

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

TRIVANDRUM - 695 011, KERALA



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Annual Report 2018-19

Sree Chitra Tirunal Institute for Medical Sciences and Technology
Trivandrum

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CONTENTS

History.....	5
Our Mission, Our Vision.....	7
Message from the President	10
2018-19: Looking Back	11
Highlights of the Year.....	15
Hospital Wing	33
Biomedical Technology Wing	92
Achutha Menon Centre for Health Science Studies	155
Division of Academic Affairs	162
Publications	168
Research Projects	184
Statutory Committees	201
Statement of Accounts	213



..... 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

I am deeply honoured to be associated with Sree Chitra and its forward trajectory, which is admirably in sync with a unique mandate of indisputable relevance to health care in contemporary India. As I transit from Missile Technology to Biomedical Technology and Human Health, my mind turns instinctively to those exquisite lines in Tennyson's Ulysses: "I am a part of all that I have met/ Yet all experience is an arch wherethrough/ Gleams that untraveled world whose margin fades/ Forever and forever when I move/ How dull it is to pause, to make an end/ To rust unburnished, not to shine in use!"

As President of an institution that has relentlessly pursued its uncommon commitment to biomedical engineering and device development, it shall be my endeavour, over the coming years, not to "rust unburnished" but "to shine in use!"

When, I peep into the history of the Institute, I am inclined to believe that successive generations have transformed Sree Chitra from an arduous dream into an adorable reality that holds out hope for the future of R & D relevant to health care. Apart from manifold, and often path-breaking, contributions over the years to the important domains of patient care and public health, the Institute is credited with the indigenous development of several biomedical technologies that have been transferred to industry and commercialized. Gratifyingly, the mandated engagement with medical device development continues with renewed dynamism here. The Technical Research Centre for Biomedical Devices, supported by the Department of Science and Technology, and the Technology Business Incubator reflect the Institute's firm resolve to deliver on its pristine promises. The Institute has already sown the seeds of ambitious projects, including Perspective Plan 2030 and Medspark, which are bound to sprout in the not-too-distant future. All of these augur well for biomedical technology and health care in the country.

The past year witnessed the launch of four major activities by Dr Harsh Vardhan, Hon'ble Union Minister for Science and Technology, Environment, Forest and Climate Change, and Earth Sciences. With substantial support from the Government of India, through the Pradhan Mantri Swasthya Suraksha Yojana and the Department of Science and Technology, a long-cherished desire, or dream as it were, of Sree Chitra and the people of the region is going to be fulfilled in the form of the Swasthya Suraksha Block. The impact of this invaluable addition on high quality super-specialty care and post-graduate training in cardiac and neurosciences assiduously provided by the Institute is hard to over-state. Further, the Combination Devices Block is expected to provide fillip to the biomedical device development programme at the Institute. The launch of the Regional Technical Resource Centre for Health Technology

Assessment at the Achutha Menon Centre for Health Science Studies is as much a tacit recognition of the first rate work carried out at the Centre as an unmistakable harbinger of our impending leap in the realm of Public Health. The state-of-the-art Data Centre could not have been set up at a more appropriate time, and the Institute is grateful to the Ministry of Electronics and the Department of Science and Technology, Government of India, for their munificent support in acquiring the facility. In the launch of these four ventures, we witness a commendable continuity of purpose that is built into the very fabric of this institution, a commitment to the core values that were spelt at the moment of its conception.

I am impressed that the technological innovations at the Institute are strikingly in line with the 'Make in India' Mission, even as the training programmes for skill enhancement and digital advancement epitomize the 'Skill India' and 'Digital India' initiatives. I am also impressed that Sree Chitra has tenaciously preserved its distinctly eclectic culture, harnessing the unique skills and strengths of its talented workforce in the service of the nation. It is intensely gratifying to see biomedical scientists joining hands with clinicians to develop novel technologies with substantial public health relevance. The stream of innovations flowed uninterrupted in the past year as well, and the technologies launched included, among others, point-of-care devices for easy diagnosis.

All of this is impressive by any reckoning. However, as we step into the future, it is imperative that we, as an organization committed to human health, continue to take stock of the state of health care in the country and examine the relevance of our institution in this context. With remarkable resilience, we in India have survived a spectrum of trials and tribulations, of gargantuan proportions, unleashed upon us from time to time, but none has been more perpetually challenging, often devastating, than the burden of disease. Despite commendable advances in the realm of clinical medicine, we continue to suffer the ravages of chronic non-communicable diseases and a host of emerging afflictions. The scourge has to be dealt with effectively, head-on. In this regard, we should address the main problems that beset optimal health care delivery in the country, cognizant of the fact that health is increasingly linked to our overall national development agenda. As per the estimates of The Global Health Workforce Alliance and WHO, India is among 57 countries at risk of severe crisis in terms of dearth of human resources for health. The country calls for greater availability of skilled professionals, especially in clinical super-specialties and sub-specialties, which is a sine qua non of health care in these times. Secondly, there is a pressing need for innovation in the domain of biomedical engineering and biomedical device development for health care delivery at an affordable cost. We should remember that about 75% of our needs is met through imports while the domestic industry predominantly manufactures low risk products. Thirdly, our institutions should promote clinical, translational and biomedical research as the indispensable bedrock on which the edifice of clinical medicine shall rest. The situation presents a challenge and an opportunity, in equal measure.

