. The total strength of students on the rolls of the Institute (excluding the joint programmes and affiliated programmes) was 335.

Admission Process

Admissions to various programmes of study is regulated by policy and procedures approved by the Academic Committee of the Institute from time to time. The Admission announcement is published all over India through advertisements in leading newspapers during 1st week of September every year and on the Institute website. The assessment and interviews for admission to postdoctoral, doctoral, postgraduate and diploma programmes are held in the Institute during the months of November/December. Admissions to PhD (Fellowship holders) and MPhil (Biomedical Technology) are carried out during July/August.

Short-Term Training/Observership

Candidates sponsored by Government/Autonomous Institutions/Health Sector Organizations/Approved Medical/Dental/Nursing/Engineering Colleges and Paramedical Institutions were provided short-term training. The training/ observership was arranged in consultation with the respective Department/Discipline. Observers from various institutions all over the country spent varying periods from 15 days to 3 months in different Departments of the Institute.

Annual Convocation

The Annual Convocation of the 33rd batch of graduates for the year 2017 was held on 15 May 2017. Dr Jagat Prakash Nadda, Hon'ble Minister for



Health & Family Welfare, Government of India, was the chief guest and he delivered the convocation address. Dr Anil Kakodkar, Former Chairman of the Atomic Energy Commission of India, was the Guest of Honour. Shri K M Chandrasekhar, Former Central Cabinet Secretary and Institute President, presided. 155 graduates received their degrees during the Convocation.

Degrees/Certificates Awarded

Name of Programme	Total	Remarks
MD	1	
DM	23	
MCh	9	
PDF	10	
PDCC	6	
PhD	14	
MPhil	10	
MPH	15	SCTIMST
MPH	2	CMC Vellore
MPH	16	NIE Chennai
MS - Bioengineering	1	CMC Vellore
DPH	1	
Diploma in Cardiovascular & Thoracic Nursing	8	
Diploma in Neuro Nursing	10	
Diploma in Cardiac Laboratory Technology	1	
Diploma in Neuro Technology	2	
Diploma in Clinical Perfusion	1	
Diploma in Advanced Medical Imaging Technology	2	
Diploma in Medical Records Science	2	
Diploma in Operation Theatre Technology	2	

Diploma in Blood Banking Technology	0	
Total	136	

National Science Day 2018 Celebrations

National Science Day 2018 was celebrated on 9 March 2018 in the Biomedical Technology Wing of the Institute (Figure 1). A large number of students from nearby colleges participated in the celebrations with the theme 'Science and Technology for a sustainable future'. Several science-related talks by internal faculty and quiz programmes were organized, followed by laboratory visits on the occasion of the National Science Day in the Institute premises. A demonstration of Raman spectroscopy was also organised for the staff and students.

Progressive Use of Hindi

The Institute complied with the provisions relating to the Official Language Act, Rules and Instructions and Directives of the Government of India.

During the year, various competitions were held for the employees in Hindi. Hindi Fortnight/Hindi Day was observed. Hindi Workshops were conducted for the benefit of staff members to increase the knowledge of functional Hindi. Letters received in Hindi were replied to in Hindi. The Institute participated in the Town Official Language Implementation Committee meetings.

Faculty

Prof Asha Kishore, Director & Chairperson

Dr Kalliyana Krishnan V, Dean of Academic Affairs

Prof Thomas Koshy, Associate Dean (Examinations & Curriculum)

Prof Shrinivas V G, Associate Dean (Faculty & Student Affairs)

Dr Kumari T V (till 30/9/2017), Associate Dean (PhD Programme)

Dr Roy Joseph (from 1/10/2017), Associate Dean (PhD Programme)

Prof Sundari Ravindran, Associate Dean (Health Sciences)



Dr Shivakumar K, Associate Dean (Research & Publication Cell)

Dr George A V, Registrar

Dr Santhosh Kumar B, Deputy Registrar

Staff

Mr Shiju (till 21/9/2017), Assistant Administrative Officer (Academic) - A

Mr Shibu Raj R (from 15/2/2018), Assistant Administrative Officer (Academic) - A

Ms Jeeva K H, Executive Assistant - A

Mr Ramaprasad P, Upper Division Clerk



Figure 1. National Science Day Celebration

NURSING EDUCATION

The speciality nursing programmes of the Institute continued to attract registered nurses as evidenced by the number of applicants for the two programmes - Diploma in Cardiovascular and Thoracic Nursing and Diploma in Neuro nursing. The number of applicants was more than two times the annual intake and majority of them were graduate nurses. The 29th batch of Cardiac nursing speciality students and 25th batch of Neuro nursing speciality students graduated in December 2017. Presently, 225 cardiac nurses and 170 neuro nurses are working in many parts of the world.

During the year, 32 students, 19 CVT Nursing and 13 Neuro nursing students were undergoing the speciality programmes, the details of which are provided in the Table below:

Programme	No. of students in 2018		Students graduated in December 2017
	First year	Second year	
Diploma in Cardiovascular and Thoracic Nursing	10	9	8
Diploma in Neuro nursing	4	9	10
Total	14	18	18

Clinical Observership

The Division hosted MSc Nursing students (124 students) from 29 Institutions for their facilitated clinical rotation during the year.

Research

The effect of CPR training among nurses was assessed



using a pre-test/post-test design. In Phase I, 163 staff nurses were pre-tested and given training based on American Heart Association Guidelines 2015. Sixteen lecture-cum-demonstration classes were taken along with return demonstration and skill development. Phase II was completed in 2017.

Staff

Dr Saramma P P, Senior Lecturer in Nursing

LIBRARY, HOSPITAL WING

The Hospital Wing library has a collection of 15741 books and 15780 back volumes of journals. During the current year, the library subscribed to 110 journals. Electronic access to the journals we subscribe was activated and made available in both the campuses.

Staff

Sudha T, Senior Librarian-cum-Documentation Officer - A

Dimple Gopi, Librarian-cum Documentation Assistant - B

Jayamohan C S, Librarian-cum-Documentation Assistant - A

Seema S, Librarian-cum-Documentation Assistant – A

LIBRARY, BMT WING

Activities

The library of the Biomedical Technology Wing has 11173 books, 6019 back volumes and subscribed to 51 journals. It subscribes to ASM Medical Materials Database, a comprehensive, peer-reviewed database developed by ASM International, which provides a single relational resource to summarize scientific and engineering knowledge on implantable medical materials data to support surgical, cardiovascular, orthopaedic and neurological medical device design. The library has a good collection of standards and patents. The standards essential for the Quality Management System and R&D activities of the BMT Wing were regularly updated.

The Document Archiving Cell is part of the library and the Librarian-cum-Documentation Officer acts

as the Archivist.

Staff

Mr Anil Kumar C, Librarian-cum-Documentation Officer - B

Mr Joy Vithayathil, Senior Librarian-cum-Documentation Assistant - B

MEDICAL ILLUSTRATION

Medical Illustration focuses on Clinical photography, Event photography and Audiovisual in connection with academic and medical research activities.

The Section documents/archives operations, treatment procedures and patient progress for training and development purposes. These images can also be used to educate trainee doctors and budding medical scientists. In addition, the Section also creates charts, posters and other resources used for annual reports, journal publishing, education, and research and development activities.

Audiovisual services of Medical Illustration provide web streaming, video conferencing and live broadcast services. Computer-based audiovisual equipment is used in clinical education, national and international conferences and seminars.

Staff

G Lijikumar, Scientific Officer

Vasanthy S (till November 2017), Senior Artist

Viji Kumar N, Projectionist



PUBLICATIONS

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RESEARCH PROJECTS



EXTERNALLY-FUNDED RESEARCH PROJECTS (ONGOING)

Hospital Wing

Title of the Project	Principal Investigator	Funding agency	Total out-lay (Rs in Lakhs)	Duration
Encoding of interhemispheric interactions in mirror dystonia: a window to the physiology of dystonia	Dr Asha Kishore	Dystonia Medical Foundation, USA	US \$ 36000.00	4 years
Effect of Yoga on motor cortex plasticity, motor learning and motor deficits on Parkinson's Disease	Dr Asha Kishore	DST	32.81	3 years
Deciphering the genetic architecture of Parkinson's Disease in Indian population	Dr Asha Kishore	Michael J Fox Foundation, USA	US \$ 299922 (US \$ 46992 to SCTIMST)	2 years
Enhancement of Research and Clinical Resources of Movement Disorder Programme under the Comprehensive Care Centre for Movement Disorders, SCTIMST	Dr Asha Kishore	Dr T S Ravikumar Foundation, USA	16.77	5 years
205MS303 – A multicentre, open-label extension study to evaluate the long-term safety and efficacy of BIIB019, Daclizumab High Yield Process (DAC HYP), monotherapy in subjects with multiple sclerosis who have completed study 205MS301	Dr Muralidharan Nair	Biogen Idec	28.00	4 years
Quantification of disability in epilepsy: A move towards rehabilitation and empowerment	Dr Sanjeev V Thomas	Centre for Disability Studies, Kerala	07.45	30 months
Growing beyond barriers: Epilepsy Care through Schools	Dr Sanjeev V Thomas	Social Justice Department, Government of Kerala	33.77	2 years
Electroencephalographic features and seizure risk in 12 to 18 year old children of women with antenatal, antiepileptic drug exposure	Dr Sanjeev V Thomas	ICMR	12.67	3 years



Establishment of a biorepository of epilepsy & investigating the relation of multidrug transporter polymorphism with fetal malformations based on the repository	Dr Sanjeev V Thomas	DBT	48.23	3 years
Prospective study of patients undergoing microneurosurgical procedures through a midline inter-hemispheric transcallosal approach	Dr Mathew Abraham	Chitra Alumni Educational and Research Foundation (CAERF)	6.18	2 years
Analysing the functional connectivity networks in brain in drug-resistant idiopathic generalized epilepsy using EEG-fMRI co-registration	Dr Ashalatha R	SERB	28.70	42 months
The Human Brain Mapping Project – A resting state fMRI study of healthy controls and patients with mild cognitive impairment (MCI) and degenerative dementia of Alzheimer`s type (AD)	Dr Ramshekhar N Menon	DST	23.09	4 years
Effect of yoga on neuropsychological functions and brain connectivity networks in mild cognitive impairment and cognitively normal subjects	Dr Ramshekhar N Menon	DST	33.82	3 years
ISCHEMIA: International Study of Comparative Health Effectiveness With Medical and Invasive Approaches	Dr Ajit Kumar V K	National Institutes of Health, USA & New York University School of Medicine	23.75	5 years
Meres 1 trial: A prospective, multicentre, single arm, open label, pilot clinical study of Meres 100 sirolimus-eluting bioresorbable vascular scaffold system in the treatment of de novo native coronary artery lesions	Dr Ajit Kumar V K	Meril Life Science Pvt. Ltd.	1.50	3 years
Equipment for Heart Failure and Transplant Clinic	Dr Harikrishnan S	Tata Trusts	317.00	2 years
Pilot study for establishing nationwide network of registries on Management of Acute Coronary Event (MACE Registry)	Dr Harikrishnan S	ICMR	17.35	4 years
Trivandrum Heart Failure Cohort	Dr Harikrishnan S	ICMR	5.89	5 years



A resting state fMRI & task-based fMRI	Dr Kesavadas C	GE Technology Centre	9	3 years
International Stroke Perfusion Imaging Registry (INSPIRE)	Dr Sylaja P N	University of Newcastle, Australia	3.17	3 years
Improvement of secondary prevention in stroke survivors by a primary health care approach	Dr Sylaja P N	Health Department Government of Kerala	9.51	1 year
Establishment of the India Stroke Clinical Trial Network (INSTRuCT)	Dr Sylaja P N	ICMR	15.16	3 years
Secondary prevention by structured semi-interactive stroke prevention package in India	Dr Sylaja P N	ICMR	1.37	3 years
Apolipoprotein B and A1 in Ischemic Stroke subtypes	Dr Sylaja P N	Emory University, USA	7.96	2 years
Mitochondrial remodelling for prevention of chronic pressure overload induced cardiac remodelling	Dr Renuka Nair	ICMR	21.20	3 years
Oxidative stress-mediated stem cell modification promotes cardiac failure in hypertrophic remodelling	Dr Renuka Nair	BRNS	20.00	3 years
Molecular mechanisms in wound healing in the heart: Regulation of the cardiac fibroblast AT1 receptor	Dr Shivakumar K	DBT	37.80	3 years
Mitochondrial metabolism and function in type 2 diabetic heart	Dr Srinivas G	SERB	50.77	3 years
In vitro beta-amyloid uptake by peripheral blood macrophages: predictor for progression from mild cognitive impairment to Alzheimer's Disease	Dr Srinivas G	ICMR	18.91	3 years
Study of carbamazepine embryotoxicity in relation to MDR1 polymorphisms	Dr Manna Jose	DST	25.81	3 years
Biochemical and functional investigation of dorsolateral prefrontal cortex in mild cognitive impairment using functional magnetic resonance spectroscopy and functional magnetic resonance imaging	Dr Anupa	SERB	18.70	2 years
A resting state fMRI and task-based fMRI study: optimization, memory lateralization and connectivity in normal subjects versus patients with epilepsy	Dr Smitha K A	IIS-DBT	9.90	5 years



Prospective single arm, multi-center, observational registry to further validate safety and efficacy of Ultimaster DES system in unselected patients representing everyday clinical practice	Dr Bijulal S	Terumo India Ltd.	11.74	18 months
Comprehensive Care Centre for Neurodevelopmental Disorders	Dr Soumya Sundaram	Federal Bank Hormis Memorial Foundation	219.00	5 years
E-delivery system for healthcare management and research at SCTIMST	Dr Geetha G	Ministry of Electronics and Information Technology, Government of India	895.00	2 years
Validation of the Malayalam version of Montreal Cognitive Assessment (MoCA) Scale and a prospective evaluation of MCI in Parkinson's Disease using the Malayalam version (MoCA-M)	Dr Syam K	ICMR	3.81	3 years
Quantitative estimation of regional brain iron deposition- a potential biomarker for Parkinson's Disease and other neurodegenerative conditions causing atypical Parkinsonism	Dr Syam K	DBT	18.73	3 years
Hypoxia and Mineralisation in Alzheimer's Disease detected in vivo with magnetic resonance imaging	Dr Sheela Kumari	SERB	18.70	2 years
Funding for Human Resources under National Health Mission for augmenting Paediatric Cardiac Surgery Services in SCTIMST	Dr Baiju S Dharan	National Health Mission	34.83	3 years
Structural and functional imaging correlates of cognitive dysfunction in relapsing remitting multiple sclerosis	Dr Sruthi S Nair	DST	32.15	3 years
Can cardiovascular patients with obstructive sleep apnea have adverse perioperative outcomes? - a prospective study	Dr Sapna Erat Sreedharan	ResMed Foundation, California	3.80	2 years
Understanding phenotypes in Moyamoya disease by resequencing 17q25ter region: An imaging genomics approach	Dr Arun K	Wellcome Trust DBT India Alliance	36.45	2 years



Biomedical Technology Wing

Project Title	Principal Investigator	Funding Agency	Total outlay (Rs in Lakhs)	Duration
Mechanism of epileptogenesis in young & adult brain - role of NMDA receptor subtypes in hippocampal neurons and astrocytes	Dr Pradeep Punnakkal	DBT (Ramalingaswamy Fellowship)	87.3	5 years
Preparation of hydrogel formulations from cholecystic extracellular matrix for biomaterial application	Dr Akhila Rajan	SERB	31.2	3.3 years
Multifunctional hydroxyapatite lanthanide core shell nanoparticles for near-infrared theranostic imaging	Dr Sunitha Prem Victor	DBT	39.69	3 years
Detailed state model of CaMKII activation & auto-phosphorylation in the presence of NR2B and its behaviour in epileptic conditions	Dr Arun Anirudhan	KSCSTE	18.36	3 years
Tissue-engineered concept for promoting osteoporotic animal models with relevance to the clinical problem in women	Dr H K Varma	DST	34.94	3 years
Defining the mechanobiology that leads to heterogeneity in muscle stem cells and its implication in regeneration	Dr Praveen K S	SERB (Ramanujan fellowship)	89.00	5 years
Effects of vascular endothelial growth factor-transfected human ADMSCs in promoting angiogenesis for chronic wound healing	Ms Amita Ajit	DST-WoS	25.96	3 years
To alleviate cognitive deficits in the offspring induced by sleep loss during pregnancy by administering alpha-asarone: A study in an animal model	Dr Kamalesh Gulia	DST-CSRI	44.08	3 years
How actin/intermediate filament structures within the cell are regulated by changes in microtubule dynamics: Role of microtubule associated proteins and cross-linking proteins in maintaining cytoskeletal network	Dr Renu Mohan	DBT (Ramalingaswamy fellowship)	88	5 years



Programme support on translational research on biomaterials for orthopedic and dental application	Drs H K Varma, Manoj Komath & A Sabareeswaran	DBT	47.05	5 years
Gold nanorod-based nanoprobe for cancer theranostics: Diagnosis by SERS and fluorescence imaging and therapy by PDT and PPT	Dr Jayasree R S	DBT	84.22	3 years
The role of NMDA and dopamine receptors in spinal pain pathways	Dr Pradeep Punnakkal	DBT	107.28	3 years
Differentiation of mesenchymal stem cells into chondrocytes by sustained delivery of miRNAs using chitosan hydrogel	Dr Prabha D Nair	SERB	76.97	2 years
Development of biomimetic strontium incorporated nanostructured ceramic coating on Cp-titanium for orthopaedic implants	Dr P V Mohanan	DBT	5.23	1 year
Enteric coating and microencapsulation of antibodies	Dr Roy Joseph	DST	6.98	1 year
Development of bioactive bone cement based on novel inorganic-organic hybrid resins	Dr Lizymol P P	KSCSTE	18.44	3 years
Blood-brain barrier targeted nanoconstructs for the diagnosis of brain diseases and the delivery of therapeutics into the brain	Dr Jayasree R S	DBT	11.45	1 year
Scaffolds base on self-assembling peptide dendrimers and resorbable calcium phosphate for endodontic tissue regeneration	Dr Manoj Komath	DBT	20.75	3 years
MUSTER- Musculoskeletal stem cell targeting	Dr Prabha D Nair	DBT- Joint Research project under the Indo-Danish collaboration in biotechnology	209.96	4 years
MUSTER- Musculoskeletal stem cell targeting	Dr Harikrishna Varma	DBT- Joint Research project under the Indo-Danish collaboration in biotechnology	96.00	4 years
Radiopaque liquid embolic materials for treatment of arteriovenous malformation	Dr Parvathy J	KSCSTE	4.72	2 years
Preclinical evaluation and commercialisation of anti-snake venom (IgY), anti-hemotoxins and anti-neurotoxins	Dr Lissy Krishnan	Division of Drug and Pharmaceutical Research (DPRP), DST	247.98	2 years



Development of novel prototype mechanical clot retriever for the treatment of acute cerebral ischemic stroke	Dr Santhosh	DST	15.08	2 years
To model the effect of mutations of HCN channels in neuronal excitability and impact of GABABR on GIRK and HCN mutation using neurons	Dr Arun Anirudhan	DBT	14.78	3 years
Development of indigenous voice prosthesis for rehabilitation of laryngectomies	Dr Roy Joseph	KSCSTE	4.37	3 years
A tissue-engineered skin substitute with localised hair follicle stem cells for hair follicles and sebaceous gland regeneration	Dr Babitha S	DST	29.40	3 years



Achutha Menon Centre For Health Science Studies

Title of the Project	Principal Investigator	Funding agency	Total outlay (Rs in Lakhs)	Duration
Survey for monitoring the National Non-Communicable Diseases Targets	Dr Sankara Sarma	NCDIR	71.41	1 year
Pilot testing the ICMR-THSTI forms for use by Ethics Committees	Dr Mala Ramanathan	Translational Health Science and Technology Institute (THSTI)	6.88	6 months
Mobile Telemedicine project for Waynad	Dr Biju Soman	DST	564.00	3 years
Kerala Diabetes Prevention Program (KDPP II)	Dr Jeemon Panniyammakal	World Diabetes Foundation, Denmark	US \$ 250541	3 years
Control and Prevention of Non-Communicable Disease in Kerala	Dr Raman Kutty V	Health and Family Welfare Department, Government of Kerala	495.00	2 years
Closing the gaps: Health Equity Research Initiative in India	Dr T K Sundari Ravindran	International Development Research Centre, Canada	295.00	4 years
A family-based Randomized Controlled Trial of cardiovascular risk reduction in individuals with family history of premature coronary heart disease in India	Dr Jeemon Panniyammakal	Wellcome Trust DBT India Alliance	64.67	5 years
Non-Communicable Disease Risk Factors among Working Population: An Institution Based Study in Kerala, India	Dr G K Mini	PHFI	29.78	2 years



Institute-funded TRC and TDF Projects

Project title	Principal Investigator	Budget outlay (Rs in lakhs)	Duration (months)
Evaluation of the bioavailability and efficacy of human proteins as delivery vehicle of curcumin in animal models	Dr Lissy Krishnan	9.90	24
Development of cell encapsulated click gels as bioink for 3D bioprinting	Dr Kalliyana Krishnan	8.11	18
Design of membrane oxygenator with active membrane vibration for enhanced gas filter	Mr Vinod Kumar V	9.50	24
Development of a novel device and a method of cell seeding for the establishment of an in vitro co-culture system	Dr Naresh Kasoju	4.90	12
Estimation of EtO and other volatile organic compounds using headspace gas chromatography	Mr Renjith S	9.80	12
An ultrasensitive sensor platform for the detection of circulating tumor cells	Dr Jayasree R S	9.99	24
Development of a dural substitute with mucoadhesive and antibacterial properties	Dr P Ramesh	9.99	12
Centrifugal blood pump along with drive unit and flow meter	Mr Vinod Kumar V	56.80	30
Paracorporeal left ventricular assist device	Mr Nagesh D S	221.40	36
Aortic stent for thoracic aortic aneurysm	Mr Sujesh S	111.68	30
Deep Brain Stimulator System	Mr Muraleedharan C V	166.28	36
Implantable cardioverter defibrillator system	Mr Muraleedharan C V	192.96	36
Leukodepletion filter and its evaluation	Dr P Ramesh	21.85	24
Annuloplasty ring for mitral valve correction	Mr Ranjith G	63.45	18
Bioprosthetic heart valve	Dr P R Umashankar	158.19	36
Bioactive inter-vertebral spacers for lumbar fusion	Dr Manoj Komath	35.84	27



Bioactive material platform for drug delivery in bone	Dr Harikrishna Varma	56.35	30
Intracranial electrodes for use in electro-cortigraphy	Mr Jithin Krishnan	26.04	24
An optical peripheral nerve stimulator	Dr R S Jayasree	28.79	18
Standardization of albumin and FVIII production and purification of IVIG from 'small pool' human plasma	Dr Lissy Krishnan	35.48	30
Injectable hydrogel for repair of cartilage injury	Dr Prabha D Nair	45.25	30
3D printing of liver tissue constructs	Dr Anil Kumar P R	341.61	30
Assay platform and sensing device for PT/INR monitoring	Dr Anugya Bhatt	27.28	18
Chitosan /alginate antioxidant polymeric WD	Dr Rekha M R	14.42	24
A wound healing matrix from porcine cholecystic EM	Dr T V Anil Kumar	28.50	36
Lint-free absorbent dressing	Dr Lynda V Thomas	34.41	27
Point-of-care diagnosis for infectious diseases	Dr Anoop Kumar T	53.31	24
Alginate scaffold with recombinant growth factors	Dr Anoop Kumar T	52.31	30
Biodegradable PLGC-fibrin graft for skin regeneration	Dr Lissy Krishnan	16.60	24
Atrial septal defect occluder	Mr Sujesh S	41.09	36
Radiopaque liquid embolization device	Dr Roy Joseph	36.54	36
Methicillin Resistant S Aureus (MRSA)	Dr A Maya Nandkumar	40.41	18
Oral insulin delivery system	Dr Rekha M R	26.96	18
Flow diverter stent	Mr Sujesh S	93.02	24
Programmable hydrocephalus shunt	Mr Anoop Gopinathan	80.30	30



Wound healing matrix -human fibrin amniotic membrane	Dr Lissy Krishnan	15.00	12
IT Infrastructure Upgradation Plan for TRC	Mr Sajith Lal M K	64.10	18
Toxicological Evaluation for TRC projects	Dr P V Mohanan	56.31	36
Large animal evaluation for TRC projects	Dr P R Umashankar	67.24	24
Blood compatibility evaluation of TRC projects	Dr Lissy Krishnan	26.19	36
Cytocompatibility evaluation of TRC projects	Dr P R Anilkumar	19.10	24
Histopathological evaluation of TRC projects	Dr Sabareeshwaran A	26.01	36
Microbiological evaluation of TRC projects	Dr Maya Nandkumar	18.40	36
Analytical characterization of TRC projects	Dr Roy Joseph	18.08	24
Design & Fabrication - Prototyping, Jigs & Fixtures for TRC projects	Dr V Ramesh Babu	51.30	24
Equipments for package validation for TRC projects	Mr Ranjith G	41.57	24
Reference Biomaterials for biological evaluations for TRC projects	Ms Leena Joseph	34.44	18



Completed Projects during 2017-18

Hospital Wing

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)
Kerala Diabetes Prevention Program (KDPP)	Dr K R Thankappan	National Health and Medical Research Council, Australia	AUD \$ 1.03 Million
Improving the Control of Hypertension in Rural India (CHIRI)	Dr K R Thankappan	Monash University	AUD \$11.9 Million
Indian European Research (AROGYAM)	Dr K R Thankappan	ICSSR	34.46
Research initiative on factors influencing women's reproductive choices	Dr T K Sundari Ravindran	Ford Foundation, USA	US \$ 42115

Biomedical Technology Wing

Project Title	Principal Investigator	Funding Agency	Total Outlay (Rs in Lakhs)
Development of cardiopulmonary devices	Mr D S Nagesh	SIDD Life Sciences	15.00
Controlled delivery of biological molecules using biodegradable microneedles	Dr Shiny Velayudhan	DBT	43.80
Do platelets in patients with type II diabetes release proteins which can activate aortic endothelial cells	Dr Anugya Bhatt	KSCSTE	22.90
Biological evaluation of Laser Rapid Manufactured Ti-porous structures	Dr A Sabareeswaran	BRNS, Government of India	18.77
How actin filament structure within the cell are affected by changes in microtubule dynamics ?	Dr Renu Mohan	DBT Biocare	48.17



An innovative tissue-engineered corneal regenerative therapy	Dr T V Kumary	DST-UKIERI	16.56
Development of dental restorative material based on inorganic-organic hybrid resin for barodontalgia	Dr Lizymol P P	INMAS-CARS, DRDO	19.91
Development of a light-weight, lead-free, thyroid collar for diagnostic radiology	Dr Roy Joseph	INMAS-CARS, DRDO	19.61
Scale-up and small scale production of fibrinogen concentrate, thrombin and factor VIII for clinical use	Dr Lissy Krishnan	SCTIMST	9.95
In vitro differentiation of adipose-derived mesenchymal stem cells for myocardial regeneration	Dr Lissy Krishnan	SCTIMST	1.50
Development of a bioactive radioopaque inorganic-organic hybrid resin for dental and orthopaedic application	Dr Lizymol P P	SCTIMST	8.03
Development of a prototype flow diversion intracranial stent for treatment of complex intracranial aneurysms	Mr Sujesh Sreedharan	SCTIMST	5.49
Alternate Adult stem cells for ocular surface regeneration	Dr T V Kumary	DST	37
In vitro evaluation of cellular uptake and cytotoxicity	Dr T V Kumary	IIST, Trivandrum	8.7
Gold nanorods for targeted photodynamic therapy and fluorescence imaging	Dr Jayasree R S	ICMR	42.33
Detection of Zinc in epileptic condition using ratiometric fluorescent molecular probes	Dr Jayasree R S	DBT	67.44



New Research Initiatives for 2018-19

Project title	Principal Investigator	Funding Agency	Total Outlay (Rs in Lakhs)	Duration
Resource Centre/Hub for conducting "Health Technology Assessment"	Dr Raman Kutty V	Department of Health Research, Government of India	44.70	3 years
Baseline Surveillance of major risk factors of NCD in Kerala (KIRAN)	Dr Raman Kutty V	Government of Kerala	258.30	3 years
Work site-based lifestyle program for reducing diabetes and cardiovascular risk in india (India-Works)	Dr Jeemon Panniyamakal	Emory University through Madras Diabetes Research foundation	50.86	2 years
An obligate role for Discoidin Domain Receptor 2 in cell cycle progression and apoptosis resistance in cardiac fibroblasts	Dr Shivakumar K	DBT	39.87	3 years
Molecular, clinicoradiologic and pathological characterization of oligodendrogliomas with CIC and FUBP1 mutations	Dr Deepti A N	SERB	47.18	3 years
Three Dimensional printing in congenital heart disease	Dr Kapila Moorthy	SERB	38.12	3 years
Practical evaluation of Fractional Flow Reverse (FFR) and its associated alternate indices during routine clinical procedure (Pressure Wire Study)	Dr Ajit Kumar	Terumo India Pvt. Ltd.	2.50	2 years



STATUTORY COMMITTEES

INSTITUTE BODY

Shri K M Chandrasekhar (President)

Former Union Cabinet Secretary &
Former Vice-chairman
Kerala State Planning Board

Shri Joy Abraham

Member of Parliament (Rajya Sabha)
Mazhuvannoor House
Melampara PO, Bharananganam, Kottayam

Shri N K Premachandran

Member of Parliament
Maheswary Cantonment PO, Kollam

Dr Pritam Gopinath Munde

Member of Parliament
601, Narmada Apartment
Dr B D Marg, New Delhi

Prof Ashutosh Sharma

Secretary to Government of India
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New Delhi

Shri J B Mohapatra

Joint Secretary and Financial Advisor
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi

Director General of Health Services

Ministry of Health & Family Welfare
Nirman Bhavan, Maulana Azad Road
New Delhi

Joint Secretary

Ministry of Health & Family Welfare
Government of India, Nirman Bhawan
Maulana Azad Road, New Delhi

Dr Suresh Das

Executive Vice-president
**Kerala State Council for Science, Technology &
Environment & Principal Secretary S & T,**
Government of Kerala,
Sasthra Bhavan, Pattom,
Thiruvananthapuram

Shri Rajeev Sadanandan

Secretary to the Government of Kerala
Department of Health & Social Welfare
Thiruvananthapuram

Prof P K Radhakrishnan

Vice-chancellor
University of Kerala, Palayam
Thiruvananthapuram

Dr G K Singh

(Former Director, AIMS, Patna)
Professor & Head
Department of Orthopaedics Surgery
King George Medical University
Lucknow

Prof Sneh Anand

Department of Biochemical Engineering
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

Dr Suranjan Bhattacharji

Christian Hospital, Bissamcuttack
Rayagada District, Orissa

Dr W Selvamurthy

President, Amity Science, Technology and
Innovation Foundation Director General for Amity
Directorate of Science and Innovation and Chair
Professor for Life Sciences
Room No 114, 1st Floor, J 3 Block
Amity Univeristy, Sector-125
Noida



Prof K George Thomas
Dean (Academic and Faculty Affairs)
Indian Institute of Science Education and Research
Computer Science Building
College of Engineering Trivandrum Campus
Trivandrum

Dr Shyam Sundar
Professor of Medicine
Institute of Medical Sciences
Banaras Hindu University, Varanasi

Prof Balram Bhargava
Director General
Indian Council of Medical Research
Ansari Nagar, New Delhi

Prof V Ramgopal Rao
Director
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

Prof M V Padma Srivastava
Department of Neurology
Room No 708, 7th Floor, Neurosciences Centre
All India Institute of Medical Sciences , New Delhi

Prof Asha Kishore
Director,
SCTIMST

Dr P R Harikrishna Varma
Head, Biomedical Technology Wing
SCTIMST

GOVERNING BODY

Shri K M Chandrasekhar (President)
Former Union Cabinet Secretary & Former
Vice-chairman, Kerala State Planning Board

Prof Ashutosh Sharma
Secretary to Government of India
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi

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Joint Secretary and Financial Advisor
Department of Science & Technology
Technology Bhavan, New Mehrauli Road, New
Delhi

Director General of Health Services
Ministry of Health & Family Welfare
Nirman Bhavan, Maulana Azad Road, New Delhi

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Executive Vice-president
Kerala State Council for Science, Technology &
Environment & Principal Secretary S & T,
Government of Kerala, Sasthra Bhavan, Pattom
Thiruvananthapuram

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All India Institute of Medical Sciences
New Delhi

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Director
SCTIMST

Dr P R Harikrisna Varma
Head, Biomedical Technology Wing
SCTIMST

Dr V Kalliyana Krishnan
Dean, Academic Affairs
SCTIMST

ACADEMIC COMMITTEE

Prof Asha Kishore (Chairperson)
Director
SCTIMST

**Dr V Kalliyana Krishnan (Member Secretary)**

Dean, Academic Affairs
SCTIMST

Dr P R Harikrishna Varma

Head, Biomedical Technology Wing
SCTIMST

Dr P K Radhakrishnan

Vice-chancellor
University of Kerala
Thiruvananthapuram

Prof V Ramakrishnan

Director, Indian Institute of Science Education &
Research
Thiruvananthapuram

Dr C P Reghunadhan Nair

Emeritus Professor, Cochin University of Science and
Technology
Kochi

Prof K P Aravindan

Department of Pathology (Retd.)
Government Medical College
Kozhikode

Prof Sunil Chandu

Director
Christian Medical College, Vellore

Prof Mukesh Doble

Department of Biotechnology
Indian Institute of Technology Madras

Prof Ajitkumar V K

Head, Department of Cardiology
SCTIMST

Prof Muraleedharan Nair

Head, Department of Neurology
SCTIMST

Prof V Ramankutty

Head, AMCHSS
SCTIMST

Shri C V Muraleedharan

Scientist G & Associate Head
Biomedical Technology Wing, SCTIMST

Dr Lissy K Krishnan

Scientist G, Division of Thrombosis Research
Biomedical Technology Wing
SCTIMST

FINANCE COMMITTEE**Prof Asha Kishore (Chairperson)**

Director
SCTIMST

Prof Ashutosh Sharma

Secretary to Government of India
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi

Shri J B Mohapatra

Joint Secretary and Financial Advisor
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi

Dr P R Harikrishna Varma

Head, Biomedical Technology Wing
SCTIMST

Shri Girijavallabhan V K (Ex-officio Convener)

Ex. IA & AS, Senior Deputy Director
(Administration), SCTIMST

PRESIDENT'S COMMITTEE**Prof M S Valiathan**

National Research Professor
Manipal Academy of Higher Education
Madhav Nagar, Manipal

Shri K M Chandrasekhar

Former Union Cabinet Secretary & Former
Vice-chairman
Kerala State Planning Board

**Dr K Mohandas**

Former Director, SCTIMST & Former Vice-chancellor
Kerala University of Health Sciences
PRA 202, Thampuram Nagar, Manvila
Engineering College PO, Thiruvananthapuram

Shri C Balagopal

Maryknoll Bungalow, TC 4/246
Taliath Lane, Kuravankonam-Ambalamukku Road
Thiruvananthapuram

Dr A Ajayaghosh

Director
National Institute for Interdisciplinary Science & Technology
Thiruvananthapuram

Shri A V Ramani

Group Advisor (R&D), TTK Group
Bangalore

Shri R P Khandelwal

Chairman & Managing Director
HLL Lifecare Ltd.
Latex Bhavan, Poojappura
Thiruvananthapuram

RESEARCH COUNCIL**Prof P Balram (Chairman)**

(Former Director, IISc, Bangalore)
Molecular Biophysics Unit
Indian Institute of Science
Bangalore

Prof Asha Kishore

Director
SCTIMST

Dr Manohar V Badiger

Senior Principal Scientist
Polymer Science and Engineering Division
CSIR - National Chemical Laboratory
Dr Homi Bhabha Road
Pune

Prof Alok Dhawan

Director
CSIR-Indian Institute of Toxicology Research
Post Box No. 80, Mahatma Gandhi Marg
Lucknow

Prof V Ramgopal Rao

Director
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

Prof Bikramajit Basu

Professor, Materials Research Centre
Associate Faculty, Centre for Biosystems Science and Engineering
Indian Institute of Science
Bangalore

Dr Jayanthi Sivaswamy

Dean (Academic), Professor
International Institute of Information Technology
Gachibowli, Hyderabad

Shri A V Ramani

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Bangalore

Prof Sabu Thomas

Director, School of Chemical Sciences
Mahatma Gandhi University, Priyadarsini Hills PO
Kottayam

Dr G Sundararajan

Former Director, ARCI, Hyderabad
Professor, Department of Metallurgical and Materials Engineering
Indian Institute of Technology Madras
Chennai

Prof Vikram Jayaram

Chair, Division of Mechanical Sciences
Department of Materials Engineering
Indian Institute of Science
Bangalore

**Prof Siddhartha Roy**

Former Director, IICB,
Senior Professor & Dean of Studies
Bose Institute, P1/12
CIT Scheme VII M, Kolkata

Dr Y S Mayya

Former Director, Electronics & Instrumentation
Group BARC
55, Sreeniketan, Anushaktinagar, Mumbai

Prof Rinti Banerjee

Madhuri Sinha Chair Professor
Professor & Head of the Department
Department of Biosciences & Bioengineering
Room No. 503, BSBE Building
Indian Institute of Technology Bombay
Powai, Mumbai

INSTITUTIONAL ETHICS COMMITTEE

Dr R V G Menon (Chairman)

No. 22, Haritha, Kesavadev Road
Poojapura, Thiruvananthapuram

Dr Rema M N

Former DME
Manjush, Puthupally Lane
Thiruvananthapuram

Dr Lekha Pandit

Professor, Clinical Neurology
Director, Centre for Advanced Neurological
Research
K S Hegde Medical Academy
Deralakatte PO, Mangaluru

Smt Sathi Nair

Retd. Chief Secretary
'Samtripthi' Devapalan Nagar
Peroorkada, Thiruvananthapuram

Dr Kala Kesavan P

Professor of Pharmacology
Alapuzha Medical College

Dr P Manickam

Scientist D, National Institute of Epidemiology
R 127, 31'd Avenue, TNHB, Ayapakkam
Chennai

Dr Christina George

Head, Department of Psychiatry
Dr Somervell Memorial CSI Medical College and
Hospital
Karakonam PO, Thiruvananthapuram

Mr Satheesh Chandran

Secretary, SOMA India, Alwaye House,
DPI Junction, Thiruvananthapuram

Dr S S Giri Sankar

Assistant Professor, Government Law College
Ernakulam, Kochi

Dr Aneesh V Pillai

Assistant Professor, School of Legal Studies
Cochin University of Science and Technology
Cochin University PO, Kochi

Dr K R S Krishnan

Retd. Director, Technical & Operation
HLL Life Care Ltd., Poojappura
Thiruvananthapuram

Dr P R Harikrishna Varma

Head, Biomedical Technology Wing
SCTIMST

Prof V Raman Kutty

Head, AMCHSS, SCTIMST

Prof Harikrishnan S

Department of Cardiology
SCTIMST

Prof Mala Ramanathan (Member Secretary)

AMCHSS
SCTIMST

Ms Sreepriya C S (Co-ordinator)

Executive Secretary to the Director
SCTIMST



INSTITUTIONAL ANIMAL ETHICS COMMITTEE

Till 27-04-017:

Shri Neelakantan Nair - Chairman
Dr Kavita Raja - Biological Scientist
Dr Lissy K Krishnan - Scientist from different biological discipline
Dr P R Umashankar - Veterinarian
Dr Annie John - Animal House Facility, Member Secretary
A G Babu - Socially Aware nominee
Dr Robin D Culas- Scientist from outside the Institute
Dr J C Stephenson - CPCSEA, Main Nominee
Dr Arun George- Link nominee

11-05-2017 onwards:

Dr Prabha D Nair (Chairperson)
Scientist G (Senior Grade)
 Division of Tissue Engineering and Regeneration Technology
 Biomedical Technology Wing
 SCTIMST

Dr P V Mohanan
 Scientist G
 Division of Toxicology
 Biomedical Technology Wing
 SCTIMST

Dr K Shivakumar
 Scientist G
 Division of Cellular and Molecular Cardiology
 SCTIMST

Dr P R Umashankar
 Scientist F, Division of In Vivo Models and Testing
 Biomedical Technology Wing
 SCTIMST

Dr V S Harikrishnan (Member Secretary)
 Scientist E
 Division of Laboratory Animal Science
 Biomedical Technology Wing
 SCTIMST

Dr R Vijayan - CPCSEA, Main Nominee
Dr Lincy Joseph - Link Nominee
Dr Mathew George - Scientist from outside the Institute
Dr Santhosh Kumar Shukla – Socially-Aware Nominee

INSTITUTIONAL COMMITTEE FOR STEM CELL RESEARCH

Dr M Radhakrishna Pillai (Chairman)
 Director, Rajiv Gandhi Centre for Biotechnology
 Thycaud PO, Poojappura
 Thiruvananthapuram

Prof Vikram Mathews
 Clinical Haematology
 Christian Medical College, Vellore
 Tamil Nadu

Prof R V G Menon
 H No. 22, Haritha, Kesavadev Road, Poojappura
 Thiruvananthapuram

Dr P G Premila (till 22-02-2018)
 7C, Kowdiar Manor, Jawahar Nagar
 Thiruvananthapuram

Smt Sathi Nair (from 23-02-2018)
 Retd. Chief Secretary
 'Samtripthi' Devapalan Nagar, Peroorkada
 Thiruvananthapuram

Dr Sheila Balakrishnan
 Additional Professor of Gynaecology & Head,
 Fertility Unit, Government Medical College
 Thiruvananthapuram

Dr Jackson James
 Scientist-E1, Neuro-Stem Cell Biology Laboratory
 Department of Neurobiology, Rajiv Gandhi Centre
 for Biotechnology
 Thycaud PO, Poojappura
 Thiruvananthapuram

**Shri Jaideep G Nair**

Advocate
Anjali, Veera Bhadra Gardens
Thiruvananthapuram

Dr Renuka Nair (till 31-08-2017)

Scientist G (Senior Grade)
Division of Cellular and Molecular Cardiology
SCTIMST

Dr P Manickam (from 23-02-2018)

Scientist D, National Institute of Epidemiology
R 127, 31'd Avenue, TNHB, Ayapakkam
Chennai

Dr Lissy K Krishnan (till 22-02-2018)

Scientist G, Thrombosis Research Unit
Biomedical Technology Wing
SCTIMST

Dr Annie John (from 23-02-2018)

UGC Emeritus Professor, Department of
Biochemistry
University of Kerala
9B2 Condor Daffodils, Kowdiar
Trivandrum

Dr Anoop Kumar T (till 22-02-2018)

Scientist F, Molecular Medicine
Biomedical Technology Wing
SCTIMST

Shri Nemom V Sanjeev (from 23-02-2018)

Advocate & Notary
Nemom Chamber, Maharani Buildings
G K N Towers, Vanchiyoor PO
Thiruvananthapuram

Dr Prabha D Nair (Member Secretary) (till 22-02-2018)

Scientist G (Senior Grade)
Division of Tissue Engineering and Regeneration
Technology
Biomedical Technology Wing
SCTIMST

Dr Neethu Mohan (Member Secretary) (from 23-02-2018)

Scientist D
Division of Cellular and Molecular Cardiology
SCTIMST

Ms Sreepriya C S (Co-ordinator)

Executive Secretary to the Director-cum-Ethics
Committee Co-ordinator
SCTIMST

**INSTITUTIONAL BIOSAFETY
COMMITTEE****Mr C V Muraleedharan (Chairman)**

Scientist G & Associate Head
Biomedical Technology Wing
SCTIMST

Dr Kavita Raja (Biosafety Officer)

Medical Superintendent
SCTIMST

Dr K Madhavan Nampoothiri (DBT Nominee)

Principal Scientist (Biotechnology) & Head
Microbial processes and Technology
National Institute of Interdisciplinary Science and
Technology (NIIST)
Trivandrum

Dr Abdul Jaleel

Scientist E-II, Proteomics Core Facility
Rajiv Gandhi Center for Biotechnology
Trivandrum

Dr P Ramesh

Scientist G
Biomedical Technology Wing, SCTIMST

Dr Sathyabhama

Scientist G, Department of Transfusion Medicine
SCTIMST

Dr Srinivas G

Scientist F, Department of Biochemistry
SCTIMST

**Dr Anugya Bhat**

Scientist E, Thrombosis Research Unit
Biomedical Technology Wing
SCTIMST

Dr A Maya Nandkumar (Member Secretary)

Scientist F, Division of Microbial Technology
Biomedical Technology Wing
SCTIMST

**TECHNOLOGY DEVELOPMENT
COMMITTEE****Prof Asha Kishore** (Chairman)

Director, SCTIMST

Dr P R Harikrishna Varma

Head, Biomedical Technology Wing, SCTIMST

Prof V Ramgopal Rao

Director
Indian Institute of Technology Delhi
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Shri C Balagopal

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Dr Suresh Das

Executive Vice-president
Kerala State Council For Science, Technology &
Environment
& Principal Secretary S & T, Government of Kerala
Sasthra Bhavan, Pattom, Thiruvananthapuram

Sri A V Ramani

Group Advisor (R&D)
TTK Group of Companies
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Pediatric Orthopedic Surgeon
Christian Medical College
Vellore, Tamil Nadu

Prof Ashok Kumar

Department of Biological Sciences & Engineering
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IIT Kanpur
Uttar Pradesh

Shri C V Muraleedharan

Scientist G & Associate Head
Biomedical Technology Wing, SCTIMST

Prof Ajit Kumar

Head, Department of Cardiology
SCTIMST

Prof Shrinivas V G

Department of Anaesthesiology
SCTIMST

BUILDING COMMITTEE**Prof Asha Kishore** (Chairperson)

Director
SCTIMST

Dr Suresh Das

Executive Vice-president
Kerala State Council For Science, Technology
& Environment & Principal Secretary S & T,
Government of Kerala, Sasthra Bhavan, Pattom,
Thiruvananthapuram

Shri G Vijayaraghavan

(Former CEO, Technopark & Former Member State
Planning Board)
TC 26/719, KakshmiPriya, Chempaka Nagar
Bakery Junction, Thiruvananthapuram

Dr P R Harikrishna Varma

Head, Biomedical Technology Wing, CTIMST

Shri K Muraleedharan Nair

Head CMD (retired) VSSC/ISRO, Trivandrum

Shri Girijavallabhan V K (Ex-officio Convener)

Ex. IA & AS, Senior Deputy Director
(Administration), SCTIMST



SENIOR STAFF SELECTION COMMITTEE

Director, SCTIMST

Head, Biomedical Technology Wing, SCTIMST

Nominee of the Secretary, DST

An expert from outside of the Institute

A scientist from among the members of the Institute Body

A senior academic staff of the Institute

JUNIOR STAFF SELECTION COMMITTEE

Medical Superintendent, SCTIMST

Head, Biomedical Technology Wing, SCTIMST

A representative of the Academic Wing

Three members nominated by the President

INTERNAL COMPLAINTS COMMITTEE ON SEXUAL HARASSMENT OF WOMEN IN THE WORKPLACE (PREVENTION, PROHIBITION AND REDRESSAL)

The Annual Report of the Internal Complaints Committee, SCTIMST, fulfils the requirements of Section 21(1) of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.

1. Number of complaints of sexual harassment received during the year: 1
2. The number of complaints disposed off during the year: 1

Complaint Number	Date of receipt of complaint	Date of disposal of complaint	Duration between receipt and disposal
CC/SPN/2018/001	02/7/2018	27/7/2018	25 days

The complaint was discussed in detail and was found to be not within the purview of the Committee and disposed.

3. Number of cases pending for more than 90 days: Nil
4. Number of Workshops or Awareness Programmes against sexual harassment carried out: A Training/ Awareness Programme was organised by the ICC-SCTIMST for the students and faculty in January 2018



STATEMENT OF ACCOUNTS

2017-18



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31st March 2018

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	2017-18 [Rs.]	2016-17 [Rs.]
Capital Fund	1	3314855834	2309495729
Reserves & Surplus	2	229938803	221557820
Earmarked Endowment Funds	3	714266971	797201599
Secured Loans & Borrowings, Unsecured Loans & Borrowings, Deferred Credit Liabilities	4,5,6	0	0
Current Liabilities & Provisions	7	528746612	248231143
Total		4787808220	3576486291
Assets			
Fixed Assets	8	1177428425	1210151684
Investments From Earmarked Endowment Funds	9	763015110	763387543
Investments-Others	10	229938803	221557820
Current Assets , Loans, Advances Etc	11	2617425882	1381389244
Miscellaneous Expenditure (To The Extent Not Written Off)			0
Total		4787808220	3576486291
Significant Accounting Policies	24		
Contingent Liabilities & Notes On Account	25		

Sd/-
Chief Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR 2017-18

	Schedule	2017-18	2016-17
		Rs.	Rs.
Income from Sales / Services	12	1139824582	1083957483
Grants Received from Govt of India(Salary & General)	13	1056136000	1123643000
Fees/Subscription	14	13166275	10344934
Income from Investments } Withdrawal from ERF }	15	22264599 0	12525518 25000000
Income from Royalty, Publication etc	16	4119692	2628988
Interest earned	17	70134122	55228711
Other Income	18	227904916	10591255
Total		2533550186	2548919889
EXPENDITURE			
Establishment Expenses	20	1545420481	1321441541
Other Administrative Expenses	21	884550859	1147456199
Bank Charges	23	120872	91172
Depreciation - Current Year		175839614	253890992
Accumulated		0	423802867
Total		2605931826	3146682771
Balance being Excess Expenditure over Income		72381640	597762881
Add: Transfer to Special Reserve Account		9708189	3864670
BALANCE BEING DEFICIT CARRIED TO CAPITAL FUND		82089829	601627551

Sd/-
Chief Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM
SCHEDULES**

SCHEDULE 1 - CORPUS/CAPITAL FUND	2017-18	2016-17
PARTICULARS	[Rs.]	[Rs.]
Balance as at the beginning of the year	4898765559	4326934180
Less Depreciation up to the end of the previous year	2589269828	1911575969
Net balance at the beginning of the year	2309495731	2415358210
Add: Plan Grants received from Government of India for creation of Capital Assets	1094755000	485692000
Add: Grants received under CSR scheme	7545001	22490109
Less: Contribution towards Corpus/Capital Fund	0	0
Deduct: Balance of net expenditure transferred from the Income and Expenditure Account	82089830	601627551
Less: Value of Assets Written off during the year	14850069	12417038
Deduct Transfer to BMT/Add Transfer from CHO	0	0
BALANCE AS AT THE YEAR-END	3314855834	2309495730
SCHEDULE 2-RESERVES AND SURPLUS:	2017-18	2016-17
1. Capital Reserve:		
As per last Account	--	--
Addition during the year	--	--
Less: Deduction during the year	--	--
3. Special Reserves:		
As per last Account	221557820	468881828
Addition during the year (Current year transfer- Increase in provision)	8380983	2675992
Less: Deductions during the year	0	-250000000
4. General Reserve:		
As per last Account	--	--
Addition during the year	--	--
Less: Deductions during the year	--	--
TOTAL	229938803	221557820

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS	2017-18	2016-17
a) Opening balance of the funds	797201599	568504318
b) Additions to the funds:		
i. Donations/grants	1049467372	1368415822
ii. Income from Investments made on account of funds		
iii. Other additions (Specify nature)	0	
TOTAL (a+b)	1846668971	1936920139
c) Utilisation / Expenditure towards objective of funds		
i. Capital Expenditure		
- Fixed Assets	83525778	93950754
- Others	336688935	
Total (Detailed Schedule Attached)	420214713	93950754
ii. Revenue Expenditure		
- Salaries, Wages and allowances etc.	66399848	54713472
- Rent & Consumables etc.,	53475845	563299384
- Other Administrative expenses	592311594	427754931
Total	712187287	1045767786
TOTAL (c) NET BALANCE AS AT THE YEAR-END (a+b+c)	714266971	797201599

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS - AS ON 31.03.2018

PROJ #	NAME OF GRANTEE/PRINCIPAL INVESTIGATOR	FUND-WISE BREAK UP			TOTAL	FIXED ASSETS
		OPENING BALANCE	ADDITIONS TO FUND			
			GRANTS	OTHER RECEIPTS		
5000	PROJ-MISCELLANEOUS	2398528.20	7084712.00	76650218.08	86133458.28	0.00
5008	GENERAL CONFERENCE,WORKSHOP	10916.00	0.00	0.00	10916.00	0.00
5033	MPH PROGRAMME	1480.00	0.00	0.00	1480.00	0.00
5040	DEVELOPING EXPERIMENTAL THERAPEUTICALS	727441.70	0.00	0.00	727441.70	0.00
5055	ROCKFELLER FOUNDATION,USA	686120.00	0.00	0.00	686120.00	0.00
5078	PROJECT GRANT/DR MALA RAMANATHAN	5810.00	0.00	0.00	5810.00	0.00
5091	EURO REG. OF EPILEPSY & PREGNANCY	26667.00	0.00	0.00	26667.00	0.00
5094	KERALA STATE AIDS CONTROL SOCIETY	159704.00	329641.00	0.00	489345.00	0.00
5100	AMC/MAC ARTHUR FOUNDATION/02-70546	46315.05	0.00	0.00	46315.05	0.00
5108	EVAL.SUB-TYPES DEMENTIA/DR.MATHURA	15800.50	0.00	0.00	15800.50	0.00
5110	TOBACCO CESSATION & RESEARCH / DR.THANKAP	1166743.02	0.00	0.00	1166743.02	17175.00
5119	STAKE HOLDER-PERCEPT/INST.REV BO	104492.73	0.00	0.00	104492.73	0.00
5130	TELE-HEALTH & MEDICAL EDUCATION/JAWAHAR	49631.00	0.00	0.00	49631.00	0.00
5133	WHO FELLOWSHIP TRAINING CBICD	215059.00	0.00	0.00	215059.00	0.00
5135	A 16-WEEK,DOUBLE BLIND/ASHA KISHORE	1024577.00	0.00	0.00	1024577.00	0.00
5139	A 24 WEEK, MULTICENTER/DR. MATHURANATH	2602046.78	0.00	0.00	2602046.78	0.00
5140	HARVARD SCHOOL OF PUBLIC HEALTH	91794.32	0.00	0.00	91794.32	0.00
5142	BANKING FOR BETTER HEALTH-MEDISAVE	153911.36	0.00	0.00	153911.36	0.00
5146	DEVELOPMENT OF SPECTROSCOPIC PROTOCOL	11026.00	0.00	0.00	11026.00	0.00



SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

Amount Rs.

UTILISATION						TOTAL EXPENDITURE	NET BALANCE
CAPITAL EXPENDITURE		REVENUE EXPENDITURE					
OTHERS	TOTAL	SALARIES/WAGES	RENT/CONSUMABLES	OTHER ADMN EXP	TOTAL		
0.00	0.00	0.00	0.00	78203335.83	78203335.83	78203335.83	7930122.45
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10916.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1480.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	727441.70
0.00	0.00	0.00	0.00	0.00	0.00	0.00	686120.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5810.00
0.00	0.00	0.00	0.00	26667.00	26667.00	26667.00	0.00
0.00	0.00	0.00	0.00	231750.98	231750.98	231750.98	257594.02
0.00	0.00	0.00	0.00	0.00	0.00	0.00	46315.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15800.50
0.00	17175.00	0.00	0.00	1149568.02	1149568.02	1166743.02	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	104492.73
0.00	0.00	29516.00	0.00	20115.00	49631.00	49631.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	215059.00
0.00	0.00	0.00	0.00	103133.00	103133.00	103133.00	921444.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2602046.78
0.00	0.00	0.00	0.00	0.00	0.00	0.00	91794.32
0.00	0.00	0.00	0.00	0.00	0.00	0.00	153911.36
0.00	0.00	0.00	0.00	0.00	0.00	0.00	11026.00



5150	PROTOCOL 6002-INT 001	160176.60	0.00	0.00	160176.60	0.00
5153	DEV REF. MANUAL FOR PRIMARY	155802.00	0.00	0.00	155802.00	0.00
5155	COMM BASED DETECTION	209315.00	0.00	0.00	209315.00	0.00
5159	NCD RISK FACTOR SURVEILLANCE	71123.00	0.00	0.00	71123.00	0.00
5161	DOSE RANGING STUDY:CGHR	1282948.00	0.00	0.00	1282948.00	0.00
5168	PROJ/VERMEER STUDY	659044.00	0.00	0.00	659044.00	0.00
5170	SAFETY OF E 2007 IN LEVODOPA	1294322.00	0.00	0.00	1294322.00	0.00
5174	CHANGES IN SLEEP WAKEFULNESS-Dr.Mohanku.	49317.00	0.00	0.00	49317.00	0.00
5175	SURGICAL TRIAL IN LOBAR INTRACEREBRAL	39125.27	0.00	0.00	39125.27	0.00
5176	WOMEN COMPONENT PLAN	59065.25	0.00	0.00	59065.25	0.00
5180	COMMUNITY BASED INTRVEN-CV DIS	18308.00	0.00	0.00	18308.00	0.00
5182	KERALA REGISTRY FOR EPILEPSY AND PREGNANCY	2441.00	0.00	0.00	2441.00	0.00
5184	COMP HEALTH CARE PROJECT ST	587472.00	2500000.00	0.00	3087472.00	0.00
5190	PREVALENCE OF TYPE II DIABATES IN RURAL	42210.00	0.00	0.00	42210.00	0.00
5191	GENEITICS OF PARKINSONS DISEASE	3777.50	0.00	1822.50	5600.00	0.00
5192	TO PROVIDE INFRASTRUCTURE TO AMCHSS	169975.50	0.00	0.00	169975.50	0.00
5193	SAFE MOTHERHOOD PROGRAMME	71796.00	0.00	0.00	71796.00	0.00
5199	CLINICAL APPLICATION CRYOPRESE	18662.05	0.00	254706.95	273369.00	0.00
5201	OPEN LABEL TRIAL IN PARKINSON	3286127.50	0.00	0.00	3286127.50	83242.00
5203	STUDY IN MRI - ISIR	45243.00	0.00	0.00	45243.00	0.00
5207	BRAIN MRI STUDIES	6692.00	0.00	0.00	6692.00	0.00
5209	MANAGEMENT - CORONARY EVENT	742575.00	60000.00	0.00	802575.00	0.00
5210	EMPOWERMENT OF WOMEN	993896.00	0.00	0.00	993896.00	0.00
5213	CREATION OF AMC FUND	12523398.92	0.00	1724030.00	14247428.92	0.00
5216	PROTOCOL SP921 A MULTICENTRE	1037920.10	0.00	0.00	1037920.10	0.00
5217	STUDY ON WORKLOAD ON NURSES	954577.50	0.00	0.00	954577.50	0.00



0.00	0.00	40000.00	0.00	15138.00	55138.00	55138.00	105038.60
0.00	0.00	0.00	0.00	0.00	0.00	0.00	155802.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	209315.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	71123.00
0.00	0.00	0.00	0.00	15000.00	15000.00	15000.00	1267948.00
0.00	0.00	0.00	0.00	32250.00	32250.00	32250.00	626794.00
0.00	0.00	0.00	0.00	262986.50	262986.50	262986.50	1031335.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	49317.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39125.27
0.00	0.00	0.00	0.00	0.00	0.00	0.00	59065.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	18308.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2441.00
0.00	0.00	0.00	0.00	1206676.00	1206676.00	1206676.00	1880796.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	42210.00
0.00	0.00	0.00	0.00	5600.00	5600.00	5600.00	0.00
0.00	0.00	0.00	0.00	22770.00	22770.00	22770.00	147205.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	71796.00
0.00	0.00	175899.00	0.00	97470.00	273369.00	273369.00	0.00
0.00	83242.00	41935.00	0.00	31877.00	73812.00	157054.00	3129073.50
0.00	0.00	0.00	0.00	13476.00	13476.00	13476.00	31767.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6692.00
0.00	0.00	403200.00	0.00	90601.00	493801.00	493801.00	308774.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	993896.00
0.00	0.00	0.00	0.00	263889.00	263889.00	263889.00	13983539.92
0.00	0.00	0.00	0.00	22283.00	22283.00	22283.00	1015637.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	954577.50



5219	HEALTH IMPACT OF TECHNOLOGY	1045488.00	0.00	0.00	1045488.00	0.00
5220	CAPACITY BUILDING WOMEN HEALTH	650101.00	0.00	0.00	650101.00	0.00
5221	RESEARCH PROJECT EQUITY ISSUES	38147.00	0.00	0.00	38147.00	0.00
5226	ISOLATION, CHARACTERIZATION OF GLIOMAS	357092.00	0.00	0.00	357092.00	0.00
5227	MONOTHERAPY/ ACTIVE CONTROL	674916.00	308692.00	0.00	983608.00	0.00
5232	CEREBELLUM AND CORTICAL	31438.00	0.00	0.00	31438.00	0.00
5234	IMPROVING LOCALIZATION IN LESION NEGATIVE	-2860415.00	0.00	0.00	-2860415.00	0.00
5237	KERALA DIABETES PREVENTION PROGRAM (K-DPP)	1353063.47	0.00	0.00	1353063.47	0.00
5238	IMPROVING LOCALIZATION IN LESION NEGA...	4884.00	0.00	0.00	4884.00	0.00
5243	STEROIDS IN CARDIAC SURGERY	265782.00	0.00	0.00	265782.00	0.00
5245	IMPROVING LOCALIZATION IN LESION N..	184938.00	0.00	0.00	184938.00	0.00
5246	COMPREHENSIVE HEART FAILURE	100000.00	0.00	0.00	100000.00	0.00
5247	A PHASE 3, 12-WEEK, DOUBLE BLIND, PLA...	2174431.85	0.00	0.00	2174431.85	121800.00
5248	A PHASE 3, DOUBLE BLIND, PLACEBO AND A..	2026003.70	0.00	0.00	2026003.70	0.00
5249	CNRS-INDO-FRENCH PROJECT	222951.00	0.00	0.00	222951.00	0.00
5252	INDO-US COLLABORATIVE STROKE	475753.00	0.00	0.00	475753.00	0.00
5256	HEALTHY LIFE STYLE	4964479.00	0.00	0.00	4964479.00	0.00
5260	INFLUENCE OF SLEEP ARCHITECTURE	24840.00	0.00	0.00	24840.00	0.00
5263	MITOCHONDRIA SPECIFIC ANTI-OXI	49552.06	131409.00	0.00	180961.06	0.00
5264	FLUORESCENCE OPTICAL BIOPSY	82.28	0.00	0.00	82.28	0.00
5265	DEVELOPING PHYSICIAN EDUCATION	617.50	0.00	0.00	617.50	0.00
5267	EVALUATION STUDY OF THE ASHA	190689.00	0.00	0.00	190689.00	0.00
5272	PORTABLE OPTICAL BRAIN-COMP	-70914.00	0.00	70914.00	0.00	0.00
5273	INTERNATIONAL STROKE	211992.00	89874.00	0.00	301866.00	0.00
5274	IMPROVING THE CONTROL OF HYPERTENSION	130984.82	0.00	0.00	130984.82	0.00
5275	ENCODING OF INTERHEMISPHERIC -	2073048.00	0.00	0.00	2073048.00	0.00



0.00	0.00	0.00	0.00	0.00	0.00	0.00	1045488.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	650101.00
0.00	0.00	18000.00	0.00	748.00	18748.00	18748.00	19399.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	357092.00
0.00	0.00	313934.00	51680.00	74141.00	439755.00	439755.00	543853.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	31438.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2860415.00
0.00	0.00	910565.00	0.00	89058.00	999623.00	999623.00	353440.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4884.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	265782.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	184938.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100000.00
0.00	121800.00	0.00	0.00	0.00	0.00	121800.00	2052631.85
0.00	0.00	0.00	0.00	15000.00	15000.00	15000.00	2011003.70
0.00	0.00	113226.00	0.00	107204.00	220430.00	220430.00	2521.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	475753.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4964479.00
0.00	0.00	0.00	0.00	24840.00	24840.00	24840.00	0.00
0.00	0.00	120477.00	27018.62	20000.00	167495.62	167495.62	13465.44
0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.28
0.00	0.00	0.00	0.00	0.00	0.00	0.00	617.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	190689.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	206594.00	3960.00	1952.00	212506.00	212506.00	89360.00
0.00	0.00	0.00	0.00	130984.82	130984.82	130984.82	0.00
0.00	0.00	386104.00	100120.00	8500.00	494724.00	494724.00	1578324.00



5276	VALIDATION OF FMRI	30980.00	0.00	0.00	30980.00	0.00
5277	VASCULAR COGNITIVE IMPAIRMENT	151870.00	0.00	0.00	151870.00	0.00
5279	FAMILY LED REHABILITATION AFTER STROKE..	25860.00	0.00	0.00	25860.00	0.00
5281	LDL RECEPTOR ON MACROPHAGES	948.00	0.00	0.00	948.00	0.00
5282	INDIAN –EUROPEAN RESEARCH	230177.00	0.00	0.00	230177.00	0.00
5283	RESEARCH INTIATIVE ON FACTORS	1627693.00	0.00	0.00	1627693.00	0.00
5284	INTERNATIONAL STUDY FOR COMPARATIVE	322622.00	33087.00	0.00	355709.00	0.00
5286	INDIAN HEART RHYTHM SOCIETY	0.00	33300.00	0.00	33300.00	0.00
5287	STUDY OF CARBAMAZEPINE ...	239236.00	0.00	0.00	239236.00	0.00
5288	BIO-REPOSITORY OF DNA -STROKE	181959.47	0.00	0.00	181959.47	0.00
5289	MITOCHONDRIAL METABOLISM...	873814.83	300000.00	0.00	1173814.83	0.00
5290	CLOSING THE GAP;HEALTH EQUITY	3670547.08	9670907.89	0.00	13341454.97	120870.75
5291	OXIDATIVE STEM MEDIATED STEM..	159942.68	0.00	86730.00	246672.68	0.00
5292	A RESTING STATE FMRI & TASK ..	173980.00	626000.00	0.00	799980.00	0.00
5293	DECIPHERING LRRK2 GENE	7076.50	0.00	0.00	7076.50	0.00
5294	MTP/EC SERVICES OF WOMEN	227053.00	0.00	0.00	227053.00	0.00
5296	ELECTROENCEPHALOGRAPHY WORKSHOP	25230.00	0.00	0.00	25230.00	0.00
5297	THE HUMAN BRAIN MAPPING PROJ..	186163.00	650000.00	0.00	836163.00	43196.26
5298	MOLECULAR MECHANISMS	551282.20	950062.00	0.00	1501344.20	0.00
5300	ANALYSING FUNCTIONAL NETWORKS	440549.00	1000000.00	0.00	1440549.00	0.00
5301	IN VITRO BETA AMYLOID UPTAKE	1464396.69	962906.00	0.00	2427302.69	366510.00
5302	/DISABILITY STUDIES IN EPILEPSY	352128.00	29048.00	0.00	381176.00	0.00
5303	MITOCHONDRIAL REMODELING	480038.00	0.00	0.00	480038.00	0.00
5305	A FAMILY BASED RANDOMIZED	47890.00	5735113.00	0.00	5783003.00	329040.00
5306	3 DAYS TRAINING	48388.00	0.00	0.00	48388.00	0.00
5307	A RESTING FMRI	735432.00	0.00	0.00	735432.00	0.00



0.00	0.00	17001.00	0.00	13979.00	30980.00	30980.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	151870.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25860.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	948.00
0.00	0.00	0.00	0.00	230177.00	230177.00	230177.00	0.00
0.00	0.00	140903.00	0.00	1174685.00	1315588.00	1315588.00	312105.00
0.00	0.00	50000.00	7770.00	0.00	57770.00	57770.00	297939.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	33300.00
0.00	0.00	86935.00	7260.00	0.00	94195.00	94195.00	145041.00
0.00	0.00	126000.00	0.00	55959.47	181959.47	181959.47	0.00
0.00	0.00	0.00	633631.72	2145.00	635776.72	635776.72	538038.11
0.00	120870.75	1475000.00	0.00	6640373.00	8115373.00	8236243.75	5105211.22
0.00	0.00	8652.00	211500.00	26520.68	246672.68	246672.68	0.00
0.00	0.00	576000.00	54660.00	0.00	630660.00	630660.00	169320.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7076.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	227053.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25230.00
0.00	43196.26	127536.00	308220.00	64261.00	500017.00	543213.26	292949.74
0.00	0.00	53420.00	874164.84	68750.00	996334.84	996334.84	505009.36
0.00	0.00	237600.00	6910.00	149556.00	394066.00	394066.00	1046483.00
0.00	366510.00	191183.00	743883.87	21474.00	956540.87	1323050.87	1104251.82
0.00	0.00	57858.00	0.00	122860.00	180718.00	180718.00	200458.00
0.00	0.00	64504.00	0.00	281514.62	346018.62	346018.62	134019.38
0.00	329040.00	1384715.00	0.00	2139091.74	3523806.74	3852846.74	1930156.26
0.00	0.00	0.00	0.00	0.00	0.00	0.00	48388.00
0.00	0.00	10000.00	29610.00	139754.00	179364.00	179364.00	556068.00



5308	EPILEPSY CARE THROUGH SCHOOLS	892049.29	287751.00	0.00	1179800.29	0.00
5310	KERALA DIABETES PREVENTION	3370641.25	2986579.00	0.00	6357220.25	0.00
5312	EVALUATING BARRIERS AND BARR	25416.00	0.00	0.00	25416.00	0.00
5313	EQUIPMENT FOR HEART FAILURE	10096544.10	0.00	367829.00	10464373.10	7996397.55
5414	NON COMMUNICABLE DISEASES	18211227.05	0.00	0.00	18211227.05	171928.00
5315	PROSPECTIV SINGLE ARM MUL	135000.00	415800.00	0.00	550800.00	113367.00
5316	HEAD POSITION IN STROKE TRIAL	4130.00	75000.00	0.00	79130.00	40400.00
5317	MERES1 TRIAL A PROSPECTIVE	31095.00	0.00	0.00	31095.00	0.00
5318	APOLIPOPROTEIN B AND A1	698463.00	0.00	0.00	698463.00	0.00
5319	ENCORE	50097.00	0.00	0.00	50097.00	0.00
5320	EFFECT OF YOGA ON MOTOR CORTEX PLAST	614625.03	600000.00	0.00	1214625.03	0.00
5321	EFFECT OF YOGA ON NEUROPSYCHOLOGICAL F	894916.00	600000.00	0.00	1494916.00	107100.00
5322	PREFRONTAL CORTEX	614046.00	910000.00	0.00	1524046.00	0.00
5323	CHITRA DHWANI	35500.00	0.00	0.00	35500.00	0.00
5325	DECIPHERING THE GENERIC	1200898.00	1226985.00	0.00	2427883.00	13852.00
5326	NEURO DEVELOPMENTAL DISORDERS	8415280.43	0.00	255941.00	8671221.43	1770637.91
5327	MOVEMENT DISORDER	1650750.00	775590.00	0.00	2426340.00	195500.00
5329	E-DELIVERY FOR HEALTH CARE	45000000.00	0.00	631034.00	45631034.00	25584116.34
5330	COAGULATION PROFILE	50000.00	0.00	0.00	50000.00	0.00
5331	MONTREAL COGNITIVE MOCA-M	381100.00	0.00	0.00	381100.00	0.00
5332	HYPOXIA AND MINERALISATION	0.00	946723.00	0.00	946723.00	0.00
5333	ELETROENCEPHALOGRAPHIC	0.00	1267670.00	0.00	1267670.00	0.00
5334	SURVEY FOR MONITORING THE NATIONAL NCD TARGETS	0.00	5622725.00	0.00	5622725.00	0.00
5335	AUGMENTING PAEDIATRIC SURGERY	0.00	3483390.00	0.00	3483390.00	0.00
5336	ESTABLISHMENT OF THE INDIAN STROKE CLINICAL TRIAL NETWORK (INSTRUCT)	0.00	1516400.00	0.00	1516400.00	0.00
5337	SECONDARY PREVENTION BY STROKE	0.00	137000.00	0.00	137000.00	0.00



0.00	0.00	40000.00	0.00	53898.00	93898.00	93898.00	1085902.29
0.00	0.00	1077457.00	0.00	1898507.00	2975964.00	2975964.00	3381256.25
0.00	0.00	15429.00	0.00	9987.00	25416.00	25416.00	0.00
0.00	7996397.55	0.00	0.00	0.00	0.00	7996397.55	2467975.55
0.00	171928.00	10139244.00	0.00	7514581.50	17653825.50	17825753.50	385473.55
0.00	113367.00	0.00	0.00	26157.00	26157.00	139524.00	411276.00
0.00	40400.00	14452.00	0.00	24278.00	38730.00	79130.00	0.00
0.00	0.00	0.00	0.00	4500.00	4500.00	4500.00	26595.00
0.00	0.00	34043.00	298797.00	14630.00	347470.00	347470.00	350993.00
0.00	0.00	0.00	0.00	29415.00	29415.00	29415.00	20682.00
0.00	0.00	720000.00	0.00	83373.00	803373.00	803373.00	411252.03
0.00	107100.00	648000.00	108730.00	215487.00	972217.00	1079317.00	415599.00
0.00	0.00	660000.00	0.00	606183.00	1266183.00	1266183.00	257863.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	35500.00
0.00	13852.00	0.00	0.00	27411.00	27411.00	41263.00	2386620.00
1221082.00	2991719.91	951090.00	0.00	2977355.50	3928445.50	6920165.41	1751056.02
0.00	195500.00	182625.00	0.00	0.00	182625.00	378125.00	2048215.00
0.00	25584116.34	0.00	0.00	175662.00	175662.00	25759778.34	19871255.66
0.00	0.00	0.00	43407.00	6593.00	50000.00	50000.00	0.00
0.00	0.00	349000.00	15486.00	0.00	364486.00	364486.00	16614.00
0.00	0.00	650833.00	0.00	142757.00	793590.00	793590.00	153133.00
0.00	0.00	668078.00	32670.00	143236.00	843984.00	843984.00	423686.00
0.00	0.00	1851558.00	0.00	1935029.00	3786587.00	3786587.00	1836138.00
0.00	0.00	1669943.00	0.00	0.00	1669943.00	1669943.00	1813447.00
0.00	0.00	588648.00	0.00	62667.00	651315.00	651315.00	865085.00
0.00	0.00	0.00	0.00	18061.00	18061.00	18061.00	118939.00



5338	ESTABLISHMENT OF A BIOREPOSITORY	0.00	2614200.00	0.00	2614200.00	0.00
5339	ANTENATAL EXPOSURE	0.00	25000.00	0.00	25000.00	0.00
5340	STRUCTURAL AND FUNCTIONAL IMAGING	0.00	1274000.00	0.00	1274000.00	181152.74
5341	SLEEP APNEA	0.00	380751.75	0.00	380751.75	0.00
5342	TRIVANDRUM HEART FAILURE	0.00	589850.00	0.00	589850.00	99500.00
5343	BRAIN IRON DEPOSITION	0.00	610000.00	0.00	610000.00	0.00
5344	IMPROVEMENT OF SECONDARY	0.00	951900.00	0.00	951900.00	0.00
5345	MOBILE TELEMEDICINE PROJECT	0.00	56442000.00	0.00	56442000.00	0.00
5346	DISEASE RISK FACTORS	0.00	1489440.00	0.00	1489440.00	0.00
5347	UNDERSTANDING PHENOTYPES	0.00	455675.00	0.00	455675.00	0.00
5348	PROSPECTIVE STUDY OF PATIENTS	0.00	618000.00	0.00	618000.00	0.00
5350	ICMR-THSTI FORMS	0.00	688620.00	0.00	688620.00	0.00
5351	INFLAMMATORY BIOMARKERS	0.00	100000.00	0.00	100000.00	0.00
5352	HYPER ACUTE STROKE	0.00	33000.00	0.00	33000.00	11294.92
5454	PROSPECTIVE OBSERVATIONAL	0.00	300000.00	0.00	300000.00	0.00
5355	REGIONAL TRC FOR HEALTH ASSESSMENT	0.00	4470778.00	0.00	4470778.00	0.00
5356	AROGYAM NETWORK (KIRAN)	0.00	25830000.00	0.00	25830000.00	0.00
6050	SALARY PROJECT	2000.00	0.00	0.00	2000.00	0.00
6055	MOVEMENT DISORDER SURGERY	0.00			0.00	0.00
6058	ATHIYANNOOR SCT ACTION/DR.K.R.T	21006.00	0.00	0.00	21006.00	0.00
6065	COMPREHENSIVE CENTRE FOR SLEEP DIS ORD.	0.00	0.00	18676.00	18676.00	0.00
6072	COMPREHENSIVE STROKE CARE	0.00	0.00	808021.00	808021.00	0.00
6077	TECHNICAL ADVISORY COMMITTEE	0.00	0.00	183200.00	183200.00	0.00
6080	COMPREHENSIVE PAIN CLINIC	345250.00	0.00	0.00	345250.00	0.00
6081	VALIDATION OF A CLINICAL PROTO	142710.00	0.00	0.00	142710.00	0.00
6082	NOSOCOMIAL INFECTION	169.60	0.00	0.00	169.60	0.00



0.00	0.00	531680.00	0.00	74454.00	606134.00	606134.00	2008066.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25000.00
0.00	181152.74	331200.00	47430.00	130604.25	509234.25	690386.99	583613.01
0.00	0.00	0.00	0.00	0.00	0.00	0.00	380751.75
0.00	99500.00	192200.00	0.00	1300.00	193500.00	293000.00	296850.00
0.00	0.00	183000.00	84640.00	14729.00	282369.00	282369.00	327631.00
0.00	0.00	208000.00	0.00	107258.00	315258.00	315258.00	636642.00
0.00	0.00	208568.00	0.00	11432.00	220000.00	220000.00	56222000.00
0.00	0.00	0.00	0.00	197327.00	197327.00	197327.00	1292113.00
0.00	0.00	225000.00	30620.00	41425.00	297045.00	297045.00	158630.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	618000.00
0.00	0.00	0.00	0.00	108687.00	108687.00	108687.00	579933.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100000.00
0.00	11294.92	0.00	0.00	10000.00	10000.00	21294.92	11705.08
0.00	0.00	0.00	0.00	0.00	0.00	0.00	300000.00
0.00	0.00	0.00	0.00	447078.00	447078.00	447078.00	4023700.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25830000.00
0.00	0.00	0.00	0.00	2000.00	2000.00	2000.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	21006.00
0.00	0.00	18676.00	0.00	0.00	18676.00	18676.00	0.00
0.00	0.00	254278.00	0.00	553743.00	808021.00	808021.00	0.00
0.00	0.00	183200.00	0.00	0.00	183200.00	183200.00	0.00
0.00	0.00	36000.00	0.00	0.00	36000.00	36000.00	309250.00
0.00	0.00	0.00	0.00	142710.00	142710.00	142710.00	0.00
0.00	0.00	0.00	0.00	169.60	169.60	169.60	0.00



6084	NEURO INTERVENTION CENTRE(NIC)	0.00	0.00	2188808.00	2188808.00	0.00
6089	THE EFFECTS OF PROPOFOL	26730.00	0.00	0.00	26730.00	0.00
6090	STUDY ON THE EFFECT OF DEXMEDE	45000.00	0.00	0.00	45000.00	0.00
6091	PUBLIC HEALTH DOCUMENTATION	229822.00	0.00	0.00	229822.00	0.00
6093	EVALUATION OF VASCULAR GRAFT	13960.00	0.00	0.00	13960.00	0.00
6095	COMPREHENSIVE HEART FAILURE CLINC	0.00	0.00	1637567.00	1637567.00	0.00
6096	MOLECULAR BIOLOGY OF PEDIATRIC	50000.00	0.00	0.00	50000.00	0.00
6097	DEVELOPMENT OF E LOG BOOK	46421.00	0.00	0.00	46421.00	41949.99
6098	RESEARCH ON MEDICAL TOURISM	46684.00	0.00	0.00	46684.00	0.00
6099	CLINICO PATHOLOGICAL CORR...	130000.00	0.00	0.00	130000.00	0.00
6102	SELECTIVE SUB-TEMPORAL SELE	59890.00	0.00	0.00	59890.00	0.00
6103	DEVELOPMENT OF A FLEXIBLE ARM	25000.00	0.00	0.00	25000.00	0.00
6104	HEALTH TECHNOLOGY ASSESSMENT	504422.00	0.00	0.00	504422.00	0.00
6105	INSTITUTE FUNDING FOR E DELIVERY FOR HEALTH CARE	0.00	0.00	3003924.00	3003924.00	3003924.00
7101	ADVANCE TO P I	-1871.00	0.00	7009846.00	7007975.00	0.00
	TOTAL (A)	154617546.73	148219579.64	94893267.53	397730393.90	40412954.46
	OTHER PROJECTS				0.00	
1014	NEW PENSION SCHEME	5654489.05		122391377.42	128045866.47	
1301	EMPLOYEES PENSION FUND	177723353.65		189696936.42	367420290.07	
1075	PATIENT WELFARE FUND	7766751.25		1213233.68	8979984.93	
					0.00	
1078	DR. RICHARD A CASH & DR K MOHANDAS AWARD	237388.00		0.00	237388.00	
1080	STAFF BENEVOLENT FUND	4443351.25		3732992.00	8176343.25	
1081	CONTINUUM - SPECIAL CME PUBLICATION FUND - HOSPITAL	51707.00			51707.00	
1096	PEDIATRIC WELFARE FUND	50000.00			50000.00	



0.00	0.00	1603969.00	0.00	584839.00	2188808.00	2188808.00	0.00
0.00	0.00	0.00	0.00	26730.00	26730.00	26730.00	0.00
0.00	0.00	0.00	0.00	45000.00	45000.00	45000.00	0.00
0.00	0.00	144514.00	0.00	5730.00	150244.00	150244.00	79578.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13960.00
0.00	0.00	1637567.00	0.00	0.00	1637567.00	1637567.00	0.00
0.00	0.00	0.00	0.00	50000.00	50000.00	50000.00	0.00
0.00	41949.99	0.00	0.00	4471.01	4471.01	46421.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	46684.00
0.00	0.00	0.00	0.00	130000.00	130000.00	130000.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	59890.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	504422.00
0.00	3003924.00	0.00	0.00	0.00	0.00	3003924.00	0.00
0.00	0.00	0.00	0.00	7007975.00	7007975.00	7007975.00	0.00
1221082.00	41634036.46	33385009.00	3722169.05	119085544.52	156192722.57	197826759.03	199903634.87
	0.00			119974549.25	119974549.25	119974549.25	8071317.22
	0.00			300287169.00	300287169.00	300287169.00	67133121.07
	0.00			32665.10	32665.10	32665.10	8947319.83
	0.00						0.00
	0.00			60000.00	60000.00	60000.00	177388.00
	0.00			2917195.00	2917195.00	2917195.00	5259148.25
	0.00				0.00	0.00	51707.00
	0.00				0.00	0.00	50000.00



	TOTAL (B)	195927040.20	0.00	317034539.52	512961579.72	0.00
5000	PROJECT EXPENSE	2779853.77	0.00	42490645.96	45270499.73	0.00
5057	DYNAMIC ORTHOPAEDIC PVT LTD, HYDROXY	6787.55	0.00	0.00	6787.55	0.00
5089	DETEC & TREAT OF CANCER BY LASER	3959.00	0.00	0.00	3959.00	0.00
7000	MISCELLANEOUS PROJECT	30944.09	0.00	0.00	30944.09	0.00
7001	PRO SAHAJANAND VASCU; DR.AURTHUR	79149.75	0.00	0.00	79149.75	0.00
7002	Dr.TOMS LABORATORY, Dr. K.KRISHNAN	13876.00	0.00	0.00	13876.00	0.00
7003	PROJ:D.S.T. DR.PV. MOHANAN	2537.40	0.00	0.00	2537.40	0.00
7004	PROJ:ATMRF:DR LISSY KRISHNAN	551.25	0.00	0.00	551.25	0.00
7005	PROJECT:DYNAMIC ORTHOPAEDICS	13656.00	0.00	0.00	13656.00	0.00
7006	PROJ: D.S.T. D.S.NAGESH	181074.00	0.00	0.00	181074.00	0.00
7008	NMITLI, PROJECT C.S.I.R	0.90	0.00	0.00	0.90	0.00
7009	CHITOSAN BASED WOUND DRESSING	4761.75	0.00	0.00	4761.75	0.00
7011	DST-FAB: CLINICALLY/SIG:SHAPE OF HEVA	213826.00	0.00	0.00	213826.00	0.00
7014	AUROLAB,ARAVIND EYE HOSPITAL	13674.00	0.00	0.00	13674.00	0.00
7015	TTK.HEALTHCARE.DEVELOPMENT OF VALVE	39424.00	0.00	0.00	39424.00	0.00
7016	INDO-GERMAN COMMITTEE MEETING-DST	5407.00	0.00	0.00	5407.00	0.00
7017	HINDUSTAN LATEX.EVALU:BLOOD BAG	346314.18	0.00	27186.00	373500.18	0.00
7018	ALL INDIA COUNCIL FOR TECHNI:EDU:SH	339919.00	0.00	0.00	339919.00	0.00
7019	DST.NIRANJAN	69847.00	0.00	0.00	69847.00	0.00
7020	IFCPAR-DR.JAYAKRISHNAN	188.00	0.00	0.00	188.00	0.00
7022	DST-LBFDPSBC-DR.SHARMA	79385.00	0.00	0.00	79385.00	0.00
7023	DEV: HYDRO-CEPHALUS-HINDUSTAN LATEX	45510.00	0.00	0.00	45510.00	0.00
7026	DEV.HEART VALVE-DST.MURALEE	2522.00	0.00	0.00	2522.00	0.00
7027	STED-DR T V KUMARY-INVITRO	5089.00	0.00	0.00	5089.00	0.00



0.00	0.00	0.00	0.00	423271578.35	423271578.35	423271578.35	89690001.37
0.00	0.00	0.00	0.00	41758797.66	41758797.66	41758797.66	3511702.07
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6787.55
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3959.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	30944.09
0.00	0.00	0.00	1041.00	0.00	1041.00	1041.00	78108.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13876.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2537.40
0.00	0.00	0.00	0.00	0.00	0.00	0.00	551.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13656.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	181074.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4761.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213826.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13674.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39424.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5407.00
0.00	0.00	0.00	558466.66	0.00	558466.66	558466.66	-184966.48
0.00	0.00	0.00	153469.00	0.00	153469.00	153469.00	186450.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	69847.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	188.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79385.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45510.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2522.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5089.00



7029	DONERG/LIFE SCIENCE BOARD	6876.00	0.00	0.00	6876.00	0.00
7031	DBT/DR P V MOHAN/DEV IN VITRO PYRO	79064.00	0.00	0.00	79064.00	0.00
7032	DST. DR. ANNINE/BONE REGENERATION	29166.00	0.00	0.00	29166.00	0.00
7033	BIOFUNCTIONAL EVALUATION DR. UMASANKER	72581.00	0.00	0.00	72581.00	0.00
7034	DST. DR. NIRMALA RACHEL	14664.00	0.00	0.00	14664.00	0.00
7035	DST-H.K.VARMA	95433.00	0.00	0.00	95433.00	0.00
7037	IN VIVO EVALUATION/ STED/DR. LISSY	6205.00	0.00	0.00	6205.00	0.00
7039	JNC/ASR/DR. MOHANAN/STUDY OF ACUTE.....	44684.00	0.00	0.00	44684.00	0.00
7040	BIOMED/ C.V. MURALEEDHARAN	44000.00	0.00	0.00	44000.00	0.00
7041	CSIR-GRANT-ASHA S MATHEW,PHD STUDENT	55973.00	0.00	0.00	55973.00	0.00
7042	CSIR-GRANT-BERNADETTE K. MADATHIL,PHD	25870.00	0.00	0.00	25870.00	0.00
7043	CSIR-GRANT-SAILAJA.G.S.SRF	9067.00	0.00	0.00	9067.00	0.00
7044	LISI NO TRIAL TRIAL MERIND	21672.65	0.00	0.00	21672.65	0.00
7045	NIRMALA RACHEL, CSIR	14063.00	0.00	0.00	14063.00	0.00
7047	U.G.C. GRANT- RESEARCH FELLOW	300935.00	0.00	0.00	300935.00	0.00
7048	CSIR GRANT- JOSENA JOSEPH	47473.00	0.00	0.00	47473.00	0.00
7049	CSIR GRANT - MARY VARGHESE	35837.00	0.00	0.00	35837.00	0.00
7050	INTEREST-PROJECT ACCOUNT	0.00	0.00	8681745.00	8681745.00	0.00
7051	CSIR GRANT - MANITHA B NAIR	12062.00	0.00	0.00	12062.00	0.00
7052	DBT/DR.PRABHA/DEV. OF TEMP - RES - CO-OPLY	-0.25	0.00	0.00	-0.25	0.00
7053	DR.SREENIVASAN/DEVEL.OF TEMP.RES.CO-OPLY	22619.00	0.00	0.00	22619.00	0.00
7054	DST-DR.ANOOP-DIFF:EXPR:RAT BRAIN.....	44434.00	0.00	0.00	44434.00	0.00
7055	CSIR-NMITLI SCHEME-C.V.MURALEEDHARAN	756552.00	0.00	0.00	756552.00	0.00
7057	DST - PROJECT.DR.JAYABALAN	14471.00	0.00	0.00	14471.00	0.00
7059	DBT-DR. PRABHA D NAIR, ISLET IMMUN.....	67574.00	0.00	0.00	67574.00	0.00
7060	ICMR PROJECT/ SUDHAKAR MUTHALEE	124392.00	0.00	0.00	124392.00	0.00



0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6876.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79064.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29166.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	72581.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14664.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95433.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6205.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44684.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55973.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25870.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9067.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21672.65
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14063.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	300935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47473.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35837.00
0.00	0.00	0.00	0.00	4782742.50	4782742.50	4782742.50	0.00	3899002.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12062.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22619.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44434.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	756552.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14471.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67574.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	124392.00



7062	DR. LIZY-SAHAJA:EVA "STENT"INVITRO.....	102361.00	0.00	0.00	102361.00	0.00
7065	DR.T.V.KUMARI,DBT.BIOGENE	38659.00	0.00	0.00	38659.00	0.00
7067	DBT.DR.JAYABALAN,DEV:&STUDIES.....	0.00	0.00	0.00	0.00	0.00
7069	VSSC - PROJECT. D.S. NAGESH	153475.00	0.00	0.00	153475.00	0.00
7070	CHO PROJECT - 5146 JAYASREE	-872.00	0.00	0.00	-872.00	0.00
7071	STEC-PROJECT: DR.MAYA NANDKUMAR	375.00	0.00	0.00	375.00	0.00
7072	SAHAJANAND MED.TECH. C.V.MURALIDHARAN	76292.00	0.00	0.00	76292.00	0.00
7073	STUDY PROJECT:DR.PV.MOHANAN	-95386.00	0.00	95386.00	0.00	0.00
7074	STUDY PROJECT: CLRI- DR.MOHAN	289303.00	0.00	0.00	289303.00	0.00
7075	STUDY PROJECT - BIOSYNC SCI	11935.00	0.00	0.00	11935.00	0.00
7076	ARROW INTERNATIONAL : DR.UMASHANKAR	399773.00	0.00	0.00	399773.00	0.00
7080	DBT-DR.MAYA- TISSUE ENGINEERING HYBRID	10518.00	0.00	0.00	10518.00	0.00
7081	USV LTD. MUMBAI - DR.MOHAN	88349.00	0.00	0.00	88349.00	0.00
7082	INDO-US JOINT PROJECT	878.00	0.00	0.00	878.00	0.00
7083	ARROW HAEMO DIALYSIS	30882.00	0.00	0.00	30882.00	0.00
7085	DR.R.V.THAMPAN - CSIR	26381.00	0.00	0.00	26381.00	0.00
7086	HORMONE RELEASING INTRA DEVICES	-86027.00	0.00	0.00	-86027.00	0.00
7087	CSIR - KALADHAR - BST	39103.00	0.00	0.00	39103.00	0.00
7092	PROJ/7092/SEA FOOD	1993.00	0.00	0.00	1993.00	0.00
7093	PROJ/7093/CSIR GRANT-LPA	50562.00	0.00	0.00	50562.00	0.00
7095	PROJ/7095/CSIR GRANT-VIOLA.B.MORRIS	22072.00	0.00	0.00	22072.00	0.00
7097	PROJ/7097/ACCELERATED AGEING	724938.39	0.00	0.00	724938.39	44954.00
7099	PROJ/7099/BCL	7011.00	0.00	0.00	7011.00	0.00
7100	PROJ/7100/ITR PROGRAMME	4079.00	0.00	0.00	4079.00	0.00
7101	PROJ/7101/CSIR/SONIA.T.A	2650.00	0.00	0.00	2650.00	0.00
7103	PROJ/7103/CSIR/VIDYARAJ	5682.00	0.00	0.00	5682.00	0.00



0.00	0.00	0.00	0.00	686.00	686.00	686.00	101675.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	38659.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	173.00	173.00	173.00	153302.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-872.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	375.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	76292.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	289303.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	11935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	399773.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10518.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	88349.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	878.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	30882.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26381.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-86027.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39103.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1993.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	50562.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22072.00
0.00	44954.00	0.00	409722.96	0.00	409722.96	454676.96	270261.43
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7011.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4079.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2650.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5682.00



7105	PROJ/7105/CSIR/ARJUN NAMBOODIRI	26821.00	0.00	0.00	26821.00	0.00
7107	PROJ/7107/CSIR/NEENA & 2 FELLOWS	34082.00	0.00	0.00	34082.00	0.00
7108	PROJ/7108/CSIR/FRANCIS.B.FERNANDEZ	2154.00	0.00	0.00	2154.00	0.00
7110	PROJ/7110/CSIR/DEEPA.R	10919.00	0.00	0.00	10919.00	0.00
7111	PROJ/7111/CSIR/SHEEJA LIZA EASO	6353.00	0.00	0.00	6353.00	0.00
7113	PROJ/7113/KSCSTE/RATHIKALA	-86.00	0.00	0.00	-86.00	0.00
7200	JOINT PROGRAME/M.TECH	530946.00	0.00	0.00	530946.00	0.00
7210	PROJ/7210/CSIR/SOMA DEY	1641.00	0.00	0.00	1641.00	0.00
7220	COST OF ANIMAL FEED	3166905.66	0.00	97550.00	3264455.66	0.00
7230	PROJ/7230/CSIR/MANJU.S	12421.00	0.00	0.00	12421.00	0.00
7250	PROJ/7250/CSIR/KIRAN.S.NAIR	15281.00	0.00	0.00	15281.00	0.00
7260	PROJ/7260/STOX083Y09/DR.PV.MOHANAN	149985.00	0.00	0.00	149985.00	0.00
7290	PROJ/7290/CSIR/RAKHI.A	24034.00	0.00	0.00	24034.00	0.00
7300	PROJ/7300/CSIR/ARIYA SARASWATHY	-7.00	0.00	0.00	-7.00	0.00
7320	90 DAY SUB-CHRONIC TOXICITY -DR.PV.MOHA	166674.00	0.00	0.00	166674.00	0.00
7330	Y.M.THASNEEM - UGC GRANT	7195.00	0.00	0.00	7195.00	0.00
7350	UGC GRANT - LAXMI.R.NAIR - BMT PROJECT	44023.00	582000.00	0.00	626023.00	0.00
7360	MAMMALIAN BONE CHROMOSOME- DR.PV.MOHANA	266292.00	0.00	0.00	266292.00	0.00
7370	VALIDATION OF ETO STERILSATION SYSTEM-	298463.00	0.00	0.00	298463.00	0.00
7375	ICMR PROJECT- MS. RENU RAMESH	33000.00	0.00	0.00	33000.00	0.00
7385	CSIR GRANT - CAROLINE DIANA SHERLY	49769.87	0.00	8330.00	58099.87	0.00
7390	TOXICITY STUDY OF MATIRIALS Dr. P V MOHANAN	682008.00	900522.00	0.00	1582530.00	0.00
7395	RAISNG ANTIBODIES IN RABITS - DR V S HARIKRISH	637425.00	0.00	0.00	637425.00	0.00
7400	CSIR GRANT: SHAIJU S NAZEER	3333.00	0.00	0.00	3333.00	0.00
7402	PROOF OF CONCEPT STUDY - DR UMA SHANKAR	100747.00	0.00	0.00	100747.00	0.00



0.00	0.00	0.00	0.00	0.00	0.00	0.00	26821.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	34082.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2154.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10919.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6353.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-86.00
0.00	0.00	0.00	17508.00		17508.00	17508.00	513438.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1641.00
0.00	0.00	0.00	215608.44	0.00	215608.44	215608.44	3048847.22
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12421.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15281.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	149985.00
0.00	0.00	0.00	0.00	4450.00	4450.00	4450.00	19584.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.00
0.00	0.00	0.00	0.00	166674.00	166674.00	166674.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7195.00
0.00	0.00	0.00	0.00	520200.00	520200.00	520200.00	105823.00
0.00	0.00	0.00	0.00	266292.00	266292.00	266292.00	0.00
0.00	0.00	0.00	0.00	22698.00	22698.00	22698.00	275765.00
0.00	0.00	750.00	0.00	0.00	750.00	750.00	32250.00
0.00	0.00	33600.00	23178.14	0.00	56778.14	56778.14	1321.73
0.00	0.00	0.00	15262.00	0.00	15262.00	15262.00	1567268.00
0.00	0.00	0.00	51180.01	0.00	51180.01	51180.01	586244.99
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3333.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100747.00



7403	ICMR GRANT - PARVATHY R S	55088.00	423200.00	0.00	478288.00	0.00
7404	BIOFUNCTIONAL AND HISTILO - DR UMA SHANKAR	761369.00	0.00	0.00	761369.00	0.00
7405	IN VITRO EVALUATION OF CELL- DR T V KUMAR	322573.95	0.00	236266.00	558839.95	0.00
7406	CSIR GRANT - R ARATHI	6135.00	0.00	0.00	6135.00	0.00
7407	TRSF MESENCHYMAL STEM CELL	1686.00	0.00	0.00	1686.00	0.00
7409	SRUTHI PHD STUDENT UGC	23000.00	0.00	0.00	23000.00	0.00
7411	DEV POLY ADHESIVE & POTT	206140.00	0.00	0.00	206140.00	0.00
7412	REMYA K CSIR FELLOW	3280.00	434860.00	0.00	438140.00	0.00
7413	PROJ/7413/ANTIMICROBIAL ACTIVITY	89585.75	0.00	0.00	89585.75	0.00
7414	PROJ/7414/EFFECT OF NANOGRAPHENE MOUSE.	13620.00	211600.00	0.00	225220.00	0.00
7415	PROJ/7415/AXONAL GUIDANCE	18450.00	0.00	0.00	18450.00	0.00
7416	PROJ/7416/PULMONARY FIBROSIS	6898.00	380000.00	0.00	386898.00	0.00
7417	PROJ/7417/INVITRO & IN VIVO EVALUATION	13000.00	0.00	0.00	13000.00	0.00
7418	PROJ/7418/THE NATURE OF FOREIGN BODY	10000.00	284000.00	0.00	294000.00	0.00
7419	PROJ/7419/DETERMINATION OF TOXICITY	10000.00	211600.00	0.00	221600.00	0.00
7421	PROJ/7421/FIBRIN BASED MATRIX	52038.00	390000.00	0.00	442038.00	0.00
7422	PROJ/7422/HISTOPATHOLOGICAL EVALUATION	93600.00	169650.00	0.00	263250.00	0.00
7423	PROJ/7423/TRACKING CARDIAC STEM	55519.00	15000.00	0.00	70519.00	0.00
7424	PROJ/7424/SYNAPTIC PROTEOME	50460.00	25000.00	0.00	75460.00	0.00
7425	PROJ/7425/BIOENGINEERED SKIN AFT FOR ...	130000.00	284000.00	0.00	414000.00	0.00
7426	PROJ/7426/POLYMERIC MICRO NEEDLES	0.00	162000.00	0.00	162000.00	0.00
7427	PROJ/7427/ANIONIC POLYSACCHARIDE BASED	0.00	16660.00	0.00	16660.00	0.00
7428	PROJ/7428/BACTERIAL RESISTANCE	0.00	380000.00	25000.00	405000.00	0.00
7429	PROJ/7429/BIORESORBABLE POLYMER MESH	0.00	103230.00	0.00	103230.00	0.00
8004	PROJ/8004/PROGRAM SUPPORT & TISSUE	-278345.00	0.00	0.00	-278345.00	0.00



0.00	0.00	386400.00	37614.00	0.00	424014.00	424014.00	54274.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	761369.00
0.00	0.00	0.00	0.00	151259.48	151259.48	151259.48	407580.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6135.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1686.00
0.00	0.00	0.00	0.00	13708.00	13708.00	13708.00	9292.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	206140.00
0.00	0.00	403200.00	15040.00	0.00	418240.00	418240.00	19900.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	89585.75
0.00	0.00	201600.00	9000.00	0.00	210600.00	210600.00	14620.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	18450.00
0.00	0.00	360000.00	3237.00	0.00	363237.00	363237.00	23661.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13000.00
0.00	0.00	260452.00	24818.00	0.00	285270.00	285270.00	8730.00
0.00	0.00	169084.00	0.00	0.00	169084.00	169084.00	52516.00
0.00	0.00	360000.00	13383.00	0.00	373383.00	373383.00	68655.00
0.00	0.00	0.00	72529.18	0.00	72529.18	72529.18	190720.82
0.00	0.00	30000.00	5366.00	0.00	35366.00	35366.00	35153.00
0.00	0.00	30000.00	7719.00	0.00	37719.00	37719.00	37741.00
0.00	0.00	264000.00	40000.00	0.00	304000.00	304000.00	110000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	162000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	16660.00
0.00	0.00	355000.00	3699.00	0.00	358699.00	358699.00	46301.00
0.00	0.00	0.00	1904.00	0.00	1904.00	1904.00	101326.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-278345.00



8005	PROJ/8005/PROGRAM SUPPORT & TISSUE	-98722.00	0.00	0.00	-98722.00	0.00
8006	PROJ/8006/BIOCONJUGATION NANO MAT.	139019.00	0.00	0.00	139019.00	0.00
8008	PROJ/8008/CSIR GRANT-PADMAJA.PNAMBI	12990.00	0.00	0.00	12990.00	0.00
8009	PROJ/8009/DBT/DR.TV.ANILKUMAR/DE...TISSUE	-719792.00	409151.00	0.00	-310641.00	0.00
8011	PROJ/8011/NANOFRONT/DR.NIRANJAN/ INTRAMAS	139900.00	0.00	0.00	139900.00	0.00
8012	PROJ/8012/VSSC/DR.NIRANJAN/DESIGN STUDIES	2148623.00	0.00	0.00	2148623.00	0.00
8014	PROJ/8014/DBT/DR.ROY JOSEPH/DEV... .V.GRAFT	-17063.00	0.00	0.00	-17063.00	0.00
8015	PROJ/8015/DR.ANOOPKUMAR/PROGRAMME...	4566.00	0.00	8015.00	12581.00	0.00
8018	PROJ/8018/ICMR/ DR. P. V. MOHANAN	-55191.00	0.00	55191.00	0.00	0.00
8019	PROJ/8019/STEC/DR.PRAMESH	82284.00	0.00	0.00	82284.00	0.00
8020	PROJ/8020/CSIR/DR.LISSY KRISHNAN	19974.36	0.00	0.00	19974.36	0.00
8021	PROJ/8021/ANGIO GENESIS EXP/DR. UMASHANKAR	79036.00	0.00	0.00	79036.00	0.00
8022	PROJ/8022/AIR POLLUTION/SUJESH SREEDHAR	-306.00	0.00	0.00	-306.00	0.00
8023	PROJ/8023/KSCSTE/DR.H.K.VARMA	76545.00	0.00	0.00	76545.00	0.00
8024	PROJ/8024/IIT/DR.PR.ANILKUMAR	2935.00	0.00	0.00	2935.00	0.00
8026	PROJ/8026/	3339.00	0.00	0.00	3339.00	0.00
8027	PROJ/8027/DR.PV.MOHANAN	79732.00	0.00	0.00	79732.00	0.00
8028	PROJ/8028/DR.DIKSHA PAINULY	22332.00	0.00	0.00	22332.00	0.00
8031	PROJ/8031	-309053.00	0.00	0.00	-309053.00	0.00
8032	PROJ/8032/O.S.N.NAIR	128471.00	0.00	0.00	128471.00	0.00
8033	PROJ/8033/DEV. OF IRON OXIDE- DR.R.S.JAYASREE	-7146.00	0.00	0.00	-7146.00	0.00
8034	PROJ/8034/FLURO PASSI...DR.ROY JOSEPH	807886.37	0.00	0.00	807886.37	0.00
8035	PROJ/EVALN OF SEWING RING-DR. UMASHANKAR	22201.00	0.00	0.00	22201.00	0.00
8038	PROJ/DEV OF MISSION PROGRAM - DR.GSB	1182223.00	0.00	0.00	1182223.00	0.00



0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-98722.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	139019.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12990.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-310641.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	139900.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2148623.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-17063.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12581.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82284.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19974.36
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79036.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-306.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76545.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3339.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79732.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22332.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-309053.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	128471.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7146.00
0.00	0.00	0.00	104954.27	0.00	104954.27	104954.27	0.00	702932.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22201.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1182223.00



8040	PROJ/SYNTHESIS OF OXIDE-DR.H.K.VARMA	115532.00	0.00	0.00	115532.00	0.00
8041	PROJ/DEV OF NANO DEVICES DNA-DR.C.P.SHARMA	-6255.00	0.00	0.00	-6255.00	0.00
8046	PROJ/DIFF. OF ADULT PRO - DR.ASHA.S.MATHEW	739755.00	0.00	0.00	739755.00	0.00
8047	PROJ/IN VIVO GENOTOXICITY- DR.PV.MOHANAN	467651.00	0.00	0.00	467651.00	0.00
8049	PROJ/NEW VISION BIOMAT-DR.C.P.SHARMA	-44861.00	0.00	0.00	-44861.00	0.00
8050	PROJ/GENOTOXICITY STUDY-DR.PV.MOHANAN	130338.00	0.00	0.00	130338.00	0.00
8051	PROJ/IN VITRO ALTE. TEST-DR.PV.MOHANAN	20144.00	0.00	0.00	20144.00	0.00
8052	PROJ/ROLL OF TRANSFORMN GROWTH-DR.ANOOP	112387.47	0.00	0.00	112387.47	0.00
8054	PROJ/MUSCULOSKELETAL STEM CELL/DR. P D NAIR	606988.78	0.00	0.00	606988.78	0.00
8055	MUSCULOSKELETAL STEM CELLS/DR. H.K.VARMA	3.00	0.00	0.00	3.00	0.00
8058	PROJ/AORC FELLOWSHIP/MAYURI.PV.	100809.00	0.00	0.00	100809.00	0.00
8059	PROJ/CELL SHEET ENGG-DR.PR.ANILKUMAR	108000.00	0.00	0.00	108000.00	0.00
8062	PROJ/ACCELERATED AREING./MR.C.V.MURALI	213728.00	0.00	0.00	213728.00	0.00
8064	NONVIRAL GENE DELIVERY VECTORS-DR.REKHA	35373.00	0.00	0.00	35373.00	0.00
8066	TO INVESTIGATE THE EFFECTS OF/ DR.GULIA	0.55	0.00	0.00	0.55	0.00
8067	QUANTUM DOT CONJUGATED -DR.R.S.JAYASREE	-5090.00	0.00	0.00	-5090.00	0.00
8068	INSPIRE RESEARCH PROJECT -DR.BINDU.PNAI R	3957.00	0.00	0.00	3957.00	0.00
8069	PROJ/8069/STUDIES BIODEGRADABLE	1425.00	0.00	0.00	1425.00	0.00
8070	PROJ/8070/PINSPIRE FACULTY AWARD-DR.SHIV	1198905.00	1901830.00	2124.00	3102859.00	1035191.00
8071	PROJ/8071/REGEN .OF INTERVERTEBRAL DISC	5840.00	0.00	0.00	5840.00	0.00
8072	PROJ/8072/NANO CALCIUM PHOSPHATE	15412.10	0.00	0.00	15412.10	0.00
8073	PROJ/8073/DEVELOP.OF CARDIOPULMONARY	32967.00	0.00	0.00	32967.00	0.00
8074	PRODUCTION OF NOVEL NANO INDO-UK DR.CPS	303180.00	0.00	0.00	303180.00	0.00
8075	DST INSPIRE FELLOWSHIP - ASWATHY B S	130.00	452000.00	0.00	452130.00	0.00



0.00	0.00	110532.00	3525.00	0.00	114057.00	114057.00	1475.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-6255.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	739755.00
0.00	0.00	0.00	467651.00	0.00	467651.00	467651.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-44861.00
0.00	0.00	0.00	130338.00	0.00	130338.00	130338.00	0.00
0.00	0.00	0.00	0.00	20144.00	20144.00	20144.00	0.00
0.00	0.00	0.00	33334.00	0.00	33334.00	33334.00	79053.47
0.00	0.00	0.00	6000.00	0.00	6000.00	6000.00	600988.78
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
0.00	0.00	0.00	0.00	100809.00	100809.00	100809.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	108000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213728.00
0.00	0.00	0.00	1572.00	0.00	1572.00	1572.00	33801.00
0.00	0.00	0.00	1000.00	0.00	1000.00	1000.00	-999.45
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5090.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3957.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1425.00
0.00	1035191.00	428943.00	550484.35	0.00	979427.35	2014618.35	1088240.65
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5840.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15412.10
0.00	0.00	29520.00	3447.00	0.00	32967.00	32967.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	303180.00
0.00	0.00	432000.00	9641.00	0.00	441641.00	441641.00	10489.00



8077	HOME BASED VITAL SIGNS - DR.NIRANJAN.D.	204509.75	0.00	0.00	204509.75	0.00
8079	DOSE RANGING STUDY FOR DES / DR.SABAREES	731710.00	0.00	0.00	731710.00	0.00
8080	PROJ/8080/DETECTION OF ZINC IN EPILEPTIC	348627.33	0.00	124918.18	473545.51	59008.00
8081	EXPLORING THE POTENTIALOF ISLET-DR.PRABH	251219.00	563200.00	0.00	814419.00	0.00
8082	ASSESSMENT OF CERAMIC CONSTRUCTS - FRANC	37118.00	0.00	0.00	37118.00	0.00
8083	IN VITRO OSTEOARTHRICITIC- DR.NEETHU MOHAN	8294.82	0.00	0.00	8294.82	0.00
8084	ROLE OF NMDA- DR.PRADEEP PUNNAKKAL-RAM	1279907.51	1610000.00	2163.10	2892070.61	184467.00
8085	PROJ/8085/ELECTROCHEMICALLY ASSISTED	40.00	0.00	0.00	40.00	0.00
8086	PROJ/8086/GOLD NANORODS FOR THERAPY	334235.56	679800.00	106398.16	1120433.72	0.00
8087	PROJ/8087/CONTROLLED DELIVERY	931952.14	0.00	110653.47	1042605.61	0.00
8088	PROJ/8088/CANCER TISSUE ENGINEERING A 3D	98.00	0.00	0.00	98.00	0.00
8089	DO PLATELETS IN PATIENTS -DR. ANUGYA BHATT	663404.25	0.00	0.00	663404.25	0.00
8090	INSPIRE FELLOW PHD KEERTHI S JRF	1084.00	0.00	0.00	1084.00	0.00
8091	BIORESORBABLE NANO BI- DR. H K VARMA	-12735.84	0.00	12736.00	0.16	0.00
8092	BIOLOGICAL STRUCTURES	379754.76	261172.00	20969.00	661895.76	0.00
8093	DR. H K VARMA - A NEW DRUG-CERAMIC MOD SUPER	0.85	0.00	0.00	0.85	0.00
8094	ALTERNATE	107116.29	400000.00	0.00	507116.29	0.00
8095	DEV RAPID UTI DR. MAYA - DST	8173.15	0.00	0.00	8173.15	0.00
8096	PREP OF HYDROGEL -DR AKHILA RAJAN	598132.77	600000.00	24000.00	1222132.77	0.00
8097	MULTIFUNCN - DBT SUNITHA PREM	421899.64	1009000.00	501455.00	1932354.64	0.00
8098	HOW ACTIN FILAMENT STRUCTUDR RENU MOH	1129.00	0.00	0.00	1129.00	0.00
8099	INSPIRE FELLOW RESHMA S	-2487.00	380000.00	0.00	377513.00	0.00
8100	DETAILED ...CONDITIONS- ARUN ANIRUDHAN	60653.10	673256.00	2297.00	736206.10	0.00
8102	ENGINEERING BIOMIMETIC.... NICHE TARA.S	423803.00	389600.00	0.00	813403.00	0.00



0.00	0.00	0.00	0.00	0.00	0.00	0.00	204509.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	731710.00
0.00	59008.00	0.00	451489.18	0.00	451489.18	510497.18	-36951.67
0.00	0.00	0.00	230600.00	0.00	230600.00	230600.00	583819.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	37118.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	8294.82
0.00	184467.00	1258200.00	328068.98	0.00	1586268.98	1770735.98	1121334.63
0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00
0.00	0.00	170400.00	867816.92	0.00	1038216.92	1038216.92	82216.80
0.00	0.00	0.00	971283.35	44741.00	1016024.35	1016024.35	26581.26
0.00	0.00	0.00	0.00	0.00	0.00	0.00	98.00
0.00	0.00	73077.00	498789.95	0.00	571866.95	571866.95	91537.30
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1084.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
0.00	0.00	348555.00	302426.66	0.00	650981.66	650981.66	10914.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
0.00	0.00	267386.00	214151.50	0.00	481537.50	481537.50	25578.79
0.00	0.00	0.00	0.00	0.00	0.00	0.00	8173.15
0.00	0.00	620968.00	467021.61	0.00	1087989.61	1087989.61	134143.16
0.00	0.00	900000.00	92937.02	0.00	992937.02	992937.02	939417.62
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1129.00
0.00	0.00	360000.00	6764.00	0.00	366764.00	366764.00	10749.00
0.00	0.00	116600.00	142084.92	0.00	258684.92	258684.92	477521.18
0.00	0.00	745920.00	5000.00	0.00	750920.00	750920.00	62483.00



8103	CORNEL REGENERATIVE THERAPY...Dr.ANNIE JOHN	279502.02	400000.00	622.00	680124.02	0.00
8104	PROJ/8104/CORNEL REGENERATIVE THERAPY	277085.52	0.00	18840.00	295925.52	0.00
8105	PROJ/8105/STUDY IN MOLECULAR MECHANISM	45108.08	183061.00	0.00	228169.08	0.00
8106	PROJ/8106/MECHANISM OF ANGIOGENESIS	0.00	20000.00	0.00	20000.00	0.00
8107	PROJ/8107/MECHANO -BIOLOGY	26786.80	1780000.00	0.00	1806786.80	0.00
8108	PROJ/8108/DEVELOPMENT OF A DENTAL RES...	272814.37	0.00	7700.00	280514.37	0.00
8109	PROJ/8109/CHRONIC WOUND HEALING	152265.77	713154.00	115000.00	980419.77	0.00
8110	PROJ/8110/TO ALLEVIATE COGNITIVE DEFECTS	935644.00	0.00	0.00	935644.00	0.00
8111	PROJ/8111/FILAMENT STRUCTURES	641087.00	1610000.00	8599.75	2259686.75	0.00
8112	PROJ/8112/DEVELOPMENT THYROID COLLAR	643391.35	0.00	736259.00	1379650.35	0.00
8113	PROJ/8113/TREATMENT OF BONE DEFECTS	139800.00	0.00	0.00	139800.00	0.00
8114	PROJ/8114/NANO PARTICLES WITH CELLS"	57482.65	390000.00	0.00	447482.65	0.00
8115	PROJ/8115/TECHNOLOGY RESEARCH CENTRE	243779851.30	146000000.00	158852555.00	548632406.30	9281607.00
8116	PROJ/8116/PROGRAMME SUPPORT ON TRAN...	2486429.85	1127000.00	202.00	3613631.85	2095026.00
8117	PROJ/8117/GOLD NANOROD BASED TARGETED	688619.32	797000.00	469.00	1486088.32	35206.00
8118	PROJ/8118/THE ROLE OF NMDA	5984851.00	1038740.00	10568.46	7034159.46	5127318
8119	PROJ/8119/MESENCHYMAL STEM CELLS	2502816.99	0.00	0.00	2502816.99	891946.00
8122	PROJ/8122/DEV. OF CENTRIFUGAL BLOOD PUMP	5023174.08	92400.00	0.00	5115574.08	0.00
8123	PROJ/8123/DEV.OF LEFT VENTRICULAR DEVICE	19602757.26	414000.00	0.00	20016757.26	4685068.36
8124	PROJ/8124/DEV. OF AORTIC STENT GRAFT	9320396.50	453600.00	108.00	9774104.50	573434.00
8125	PROJ/8125/DEV. OF DEEP BRAIN STIMULATOR	15453580.94	414000.00	71855.97	15939436.91	502918.54
8126	PROJ/8126/CARDIO VERTER DEFIBRILLATOR	0.00	19296000.00	0.00	19296000.00	0.00
8127	PROJ/8127/DEVELOPMENT OF LEUKODEPLETION	1983000.00	201600.00	0.00	2184600.00	0.00
8128	PROJ/8128/DEPT. OF ANNULOPLASTY/MITRAL VALVE CORRECTION	0.00	6345200.00	0.00	6345200.00	0.00



0.00	0.00	9000.00	87415.00	0.00	96415.00	96415.00	583709.02
0.00	0.00	0.00	295925.45	0.00	295925.45	295925.45	0.07
0.00	0.00	180238.00	35680.22	0.00	215918.22	215918.22	12250.86
0.00	0.00	0.00	0.00	0.00	0.00	0.00	20000.00
0.00	0.00	1299508.00	296524.04	0.00	1596032.04	1596032.04	210754.76
0.00	0.00	49840.00	186117.92	0.00	235957.92	235957.92	44556.45
0.00	0.00	480000.00	248923.72	0.00	728923.72	728923.72	251496.05
0.00	0.00	120000.00	277222.00	0.00	397222.00	397222.00	538422.00
0.00	0.00	1110000.00	571243.62	0.00	1681243.62	1681243.62	578443.13
0.00	0.00	171038.00	1208612.67	0.00	1379650.67	1379650.67	-0.32
0.00	0.00	0.00	0.00	0.00	0.00	0.00	139800.00
0.00	0.00	360000.00	7931.00	0.00	367931.00	367931.00	79551.65
335467853.00	344749460.00	2242179.00	10843120.03	0.0	13085299.03	357834759.03	190797647.27
0.00	2095026.00	475200.00	156726.34	0.00	631926.34	2726952.34	886679.51
0.00	35206.00	359194.00	374547.77	0.00	733741.77	768947.77	717140.55
0.00	5127318.00	633930.00	509232.11	0.00	1143162.11	6270480.11	763679.35
0.00	891946.00	237581.00	692095.75	0.00	929676.75	1821622.75	681194.24
0.00	0.00	679944.00	1155558.09	0.00	1835502.09	1835502.09	3280071.99
0.00	4685068.36	1218633.00	2289017.27	73393.00	3581043.27	8266111.63	11750645.63
0.00	573434.00	780248.00	350706.61	26045.00	1156999.61	1730433.61	8043670.89
0.00	502918.54	1034573.00	2963558.01	193426.00	4191557.01	4694475.55	11244961.36
0.00	0.00	284082.00	0.00	0.00	284082.00	284082.00	19011918.00
0.00	0.00	367161.00	40760.67	0.00	407921.67	407921.67	1776678.33
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6345200.00



8129	PROJ/8129/DEVPT.OF BIOPROSTHETIC HEART VALVE	0.00	15818800.00	0.00	15818800.00	0.00
8130	PROJ/8130/INTER VERTEBRAL SPACER	2434238.35	601199.00	0.00	3035437.35	1869307.50
8131	PROJ/8131/BIOACTIVE MATERIAL PLATFORM	4330762.23	129600.00	0.00	4460362.23	1394410.35
8132	PROJ/8132/DEV. INTRACRANIAL ELECTRODES	2238629.19	67200.00	4266.00	2310095.19	376762.57
8133	PROJ/8133/OPTICAL PERIPHERAL NERVE	2854000.00	25200.00	0.00	2879200.00	0.00
8135	PROJ/8135/STANDARDIZATION OF ALBUMIN	3308850.00	148600.00	51991.98	3509441.98	592279.00
8140	PROJ/8140/REPAIR OF CARTILAGE INJURY	4132470.73	174000.00	0.00	4306470.73	1381103.00
8141	PROJ/8141/3D PRINTING OF LIVER TISSUE	29796040.17	102000.00	12018.00	29910058.17	1570307.00
8142	PROJ/8142/DEVELOPMENT OF ASSAY PLATFORM	2446626.00	236000.00	12902.40	2695528.40	0.00
8143	PROJ/8143/POLYMERIC WOUND	1068267.23	174000.00	0.00	1242267.23	0.00
8144	PROJ/8144/WOUND HEALING MATRIX	2277242.16	302400.00	29125.00	2608767.16	462158.80
8145	PROJ/8145/LINT FREE ABSORBENT DRESSING	3027859.38	63200.00	91.00	3091150.38	2090332.00
8147	PROJ/8147/POINT OF CARE DIAGNOSIS	237230.01	4956400.00	0.00	5193630.01	1296889.00
8148	PROJ/8148/ALGINATE SCAFFOLD	3914118.40	28800.00	0.00	3942918.40	3492127.00
8149	PROJ/8149/EVALUATION OF PLGC	705403.27	510800.00	17560.25	1233763.52	0.00
8150	PROJ/8150/DEV. OF OCCLUSION DEVICE	3239865.00	57600.00	4576.00	3302041.00	562408.00
8151	PROJ/8151/DEV. EMBOLIZATION DEVICE	3022084.57	118800.00	0.00	3140884.57	1183184.00
8153	PROJ/8153/CHARACTERISATION OF BACILLUS SPECIES-(MRSA)	0.00	4041200.00	0.00	4041200.00	0.00
8154	PROJ/8154/DEPT.OF BIOMATERIAL SCIENCE &TECHNOLOGY	0.00	2696000.00	0.00	2696000.00	533200.00
8155	PROJ/8155/DEVPT.OF FLOW DIVERTER TREATMENT OF ANEURYSMS	0.00	9301600.00	0.00	9301600.00	0.00
8159	PROJ/8159/ITI INFRASTRUCTURE UPGRADTION PLAN	0.00	6410000.00	0.00	6410000.00	0.00
8160	PROJ/8160/TOXICOLOGICAL EVALUATION	4284000.00	1346800.00	0.00	5630800.00	0.00
8161	PROJ/8161/LARGE ANIMAL EVALUATION	3751527.00	2947400.00	0.00	6698927.00	0.00
8162	PROJ/8162/BLOOD COMPATIBILITY	2234600.00	370400.00	0.00	2605000.00	0.00
8163	PROJ/8163/CYTOCOMPATIBILITY	1215785.26	574800.00	0.00	1790585.26	393291.00



0.00	0.00	483064.00	996379.44	0.00	1479443.44	1479443.44	14339356.56
0.00	1869307.50	377145.00	86776.20	20761.00	484682.20	2353989.70	681447.65
0.00	1394410.35	359600.00	390494.74	21000.00	771094.74	2165505.09	2294857.14
0.00	376762.57	523967.00	391804.67	46458.00	962229.67	1338992.24	971102.95
0.00	0.00	292027.00	200.00	0.00	292227.00	292227.00	2586973.00
0.00	592279.00	59658.00	876218.66	500.00	936376.66	1528655.66	1980786.32
0.00	1381103.00	426448.00	287887.06	0.00	714335.06	2095438.06	2211032.67
0.00	1570307.00	634888.72	1292430.42	1553993.00	3481312.14	5051619.14	24858439.03
0.00	0.00	196889.00	291218.61	0.00	488107.61	488107.61	2207420.79
0.00	0.00	163200.00	186678.09	0.00	349878.09	349878.09	892389.14
0.00	462158.80	222000.00	120168.46	62200.00	404368.46	866527.26	1742239.90
0.00	2090332.00	191726.00	87600.13	0.00	279326.13	2369658.13	721492.25
0.00	1296889.00	192056.00	114542.66	0.00	306598.66	1603487.66	3590142.35
0.00	3492127.00	207643.00	131954.15	0.00	339597.15	3831724.15	111194.25
0.00	0.00	143880.00	1152765.97	7560.00	1304205.97	1304205.97	-70442.45
0.00	562408.00	459816.00	320705.61	0.00	780521.61	1342929.61	1959111.39
0.00	1183184.00	386400.00	282325.84	0.00	668725.84	1851909.84	1288974.73
0.00	0.00	193091.00	111871.17	0.00	304962.17	304962.17	3736237.83
0.00	533200.00	122071.00	733432.98	0.00	855503.98	1388703.98	1307296.02
0.00	0.00	250015.00	1885038.44	0.00	2135053.44	2135053.44	7166546.56
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6410000.00
0.00	0.00	396222.00	403593.71	0.00	799815.71	799815.71	4830984.29
0.00	0.00	275400.00	185228.24	0.00	460628.24	460628.24	6238298.76
0.00	0.00	204560.00	296176.62	0.00	500736.62	500736.62	2104263.38
0.00	393291.00	294000.00	49737.25	0.00	343737.25	737028.25	1053557.01



8164	PROJ/8164/HISTOPATHOLOGICAL EVALUATION	2361115.00	226000.00	0.00	2587115.00	0.00
8165	PROJ/8165/MICROBIOLOGICAL EVALUATION	1201913.79	360400.00	3162.00	1565475.79	55399.11
8166	PROJ/8166/ANALYTICAL CHARACTERISATION	1552850.00	219800.00	0.00	1772650.00	0.00
8167	PROJ/8167/DESIGN & PROTOTYPING	3512459.00	1553600.00	111073.58	5177132.58	131391.60
8168	PROJ/8168/DEVPT OF EQPT FOR PCKG VALIDATION	0.00	4156600.00	0.00	4156600.00	0.00
8169	PROJ/8169/PREPARATION STD FOR BIOLOGICAL EVALUATION	0.00	3444000.00	852.00	3444852.00	320960.00
8170	PROJ/8170/ORTHOPAEDIC IMPLANTS	523000.00	0.00	0.00	523000.00	0.00
8171	PROJ/8171/ENTERIC COATING	605768.00		5700.29	611468.29	0.00
8172	PROJ/8172/BIOACTIVE BONE CEMENT	604964.00	0.00	4472.79	609436.79	0.00
8173	PROJ/8173/BLOOD BRAIN BARRIER	784262.50	247.00	0.00	784509.50	0.00
8174	PROJ/8174/SCAFFOLDS BASED ON SELF-ASSE..	1022726.93	221200.00	0.00	1243926.93	0.00
8175	PROJ/8175/MUSTER- MUSCULOSKELETAL STEM..	7583000.00	230400.00	0.00	7813400.00	891170.00
8176	PROJ/8176/MUSTER- MUSCULOSKELETAL STEM..	3281000.00	0.00	0.00	3281000.00	0.00
8177	PROJ/8177/RADIOPAQUE LIQUID	0.00	472400.00	0.00	472400.00	0.00
8178	PROJ/8178/ANTI SNAKE VENOM (IGY)	0.00	14466800.00	43348.52	14510148.52	0.00
8179	PROJ/8179/DEVELOPMENT OF NOVEL PROTOTYPE	0.00	1133300.00	0.00	1133300.00	0.00
8180	PROJ/8180/TO MODEL THE EFFECT OF MUTA...	0.00	545000.00	0.00	545000.00	0.00
8181	PROJ/8181/VOICE PROSTHESIS	0.00	437000.00	0.00	437000.00	0.00
8182	PROJ/8182/A TISSUE ENGINEERED SKIN SU.	0.00	1010000.00	0.00	1010000.00	0.00
	TOTAL OF EXTERNAL PROJECTS BMT (C1)	444571234.34	275257632.00	212756947.86	932585814.20	43112823.83
	INTERNAL PROJECTS					
6200	SCALE UP AND SMALL SCALE PRODUC-Dr Lissy	0.00	0.00	33600.00	33600.00	0.00
6208	IN VITRO DIFFERENTIATION	0.00	0.00	150.00	150.00	0.00
6210	DEV OF BIO ...APPLCN P P LIZYMOL	0.00	0.00	211119.00	211119.00	0.00



0.00	0.00	28800.00	0.00	0.00	28800.00	28800.00	2558315.00
0.00	55399.11	221160.00	208393.49	0.00	429553.49	484952.60	1080523.19
0.00	0.00	159399.00	291727.00	0.00	451126.00	451126.00	1321524.00
0.00	131391.60	512445.00	1597327.63	0.00	2109772.63	2241164.23	2935968.35
0.00	0.00	184760.00	65472.96	0.00	250232.96	250232.96	3906367.04
0.00	320960.00	111981.00	62764.25	0.00	174745.25	495705.25	2949146.75
0.00	0.00	0.00	159808.24	0.00	159808.24	159808.24	363191.76
0.00	0.00	86400.00	348078.58	0.00	434478.58	434478.58	176989.71
0.00	0.00	169852.00	246190.03	0.00	416042.03	416042.03	193394.76
0.00	0.00	315200.00	158630.42	0.00	473830.42	473830.42	310679.08
0.00	0.00	306774.00	812074.91	0.00	1118848.91	1118848.91	125078.02
0.00	891170.00	700195.01	817536.00	0.00	1517731.01	2408901.01	5404498.99
0.00	0.00	216232.94	100768.00	0.00	317000.94	317000.94	2963999.06
0.00	0.00	99923.00	361857.40	0.00	461780.40	461780.40	10619.60
0.00	0.00	1104886.00	2852383.77	0.00	3957269.77	3957269.77	10552878.75
0.00	0.00	38572.00	0.00	0.00	38572.00	38572.00	1094728.00
0.00	0.00	135000.00	58162.00	0.00	193162.00	193162.00	351838.00
0.00	0.00	19900.00	70800.00	0.00	90700.00	90700.00	346300.00
0.00	0.00	134839.00	100000.00	0.00	234839.00	234839.00	775161.00
335467853.00	378580676.83	32410621.67	49148248.19	49858710.64	131417580.50	509998257.33	422587556.87
0.00	0.00	0.00	33600.00	0.00	33600.00	33600.00	0.00
0.00	0.00	0.00	150.00	0.00	150.00	150.00	0.00
0.00	0.00	205471.00	5648.00	0.00	211119.00	211119.00	0.00



6211	DEV OF PROTOTYPE ANEURYSM SUJESH SREEDHAR	0.00	0.00	102982.00	102982.00	0.00
6212	DEV OF ...VALVE CORRECTION RANJITH G	0.00	0.00	32964.00	32964.00	0.00
6215	PROJ/6215/PROTOTYPE SAFETY SYSTEM	0.00	0.00	292801.20	292801.20	0.00
6216	PROJ/6216/EFFICACY OF HUMAN PROTEINS	0.00	591.00	333955.92	334546.92	0.00
6217	PROJ/6217/BIOINKS FOR 3D BIO PRINTING	0.00	2000.00	199481.98	201481.98	0.00
6500	OHF PROJECT - DR.ANNIE JOHN	1397.00	0.00	0.00	1397.00	0.00
6501	OHF PROJ. - DR. KALADHAR KAMALASANAN	160000.00	0.00	0.00	160000.00	0.00
6502	OHF PROJECT DR SACHIN J SHENOY	180000.00	0.00	0.00	180000.00	0.00
6504	DEVELOPMENT OF IRON NANO PRACTICLE	6917.72	0.00	0.00	6917.72	0.00
6505	REM SLEEP RESTRICTION	16694.00	0.00	0.00	16694.00	0.00
7420	FEASIBILITY OF USING GLUTARA-DR.GIRISH M	0.00	0.00	95760.00	95760.00	0.00
2622	OHF- FOR INNOVATIVE PROJECTS	1460000.00	0.00	0.00	1460000.00	0.00
2621	IIPC FUND(INDUSTRY INSTITUTE PARTNERSHIP - BMT	260769.00	0.00	0.00	260769.00	0.00
	TOTAL OF INTERNAL PROJECTS BMT (C2)	2085777.72	2591.00	1302814.10	3391182.82	0.00
C	TOTAL OF EXTERNAL & INTERNAL PROJECTS BMT (C1+C2)	446657012.06	275260223.00	214059761.96	935976997.02	43112823.83
	GRAND TOTAL SCHEDULE 3 (A)+(B)+(C)	797201598.99	423479802.64	625987569.01	1846668970.64	83525778.29



0.00	0.00	41200.00	61782.00	0.00	102982.00	102982.00	0.00
0.00	0.00	32964.00	0.00	0.00	32964.00	32964.00	0.00
0.00	0.00	203912.20	88889.00	0.00	292801.20	292801.20	0.00
0.00	0.00	56258.00	278288.92	0.00	334546.92	334546.92	0.00
0.00	0.00	64412.00	137069.98	0.00	201481.98	201481.98	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1397.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	160000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	180000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6917.72
0.00	0.00	0.00	0.00	0.00	0.00	0.00	16694.00
0.00	0.00	0.00	0.00	95760.00	95760.00	95760.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1460000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	260769.00
0.00	0.00	604217.20	605427.90	95760.00	1305405.10	1305405.10	2085777.72
335467853.00	378580676.83	33014838.87	49753676.09	49954470.64	132722985.60	511303662.43	424673334.59
336688935.00	420214713.29	66399847.87	53475845.14	592311593.51	712187286.52	1132401999.81	714266970.83



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 4-SECURED LOANS AND BORROWINGS:	2017-2018	2016-2017
1. Central Government	--	--
2. State Government (Specify)	--	--
3. Financial Institutions	--	--
a) Term Loans	--	--
b) Interest accrued and due	--	--
4. Banks:	--	--
a) Term Loans-Interest accrued and due	--	--
b) Other Loans(specify)- Interest accrued and due-Over draft	--	--
5. Other Institutions and Agencies	--	--
6. Debentures and Bonds	--	--
7. Others(Specify)	--	--
Against OD facility- cheques issued	--	--
TOTAL		
SCHEDULE 5-UNSECURED LOANS AND BORROWINGS	2017-2018	2016-2017
1. Central Government	--	--
2. State Government (Specify)	--	--
3. Financial Institutions	--	--
4. Banks:	--	--
a) Term Loans	--	--
b) Other Loans(specify)	--	--
5. Other Institutions and Agencies	--	--
6. Debentures and Bonds	--	--
7. Fixed Deposits	--	--
8. Others(Specify)	--	--
TOTAL		
SCHEDULE 6-DEFERRED CREDIT LIABILITIES:	2017-2018	2016-2017
a) Acceptances secured by hypothecation of capital equipment and other assets	--	--
b) Others		
TOTAL	--	--
SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS	2017-2018	2016-2017
1. Acceptances		

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

	2. Sundry Creditors:		
	a) For Goods	154350237	118678936
	b) Others	0	0
	3. Advances Received	93105998	52397159
	4. Interest accrued but not due on:	0	0
	a) Secured Loans / borrowings	0	0
	b) Unsecured Loans / borrowings	0	0
	5. Statutory Liabilities:	0	0
	a) Overdue		
	b) Others	4248352	13575440
	6. Other current Liabilities	273624362	61659150
	TOTAL(A)	525328949	246310686
	B. PROVISIONS		
	1. For Taxation	0	0
	2. Gratuity	0	0
	3. Accumulated Leave Encashment	0	0
	4. Trade Warranties/Claims	0	0
	5. Others(Specify) Audit fee	400000	230000
	Emergency Reserve Fund contribution	0	0
	Technology Development Fund contribution	3017663	1690457
	TOTAL(B)	3417663	1920457
	TOTAL(A+B)	528746612	248231143

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL

SCHEDULE 8- FIXED ASSETS

GROSS BLOCK

PARTICULARS	Cost/valuation as at the beginning of the year 01/04/2017	Additions during the year 2017-18	Deductions during the year 2017-18	
A. FIXED ASSETS:				
1. LAND:				
a) Freehold	16894606	0	0	
b) Leasehold				
2. BUILDINGS:				
a) On Freehold Land *	47037608	354000	0	
b) On Leasehold Land				
c) Ownership Flats/Premises				
d) Superstructures on Land not belonging to the entity	477182357	0		
3. PLANT MACHINERY & EQUIPMENT	2787189803	112836679	14642856	
4. Equipment - From Non Monetary grants	0	1	0	
4. VEHICLES	8532834	13966		
5. FURNITURE, FIXTURES	80339782	664813	19309	
6. OFFICE EQUIPMENT	1236622	0	0	
7. COMPUTER/PERIPHERALS	6857983	3015857	0	
8. ELECTRIC INSTALLATIONS	168952752	4106595	42000	
9. LIBRARY BOOKS	193282355	10290899	0	
10. TUBEWELLS & W.SUPPLY	301965	0		
11. OXYGEN CYLINDERS/GAS PLANT INSTALLATIONS	1405581	36091		
12) KITCHEN/CANTEEN EQUIPMENTS	2620678	48730	145902	
13) PAINTINGS	450216	0		
14) SURGICAL EQUIPMENTS	7136375	0	0	
Total for the year (Total -A)	3799421513	131367631	14850068	
Total for the previous year	2898240672	913597880	12417038	
Captial Work in Progress (B)		26598791	0	
Total for the year (A+B)	3799421513	157966422	14850068	
* Depreciation for item2(a) has been provided along with depreciation on 2(d)				

Sd/-
Chief Financial AdviserSd/-
Director



SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

DEPRECIATION					NET BLOCK	
Cost/valuation at the year end (31.03.2018)	Depreciation as at the beginning of the year (01.04.2017)	Depr on items written off	During the year 2017-18	Total up to the year end (31.03.2018)	As at the end of current year end (31.03.2018)	As at the previous year end (31.03.2017)
16894606	0	0	0	0	16894606	16894606
47391608	0		0	0		
477182357	265385596	0	25918837	291304433	233269532	258834369
2885383625	1984752289	13048298	124003647	2108755937	776627688	802437512
1	0	0	0	1	1	0
8546800	6585617		294177	6879795	1667005	1947216
80985285	40110528	15941	4073129	44183657	36801628	40229253
1236622	1024228		21239	1045468	191154	212393
9873840	6410809	0	2077819	8488627	1385213	447174
173017347	89403745	35346	8329549	97733294	75284053	79549007
203573254	185322533	0	10950432	196272965	7300288	7959821
301965	209366		9260	218626	83339	92599
1441671	1400594		24646	1425240	16431	4986
2523506	1436314	110552	9222	1445536	1077969	1184364
450216	397892		5232	403124	47092	52324
7136375	6830316	0	122424	6952740	183635	306059
3915939077	2589269828	13210136	175839614	2765109443	1150829634	1210151684
3799421513	1911575969	10936843	677693859	2589269828	1210151684	986664702
26598791	0	0	0	0	26598791	0
3942537868	2589269828	13210136	175839614	2765109443	1177428425	1210151684

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		2017-2018	2016-2017
1. In Government Securities		56010278	56010278
2. Other approved Securities		5685391	5685391
3. Shares		0	0
4. Debentures and Bonds		0	0
5. Subsidiaries and Joint Ventures		0	0
6. Others (to be specified)			
	Pension & staff funds	110141620	128385834
	Project funds	591177821	573306040
	TOTAL	763015110	763387543
SCHEDULE 10-INVESTMENTS-OTHERS		2017-2018	2016-2017
1. In Government Securities		--	--
2. Other approved Securities		--	--
3. Shares		--	--
4. Debentures and Bonds		--	--
5. Subsidiaries and Joint Ventures		--	--
6. Others (to be specified) Sinking Fund Investments		150000000	150000000
	Technology Fund	79938803	71557820
6. Others (to be specified)		--	--
	TOTAL	229938803	221557820
SCHEDULE 11-CURRENT ASSETS, LOANS, ADVANCES ETC		2017-2018	2016-2017
A. CURRENT ASSETS			
1. Inventories:			
	a) Stores and Spares	0	0
	b) Instruments & Loose Tools	0	0
	c) Stock-in trade		
	Store items	75696488	81067247
	Stamps	5185	104103
	Medicine	20143301	20022734
2. Sundry Debtors:			
	a) Debts Outstanding for a period exceeding six months	30810182	31403530
	b) Others	380674423	134011955
	2.1 Income tax deducted at source	18267526	9936975
	3. Cash balances in hand(including cheques/ drafts and imprest)	2409722	1156161
4. Bank Balances:			



	a) With Scheduled Banks:		
	-On Current Account	1	1
	-On Deposit Accounts(L.C. margin & Commitment deposit)	1314267337	314339793
	-On Savings Accounts	176597483	440769296
	b) With non-Scheduled Banks:		
	-On Current Account	0	0
	-On Deposit Accounts	0	0
	-On Savings Accounts	0	0
	5. Post-Office-Savings Accounts	0	0
	TOTAL(A)	2018871648	1032811794
	B.LOANS, ADVANCES AND OTHER ASSETS		
	1. Loans:		
	a) Staff	6941628	7930433
	b) Other Entities engaged in activities/ objectives similar to that of the Entity	0	0
	c) Other(specify)	0	0
	2. Advances and other amounts recoverable in cash or in kind or for value to be received:	0	0
	a) On Capital Account	328123883	97769779
	b) Prepayments		
	c) Others	19462791	223473315
	3. Income Accrued:	0	0
	a) On Investments from Earmarked/ endowment Funds	28813856	17894350
	b) On Investments-Others	0	0
	c) On Loans and Advances	0	0
	d) Others (Royalty)	2597830	1509574
	(includes income due unrealised)	0	0
	4. Claims Receivable	0	0
	From Govt of India on Plan Funds	212614247	0
	TOTAL(B)	598554234	348577450
	TOTAL(A+B)	2617425882	1381389244
	Savings bank account includes Rs.15/- (GL code No.2410-Synd Bank vikas certificate)		
	SCHEDULE 12- INCOME FROM SALES/SERVICES	2017-2018	2016-2017
	1. Income from Sales		
	a) Sale of Finished Goods	0	0
	b) Sale of Raw Material	0	0
	c) Sale of Scraps	0	0
	2. Income from Services		



	a) Labour and processing charges	0	0
	b) Professional/Consultancy Services	0	0
	c) Agency Commission and Brokerage	0	0
	d) Maintenance Services	0	0
	e) Others (Specify)	0	0
	From Hospital Services-Gross Income	1131128019	1072210809
		0	0
	From Projects	4997569	7643567
	Testing & Facility charges received	3698995	4103107
	TOTAL	1139824582	1083957483
SCHEDULE 13- GRANTS/SUBSIDIES		2017-2018	2016-2017
	(Irrevocable Grants & Subsidies Received)		
	1. Central Government - Plan	1056136000	1119243000
	- Non Plan	0	4400000
	2. State Government(s)	0	0
	3. Government Agencies	0	0
	4. Institution/Welfare Bodies	0	0
	5. International Organisations	0	0
	6. Others(Specify)	0	0
	TOTAL	1056136000	1123643000
SCHEDULE 14-FEES/SUBSCRIPTIONS		2017-2018	2016-2017
	1. Entrance Fees	609900	351590
	2. Annual Fees/ Subscriptions	10624375	8972570
	3. Seminar/Program Fees	0	0
	4. Consultancy Fees	0	0
	5. Examination Fees and others	1932000	1020774
	TOTAL	13166275	10344934
SCHEDULE 15- INCOME FROM INVESTMENTS		2017-2018	2016-2017
	(Income on Invest.from Earmarked/Endowment Funds transferred to Funds)		
	1) Interest		
	a) On Govt. Securities	0	0
	b) Other Bonds/Debentures	0	0
	2) Dividends:		
	a) On Shares	0	0
	b) On Mutual Fund Securities	0	0
	3) Rents	0	0



4) Others(Special Reserve Funds)	20145398	8888462
i. Interest on Sinking Fund		
ii. Withdrawal from Sinking Fund	0	250000000
iii Interest on Technology Fund	2119201	3637056
TOTAL	22264599	262525518
SCHEDULE 16- INCOME FROM ROYALTY,PUBLICATION ETC	2017-2018	2016-2017
1) Income from Royalty	4119692	2628988
2) Income from Publications	0	0
3) Others(Specify)	0	0
TOTAL	4119692	2628988
SCHEDULE 17- INTEREST EARNED	2017-2018	2016-2017
1) On Term Deposit		
a) With Scheduled Banks	41203928	34642537
b) With non-scheduled banks	0	0
c) With Institutions	0	0
d) Others	0	0
2) On Savings Account	0	0
a) With Scheduled Banks	11530374	6012849
b) With non-scheduled banks	0	0
c) Post Office Savings Account	0	0
d) Others(accrued)	15490831	13323025
3) On Loans	0	0
a) Employees/Staff	1908989	1250301
b) Others	0	0
4) Interest on Debtors and other Receivables		
TOTAL	70134122	55228711
SCHEDULE 18- OTHER INCOME	2017-2018	2016-2017
1. Profit on Sale/disposal of Assets:		
a) Owned assets	0	0
b) Assets acquired out of grants, or received free of cost	0	0
c) WIP written back from Repairs and Maintenance	0	0
2. Rent	1625576	1649260
3. Fees for Miscellaneous Services	0	0
4. Miscellaneous Income Rent	370000	291500
Other Income (including grant receivable from DST for 7th CPC	225909340	5050495
Prior period income	0	3600000
TOTAL	227904916	10591255



SCHEDULE 20-ESTABLISHMENT EXPENSES		2017-2018	2016-2017
a) Salaries and Wages			
1. from PLAN Grant		720499000	674360000
2. from PLAN (SC)		23679000	53065000
3. from Internal generation		298649957	119461427
b) Allowances and Bonus		8643984	11626279
c) Contribution to Provident Fund		0	0
d) Contribution to other fund(specify)		0	0
e) Staff Welfare Expenses		19349705	20612256
f) Expenses on Employee's Retirement and Terminal Benefits		269009891	275984547
g) Others(Specify) PG Training & Accademic payments		205588944	166332032
TOTAL		1545420481	1321441541
SCHEDULES 21- ADMINISTRATIVE EXPENSES		2017-2018	2016-2017
a) Purchases			
1. from PLAN Grant		250926000	371818000
2. from Internal Generation		340680818	241988951
b) Concession to Poor patients/Labour and processing expenses		63198023	89203829
c) Cartage and Carriage Inwards		215468	136084
d) Electricity and power		0	0
1. from NON-PLAN Grant		0	4400000
2. from Internal Generation		52579128	48529779
e) Water charges		3368031	5669840
f) Insurance		244370	164539
g) Repairs and maintenance		62124599	59446099
h) Excise duty		0	0
i) Rent,Rates and Taxes		390143	581262
j) Vehicles Running and Maintenance		899482	851277
k) Postage,Telephone and Communication Charges		2452794	3375826
l) Printing and Stationary		80189	49900
m) Travelling and Conveyence Expenses		3699388	4163460
n) Expenses on Seminar/Workshop		1224982	751494
o) Subscription Expenses		85580	148768
p) Expenses on Fees		0	0
q) Auditors Renumeration		564012	301386
r) Hospitality Expenses		0	0
s) Professional Charges		0	0
t) Provision for Bad and Doubtful Debts/Advances		0	0



	u) Irrecoverable Balances Written-off	0	0
	v) Packing Charges	0	0
	w) Freight and Forwarding Expenses	0	0
	x) Prior period expenses	9113506	270982456
	y) Distribution Expenses	0	0
	z) Advertisement and Publicity	3968101	2624240
	z1) Others(specify)	88736245	42269008
	TOTAL	884550859	1147456199
SCHEDULE 23-INTEREST		2017-2018	2016-2017
	a) On Fixed Loans		
	b) Bank Charges	120872	91172
	c) Others(specify)	0	0
	TOTAL	120872	91172

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE TO RECEIPTS & PAYMENTS ACCOUNT FOR THE PERIOD FROM 01-04-2017 TO 31-03-2018

RECEIPTS		2017-18	2016-17	Payments		2017-18	2016-17
		Rs.	Rs.			Rs.	Rs.
I	Opening Balances			I	Expenses		
a)	Cash In Hand	1156161.00	1435619.28				
b)	Bank Balances			a)	Establishment expenses	1699996718.93	1676478837.90
	l) In Current Account	1.15	1.15	b)	Administrative Expenses		
	ii) In deposit Account				For Purchases	24374224.00	24194990.00
	iii) Savings Account *	444797743.62	636457679.22		Other expenses	125814314.00	77177770.00
				II	Payments made against funds for various		
II	Grant Received				Projects		
	From Government of India				As Per schedule	103312384.50	444272554.66
	Under Plan - Capital scheme	994146000.00	485692000.00				
	Under Plan Salary/ General scheme	1056136000.00	1119243000.00	III	Investments & Deposits made		
	Under Plan scheme -NCMMR	0.00	0.00				
	Non-Plan scheme	0.00	4400000.00	a)	Out of Earmarked funds	84101460.88	149735715.00
				b)	Out of own funds		
III	Receipts against Earmarked Funds						
				IV	Expenditure on Fixed Assets & Capital work		
	a) Earmarked funds	26966393.00	250797596.75		-in- progress		



	b)Own funds					
				a) Purchase of Fixed Assets	24073916.00	84917462.00
IV	Interest Received			b)Capital work-in-progress		
	a) On Bank deposits	35603837.01	44649064.68	V Refund of Loans		
	b) Loans Advances etc	335100.00	16.00			
	c) On NCMMR funds	141427.00	144544.00			
V	Receipts from services			VI Finance Charges(Bank charges)	107490.15	61924.05
	Receipts from Patient services	864819786.50	979899145.88			
	Other receipts including Royalty	23045766.18	22888284.47	VII Other Payments		
				To Funds/ Deposit- refunds	1843884253.50	1228867514.75
VI	Other receipts			VIII Closing Balance		
	Grant received for Projects	170612000.62	269544918.57	a) Cash in hand	2409722.00	1156161
	Refund of Deposits(LC Margin)			b) Bank Balances		
	Other receipts	471055626.97	316508804.13	l) In current Account	1.15	1.15
				4		
				iii) Savings Account *	180741357.94	444797743.62
	Total	4088815843.05	4131660674.13	Total	4088815843.05	4131660674.13

*Closing balance of Bank include grant amount received from DST for setting up of NCMMR, Thiruvananthapuram

Sd/-
Chief Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

Provident Fund Account for the Year ended 31-03-2018

Particulars	2017-18	2016-17
	[Rupees]	[Rupees]
LIABILITIES		
MEMBERS BALANCE	159647539	216470304
MEMBERS CREDITS [for march]	3581026	3532121
BALANCE DUE TO MEMBERS NOT IN SERVICE		
Under EPF scheme	7696198	7696198
,, GPF ,,	532055	532055
PENSION FUND DUES	0	0
RESERVES&SURPLUS-INTEREST	165530310	154637651
TOTAL	336987128	382868329
ASSETS		
INVESTMENT AT COST	312183096	345078659
DUES TO PF ACCOUNT		
FROM INSTITUTE	3581026	3532121
FROM PF COMMISSIONER	0	8403467
INTEREST ACCRUED NOT DUE	10173585	13696323
BALANCE WITH BANKS		
SBT -GPF A/C	11049421	12157759
TOTAL	336987128	382868329

Sd/-
Chief Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES &
TECHNOLOGY, THIRUVANANTHAPURAM**

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH

Receipts & Payments Account for the period 01.04.2017 -31.03.2018

	2017-18	2016-17		2017-18	2016-17
Receipts	Rs.	Rs.	Payments	Rs.	Rs.
Opening Balance - Bank	4028448	3883904	Audit Fees	17250	0
Grant in aid	0	0	Bank Charges	6	0
Interest earned	158683	144544	Closing Balance - Bank	4169875	4028448
	4187131	4028448		4187131	4028448

**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH

Income & Expenditure Account for the period 01.04.2017 -31.03.2018

	2017-18	2016-17		2017-18	2016-17
Expenses	Rs.	Rs.	Income	Rs.	Rs.
Audit Fees	17250		Interest	158683	144544
Bank charges	6	0			
Excess of Income over expenditure	141427	144544	Excess of Expenditure over income	0	
	158683	144544		158683	144544

**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH -
BALANCE SHEET AS ON 31-03-2018

Particulars	2017-18	2016-17
	[Rs]	[Rs]
LIABILITIES		
CAPITAL FUND		
Opening Balance	4028448	3883904
Add: Grant received	0	
Add/Less (-): Excess of Income over Expenditure	141427	144544
TOTAL	4169875	4028448
ASSETS		
BANK BALANCE	4169875	4028448
(Union Bank of India Account No.541502010002675)		
TOTAL	4169875	4028448

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF ACCOUNTS AS AT 31-03-2018

SCHEDULE 24- SIGNIFICANT ACCOUNTING POLICIES

1. ACCOUNTING CONVENTION

Financial Statements are prepared on the basis of historical cost convention and on accrual method of accounting except in the accounts not directly connected with the functioning of the Institute including Staff Benevolent Fund, Pension, etc.

2. INVENTORY VALUATION

Stores and spares including machinery spares are valued at cost.

3. INVESTMENTS

Investments including long term investments are carried at cost.

4. FIXED ASSETS

Fixed assets are stated at cost of acquisition inclusive of inward freight, duties and taxes incidental and direct expenses related to acquisition. Non monetary assets acquired free of cost are recorded at a nominal value ie. Re.1 (Rupee One).

5. DEPRECIATION

Depreciation is provided on reducing balance method at the rates specified by the Income Tax Act 1961. In respect of additions to fixed assets during the year depreciation is provided for full year. In case of condemnation of an asset, depreciation for the current year has not been provided and the accumulated depreciation for the previous years has been duly adjusted from the depreciation of the current year.

6. GOVERNMENT GRANTS/SUBSIDIES

Government Grant from Plan fund-Capital is treated as additions to Capital fund of Institute. Grants in respect of specific fixed assets acquired are shown as deduction from the cost of the related asset. Government Grants/subsidies are accounted on Grant release order basis, except grant in aid receivable for meeting arrears on account of 7th CPC.

7. FOREIGN CURRENCY TRANSACTIONS

Transactions denominated in foreign currency are accounted at exchange rate prevailing at the date of transactions.

8. RETIREMENT BENEFITS

Gratuity: From the year 2006, (with the implementation 6th Pay Commission report), the gratuity payments are treated as Institute expenses and accounted on actual payment basis.

Leave Salary: Leave encashment eligible at the time of retirement/reliving is treated as Institute expenses and accounted on actual payment basis.

Pension: From the year 2006, (with the implementation 6th Pay Commission report) 12% of the salary is transferred to the Pension Fund.

New Pension Scheme: In the case of employees who joined on or after 01.01.2004, 10% of the salary is deducted as employees subscription and equal contribution is being made by the Institute. The funds are remitted to NPS Trust Account maintained by GOI and subscription details forwarded to NSDL/CRA every month.

9. PROVIDENT FUND

Assets and Liabilities of General Provident Fund account were separated from Balance sheet of Institute and shown as separate statement. Interest is provided on the accumulations as per the rates prescribed by Central Government from time to time.

10. EMERGENCY RESERVE FUND

An amount equal to 7.50 percent of receipts from patient is to be transferred to a Fund for meeting unexpected requirements for Fixed assets subject to a maximum of Rs.50 Crore. It was decided to reduce the limit of ERF to Rs.15 crore and to utilize the remaining funds and the guideline of recouping these funds do not apply till further decision.

11. TECHNOLOGY DEVELOPMENT FUND

Receipts against technology developed by the Institute are transferred to the above fund and interest earned is utilized for meeting additional expenses on Improvement of technologies already developed.

12. OVER HEAD SCHEME

Overhead Funds scheme for Innovative Projects has been introduced from the year 2012-13. An amount of upto Rs.10 lakhs can be transferred to this account every year and utilised for innovative projects.

Sd/-

Chief Financial Adviser

Sd/-

Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 25-CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES

	Rs. In lakhs	
	2017-18	2016-17
Claims against the Institute not acknowledged as debts	NIL	NIL
Bank Guarantee given by Institute	45.04	41.66
Letters of credit opened on behalf of Institute	550.82	10.94
In respect of claims from parties for non- execution of orders	NIL	NIL

Service Tax :

“ The office of the Commissioner of Central Excise and Customs vide order no: C.No.IV/16/152/2014 ST ADJ. Dated 08.06.2015 confirm demand of Service tax Rs.4.72 Lakhs under section 73(2) of the Finance Act 1994, being service tax short paid under the category “Technical Inspection and certification service” during the period 1.4.2009-31.03.2012 . Further impose a penalty of Rs 2.36 lakhs towards penalty under section 78 and Rs.0.05 lakhs for contravention of section 70 of the Act. In order to file appeal against the order, the institute paid Rs.0.35 lakhs towards deposit (i e 7.5% of demand confirmed).”

Name of the Statute	Nature of Dues	Amount in Rs. in lakhs	Period to which the amount relates	Forum where dispute is pending.
Service Tax	Service tax and penalty	7.13	01/04/2009 to 31/03/2012	Commissioner Appeals, Central Excise

2. UNEXPIRED CAPITAL COMMITMENTS

Rs. in lakh

	2017-18	2016-17
Estimated value of orders remaining to be executed on Capital Account	73.37	326.13
Construction of new Hospital block	15493.91	21000.00

Ministry of Health and Family Welfare approved the construction of a new Hospital Block in the Institute at a cost of Rs.23000 lakh. The project will be funded by Ministry of Health and Family Welfare (Rs.12000 lakh) and Department of Science & Technology (Rs.11000 lakh). Out of this, Institute received Rs.6500 lakh from DST and Rs.1006.09 lakh from Ministry of Health & Family Welfare.

Lease obligation for rentals for Plant & Machinery	NIL	NIL
----------------------------------------------------	-----	-----

3. CURRENT ASSETS, LOANS & ADVANCES

The aggregate amount shown in the Balance sheet for the Current assets, Loans and Advances, have the value, which is realisable in the ordinary course of business.

4. PROVISIONS

Provision for Income tax not made since there is no taxable income for Institute under Income tax Act 1961, during the year.

5. FOREIGN CURRENCY TRANSACTIONS:

Rs. in lakh

	2017-18	2016-17
5.1 Value of Imports	2112.89	1141.02
Capital Goods Stores Spare & Consumables	132.13	29.50
5.2 Expenditure in foreign currency Travel Expenses	NIL	NIL
5.3 Earnings: Value of Exports	NIL	NIL

- Current year Income, net of expenditure, under Institute Ethics Committee has been treated as income of the Institute amounting to Rs.30.62 lakh (previous year Rs.53.20 lakh).
- Claim for Audit fees by C&AG amounting to Rs.2.33 lakh has been paid during the year. Provision for Audit fees has been made for current year amounting to Rs.4.00 lakh.
- As suggested by C&AG Auditors, Plan and Non Plan expenditure on account of Salary and General Expenses has been separately disclosed in the accounts.



9. Accrued Interest on Investment amounting Rs.278.98 lakh (previous year Rs. 178.94 lakh) has been provided in the current year accounts.
10. In order to release the pension dues as per the CCS pension rules, an additional amount of Rs.1451.11 lakh has been expended over and above the sanctioned 12% Institute contribution (amounting to Rs.343.89 lakh) to the Pension Fund.
11. Institute has done the actuarial valuation to ascertain the liability on account of Gratuity, Pension and Leave Encashment in respect of serving employees through an Actuary. As per their valuation report the liability is as follows :

Present value of the past service gratuity	Rs. 5182.16 lakh
Present value of the pensionary liability for serving employees	Rs. 9768.62 lakh
Present value of the pensionary liability for Existing pensioners	Rs.16016.23 lakh
Present value of the past service leave encashment	Rs. 7049.91 lakh

- 12.(a) Value of assets acquired from externally funded projects during the last three years has been identified as detailed below:-

FY 2014-15	Rs. 15.36 lakh
FY 2015-16	Rs.117.22 lakh
FY 2016-17	Rs. 718.52lakh
FY 2017-18	Rs. 850.68lakh

Since the cost of acquisition of these assets is nil, no depreciation has been charged on these assets.

- (b) Value of non monetary assets acquired by the Institute is shown at nominal value of Re.1.

13. Technology Development Fund

An amount of Rs.66.90 lakh (previous year Rs.26.76 lakh) was transferred to Technology Development Fund. During the year Rs.15.59 lakhs has been spent from Technology Development Fund.

14. Overhead Fund Scheme

During the year an amount of Rs. NIL (previous year Rs.NIL) has been twed to the Fund from the Overhead Charges collected from External Projects.

15. Funding of In house Projects to set off negative balance.

Administrative expenses include an amount of Rs.48.37 lakh (Previous year Rs.87.03 lakh) transferred to nullify the negative balances in the In house projects accounts.

- 16.Implementation of 7th CPC to the employees of the Institute

7th CPC was implemented to Non academic staff and pensioners of the Institute with effect from 01.01.2016 vide letter No.AI/1/31/SCTIMST/2017 dated 30.08.2017 and No.AI/1/31/SCTIMST/2017 dated 10.11.2017 respectively. DST agreed to bear 100% financial impact arising out of the disbursal of the arrears of the 7th CPC. Total financial commitment on this account comes to Rs.2126.12 lakh for the period January 2016 to July 2017/November 2017 and has been fully provided for in the accounts during the year 2017-18 under Establishment Expenses (Schedule 20). Based on the assurance given by DST vide letter dated 30.08.2017 & 10.11.2017 grant amount, equivalent to the 7th CPC arrear, has been shown as other income as required in Accounting Standard (AS) 12- Accounting for Government Grants.

17. Corpus fund for M Tech Clinical Engineering Program

As decided by the GB, an amount of Rs.16 lakh each is due to partner Institutes viz., CMC Vellore and IIT Madras for the year 2013-14 & 2014-15.

- 18.National Centre for Molecular Materials Research, Thiruvananthapuram

Receipts and Payments Account, Income and Expenditure Account and Balance Sheet in respect of NCMMR has been prepared separately and annexed to the accounts.

- 19.Corresponding figures for previous years have been regrouped, wherever necessary.

Schedules 1 to 25 annexed, form an integral part of the Balance Sheet as at 31-03-2018, and Income & Expenditure Account for the year ended on that date.

Sd/-
Chief Financial Adviser

Sd/-
Director



Separate Audit Report of the Comptroller & Auditor General of India on the Accounts of the Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram for the year ended 31 March 2018

1. We have audited the Balance Sheet of the Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram as at 31 March 2018, the Income & Expenditure Account and the Receipts & Payment Account for the year ended on that date under Section 19(2) of the Comptroller & Auditor General's (Duties, Powers & Conditions of Service) Act, 1971 read with section 18(2) of the SCTIMST Act, 1980. These financial statements include the accounts of Bio-Medical Technology (BMT) wing of the SCTIMST. These financial statements are the responsibility of the SCTIMST's management. Our responsibility is to express an opinion on these financial statements based on our audit.
2. This Separate Audit Report contains the comments of this office on the accounting treatment only with regard to classification, conformity with the best accounting practices, accounting standards and disclosure norms, etc. Audit observations on financial transactions with regard to compliance with the Law, Rules & Regulations (Propriety and Regularity) and efficiency-cum-performance aspects etc., if any, are reported through Inspection Reports/ CAG's Audit Reports separately.
3. We have conducted our audit in accordance with auditing standards generally accepted in India. These standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatements. An audit includes examining, on a test basis, evidences supporting the amounts and disclosure in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of financial statements. We believe that our audit provides a reasonable basis for our opinion.
4. Based on our audit, we report that:
 - i. 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.
 - ii. The Balance Sheet, Income & Expenditure Account and Receipt & Payment Account dealt with by this report have been drawn up in the format approved by the Government of India, Ministry of Finance.
 - iii. In our opinion, proper books of accounts and other relevant records have been maintained by the SCTIMST as required under Section 18 (1) of SCTIMST Act, 1980 in so far as it appears from our examination of such books subject to observations made hereunder.
 - iv. Based on our audit, we further report that:



(A) Balance Sheet

A.1 Current liabilities and provisions Schedule -7 Rs.52.88 crore

Actuarial valuation of retirement benefits was done for the year 2017-18. As per the actuarial valuation (paragraph 11 of Schedule 25) liability of SCTIMST as at 31 March 2018 towards gratuity, pension and accumulated leave encashment was Rs.51.82 crore, Rs.257.85 crore and Rs.70.50 crore respectively.

Against this Institute has created Pension Fund amounting to Rs.16.42 crore only as on 31 March 2018 when the liability on account of gratuity pension and leave encashment was Rs.380.17 crore. This has resulted into understatement of Schedule - 7 Current Liabilities and Provisions by Rs.363.75 crore (Rs.380.17 crore - Rs.16.42 crore) and understatement of expenses account (Schedule 20 - Establishment Expenses Account).

A. 2 The Institute received the Rs.810.32 lakh general purpose (other than salary) revenue grant from DST towards Scheduled Tribe purpose.

Out of this grant Rs.810.32 lakh, and amount of Rs.2.20 lakh was expensed by SCTIMST for the purpose of Mobile Telemedicine project at Wayanad (Code 5345) for the welfare of scheduled tribes during the year 2017-18. Out of the balance of Rs.810.32 lakh Governing Bodies decided to transfer Rs.564.42 lakh to the project at Wayanad (code no.5345) under 'Schedule - 3: Earmarked/ Endowment fund'. The remaining un-spent balances of Rs.245.90 lakh was held under 'Schedule -1: Capital Fund' of the Balance sheet. Thus, the total unspent balances under the general purpose revenue grant (other than salary) was Rs.808.12 lakh.

It resulted the overstatement of Capital fund by Rs.245.90 lakh and overstated of Earmarked fund by Rs.562.22 lakh and understatement of Schedule - 7 Current Liabilities and Provisions by Rs. 808.12 lakh.

A.3 Accounting of Inventories

The physical verification report of the Hospital wing for the year 2017-18 had reported that inventories available in the books of accounts of the Institute such as accessories, spares, deposit items are not physically available in the store. Similarly BMT wing had also reported missing items due to programmatic error. These discrepancies need to be reconciled/investigated.

(B) General

B.1 Grant in aid

The grants-in-aid received by SCTIMST during the year 2017-18 was Rs.205.03¹ crore



The details of the grants received are as under

- Grants-in-aid towards Salary received from DST was Rs.7441.78 lakh.
- Grants-in-aid towards General purpose (revenue other than salary) received from DST was Rs.3119.58 lakh.
- Grants-in-aid for creation of Capital Asset received from DST was Rs.9941.46 lakh (including Rs.4500 lakh for the construction of New Hospital Block).

Out of these grants of Rs.205.03 crore received, Rs.123.97 crore was utilized and balance of Rs.81.06 crore was un-utilized as on 31 March 2018.

B.2 Understatement of Fixed Asset Account (Schedule - 8) of Rs.117.74 crore by Rs.17.02.crore.

As per Rule 233(iii) of GFR 2017, on completion of the projects or schemes, if the assets are allowed to be retained by the sponsoring Institute/ organization, the implementing agency (SCTIMST) should include the assets at book value in their own accounts. SCTIMST disclosed assets procured out of external aided projects amounting to Rs.17.02 crore under Para No.12 of Schedule No.25 in the Notes to Accounts. However, Institute did not obtain the consent of the sponsoring agencies to include the value of these assets at book value in their accounts. The depreciated value also is required to be ascertained before such inclusion. Thus, Fixed Asset Account was understated by Rs.17.02 crore.

(C) Management letter

Deficiencies which have not been included in the Separate Audit Report have been brought to the notice of Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram through a **Management letter** issued separately for remedial/corrective action.

- i) Subject to our observations in the preceding paragraphs, we report that the Balance Sheet, Income & Expenditure Account and Receipts & Payment Account dealt with by this report are in agreement with the books of accounts.
- ii) In our opinion and to the best of our information and according to the explanations given to us, the said financial statements read together with the Accounting Policies and Notes on Accounts, subject to the significant matters stated above and other matters mentioned in Annexure to this Audit Report give a true and fair view in conformity with accounting principles generally accepted in India.

¹Excludes Grants-in-aid for creation of Capital Assets towards Construction of New Hospital Block amounting to Rs. 1006.09 lakh was transferred by Ministry of Health and Family Welfare to CPWD directly.



- a. In so far as it relates to the Balance Sheet of the state of affairs of the Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram as at 31st March 2018; and
- b. In so far as it relates to Income & Expenditure Account of the deficit for the year ended on that date.

Sd/-

Director General of Audit



**REPLY OF THE INSTITUTE TO SEPARATE AUDIT REPROT ISSUED BY C &
AG AUDIT ON THE ACCOUNTS FOR THE YEAR 2017-18**

Audit Para No. & date	Audit Para	Reply of the Institute
<p>A. Balance Sheet</p>	<p>A.1 Current liabilities and provisions Schedule -7 Rs.52.88 crore</p> <p>Actuarial valuation of retirement benefits was done for the year 2017-18. As per the actuarial valuation (paragraph 11 of Schedule 25) liability of SCTIMST as at 31 March 2018 towards gratuity, pension and accumulated leave encashment was Rs.51.82 crore, Rs.257.85 crore and Rs.70.50 crore respectively.</p> <p>Against this Institute has created Pension Fund amounting to Rs.16.42 crore only as on 31 March 2018 when the liability on account of gratuity pension and leave encashment was Rs.380.17 crore. This has resulted into understatement of Schedule - 7 Current Liabilities and Provisions by Rs.363.75 crore (Rs.380.17 crore - Rs.16.42 crore) and understatement of expenses account (Schedule 20 - Establishment Expenses Account).</p>	<p>The liability in respect of Gratuity, Pension and Leave Encashment is disclosed in para 11 of Schedule No. 25- Notes on accounts. Governing Body of the Institute in its meeting held on 30.07.2016 and 08.07.2017 discussed the need for creation of a separate fund for Gratuity, Pension and Leave Encashment and transfer required contribution to those funds so as to comply with the requirements of Accounting Standards 15. However, considering the financial position of the Institute, GB decided to continue the existing practice of settling the payments on cash basis and creation of funds to be considered once the financial position improves. GB also approved that, every year the liability may be reassessed and proper disclosure made in the financial statements. Actuarial valuation was done as on 31.03.2018 to ascertain the current liability on account of Gratuity, Pension and Leave Encashment. The Institute had complied with the decision of Governing Body and liability disclosed in the notes to accounts.</p>



A.2 The Institute received the Rs.810.32 lakh general purpose (other than salary) revenue grant from DST towards Scheduled Tribe purpose.

Out of this grant Rs.810.32 lakh, and amount of Rs.2.20 lakh was expensed by SCTIMST for the purpose of Mobile Telemedicine project at Wayanad (Code 5345) for the welfare of scheduled tribes during the year 2017-18. Out of the balance of Rs.810.32 lakh Governing Bodies decided to transfer Rs.564.42 lakh to the project at Wayanad (code no.5345) under 'Schedule - 3: Earmarked/Endowment fund'. The remaining un-spent balances of Rs.245.90 lakh was held under 'Schedule -1: Capital Fund' of the Balance sheet. Thus, the total unspent balances under the general purpose revenue grant (other than salary) was Rs.808.12 lakh.

It resulted the overstatement of Capital fund by Rs.245.90 lakh and overstated of Earmarked fund by Rs.562.22 lakh and understatement of Schedule - 7 Current Liabilities and Provisions by Rs. 808.12 lakh.

DST released a total of Rs.810.32 lakh under the head "ST-General Component" during the years 2016-17 & 2017-18. Since the amount could be used only of specific purpose, a proposal was placed before Governing Body for the implementation of "Mobile Telemedicine Project for Wayanad", as a project of Achutha Menon Centre for Health Science Studies (AMCHSS) to provide specialists services in the Wayanad district of State of Kerala, based on the established theory of Social Shaping of Technology (SST) concepts. Governing Body of the Institute approved the project at a cost of Rs.564.42 lakh vide P & A order No.30 dated 22.03.2018 and the amount was transferred to a project account (General Ledger code No.5345) which is shown as liability under Schedule 3 with corresponding entry in Administrative expenses (Schedule 21). The balance available amounting to Rs.2.46 crore (Rs.1.27 crore & Rs.1.19 crore) was received in the Institute only at the fag end of the financial year ie.Feb/ March 2018. This amount has been shown as income and finally transferred to Capital fund. Institute is committed to utilize this amount only for the purpose for which it is sanctioned and necessary entries will be made in the books of accounts after identifying the proposals in the year 2018-19.



	<p>A.3 Accounting of inventories</p> <p>The physical verification report of the Hospital wing for the year 2017-18 had reported that inventories available in the books of accounts of the Institute such as accessories, spares, deposit items are not physically available in the store. Similarly BMT wing had also reported missing items due to programmatic error. These discrepancies need to be reconciled/investigated.</p>	<p>The audit observation is noted for future guidance. Stores division of Hospital wing and BMT wing has been directed to look in to the discrepancies noticed in physical verification of inventories and to submit report in a time bound manner so that necessary proposal can be placed before Finance Committee and Governing Body of the Institute to write off the balances after following due diligence process. The process is planned to be completed by March 2019.</p>
<p>B. General</p>	<p>B.1 Grant in aid</p> <p>The grants-in-aid received by SCTIMST during the year 2017-18 was Rs.205.03 crore. The details of the grants received are as under.</p> <ul style="list-style-type: none"> • Grants-in-aid towards Salary received from DST was Rs.7441.78 lakh. • Grants-in-aid towards General purpose (revenue other than salary) received from DST was Rs.3119.58 lakh. • Grants-in-aid for creation of Capital Asset received from DST was Rs.9941.46 lakh (including Rs.4500 lakh for the construction of New Hospital Block). • Out of these grants of Rs.205.03 crore received, Rs.123.97 crore was utilized and balance of Rs.81.06 crore was un-utilised as on 31 March 2018. 	<p>Institute received an amount of Rs.205.03 core (Revenue grant & Capital grant) as grant in aid from Department of Science and Technology, New Delhi during the year 2017-18. Rs.81.06 crore includes Rs.45 crore for the construction of New Hospital Block, Rs.20 crore for completion of balance construction works of Combinational Devices Block and animal house, Rs.16.06 crore for procurement of equipments. The amount will be released to CPWD when demanded by them who is the executing agency. Regarding procurement of equipments the purchase is in process.</p>



	<p>B.2 Understatement of Fixed Asset Account (Schedule - 8) of Rs.117.74 crore by Rs.17.02.crore</p> <p>As per Rule 233(iii) of GFR 2017, on completion of the projects or schemes, if the assets are allowed to be retained by the sponsoring Institute/organization, the implementing agency (SCTIMST) should include the assets at book value in their own accounts. SCTIMST disclosed assets procured out of external aided projects amounting to Rs.17.02 crore under Para No.12 of Schedule No.25 in the Notes to Accounts . However, Institute did not obtain the consent of the sponsoring agencies to include the value of these assets at book value in their accounts. The depreciated value also is required to be ascertained before such inclusion. Thus, Fixed Asset Account was understated by Rs.17.02 crore.</p>	<p>Rule 233 (ii) & (iii) of GFR 2017 on Funding of Sponsored Projects or Schemes states that – (ii) On completion of the Projects or Schemes and the receipt of technical and financial reports, the Ministries/ Departments should decide and communicate to the implementing agencies whether the assets should be returned, sold or retained by them. (iii) If the assets are allowed to be retained by the Institution/Organisation, the implementing agency should include the assets at the book value in their own accounts.</p> <p>Institute disclosed the value of assets acquired out of external projects in the Notes to Accounts (para 12 (a). These assets were acquired mainly out of funds received from GoI (DST -TRC & Meity etc) and the projects are on going.</p> <p>Since the projects funded by external agencies are yet to be completed and final report is yet to be forwarded to funding agencies, value of assets will be included in the accounts of the Institute (Schedule 8) in the coming years after due closure of the projects.</p>
<p>(C)</p>	<p>Management letter</p> <p>Deficiencies which have not been included in the Separate Audit Report have been brought to the notice of Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram through a Management letter issued separately for remedial/corrective action.</p>	<p>The observations mentioned in the Management letter have been noted for future guidance.</p>