With its remarkable success in blending the different strands of Clinical Medicine, Biomedical Technology and Public Health within a single institutional framework, Sree Chitra is ideally equipped to take on the challenges of the complex health scenario unfolding in this country. As I place on record my deep admiration for all the good work you are doing, I would hasten to add that India expects a great deal from you as an institution because you are the proud inheritors of a great legacy, which places a tall demand on your able shoulders. If you fulfil your sacrosanct responsibility, you shall have made your country proud of you.

My very best wishes to you all!

V K Saraswat



2018-19: Looking back

Prof Asha Kishore, Director, SCTIMST

The best way to find yourself is to lose yourself in the service of others.

- Mahatma Gandhi

As we celebrate the 150th birth anniversary of the Father of the Nation, we rejoice over our achievements and, more importantly, over what they mean to the sick in whose service we seek the meaning of our existence as an institution. It is my pleasure and privilege to report on the accomplishments of the Institute during an extraordinary year when we shepherded our resources prudently and made rapid strides along the diverse dimensions of our distinct mandate.

What strikes me instantly as I pen this report is that all our achievements in the past year were admirably aligned with our broad objectives, which are to promote Biomedical Engineering and Technology, provide and demonstrate high standards of patient care in advanced medical super-specialties, develop post-graduate training programmes of the highest quality in advanced medical specialties and biomedical technology and to participate in public health reforms through research, training and interventions. No single event could have epitomized a convergence of these goals more explicitly than the launch of the Swasthya Suraksha Block under the Pradhan Mantri Swasthya Suraksha Yojana (PMSSY), the Combination (Medical) Devices Block, the Regional Technical Resource Centre for Health Technology Assessment and the Data Centre by Dr Harsh Vardhan, Hon'ble Union Minister for Science and Technology, Environment, Forest and Climate Change, and Earth Sciences, on 23rd June 2018. The Institute and the people of the region are beholden to the Government of India for its unstinted support to these projects.

The Institute's activities blended in harmony with national missions, including Make in India, Skill India, Swachh Bharat and Digital India. The ties with industries were further strengthened at the 3rd Technology Conclave on 24 March 2019 when two promising technologies developed indigenously – the Vein Viewer System by our teams and DRIPO infusion monitor incubated in the Institute – were commercially launched. The event also witnessed the transfer to industries of 6 technologies, namely, the paracorporeal left ventricular assist device, PT/INR monitoring device, tuberculosis screening device, injectable hydrogel, lint-free absorbent wound dressing and albumin-conjugated anti-cancer drug formulation technology. Under the Technical Research Centre for Biomedical Devices, 34 mission mode R & D projects aimed

at developing medical device technologies were underway and 6 technology tie-ups were initiated with various medical device industries. MoUs to facilitate exchange of technical information and 6 industry tie-ups were finalized during the year. The Technology Business Incubator continued to be a platform for generating innovative technologies tapping talent outside the Institute. The activity was supported with funds from the Department of Science and Technology (DST) under the NIDHI Seed Support Scheme. NIDHI PRAYAS Scheme for supporting early stage innovators, to move from idea to prototype stage, was rolled out at TIMed. Training programmes to foster technical skills were conducted, particularly for the weaker sections of the society. The Institute also reaffirmed its commitment to the goal of complete digitalization with the introduction of e-payment kiosks and up-gradation of the information storage facilities.

Collaborations across disciplines and departments of the Institute led to many new faculty initiatives, culminating in the execution of many MoUs with government departments, institutions and industries. Notably, the Institute entered into an MoU with the Indian Council of Medical Research for co-operation and collaboration in planning and conducting clinical trials of various medical devices, biomaterials and in vitro diagnostic devices and kits developed at the Institute. To augment Technology Transfer, an Expression of Interest was invited from the medical device industry and start-ups for different products.

The focus of clinical activities this year continued to be on the treatment of complex heart diseases, interventional cardiology, pediatric congenital cardiac problems, cardiac electrophysiology, comprehensive heart failure care, cardiac and thoracic surgery, brain tumors, movement disorders, epilepsy, developmental brain disorders, neuromuscular disorders, sleep disorders, stroke and pediatric neurology. The Department of Cardiology was identified as one of the 10 National Centres of Advanced Research and Excellence (CARE) in Heart Failure and was provided a funding of Rs 5 Crores over a period of 5 years. Eight research projects were identified under this Initiative, which included a National Heart Failure Biobank, assessment of economic impact and quality of life in heart failure, and developing a point-of-care device for estimating brain natriuretic peptide.

As in the past, Sree Chitra remained a much sought-after destination for several academic programmes, which contributed significantly to human resource development. Admission to various academic programmes of study at the Institute is regulated by policies and procedures approved by the Academic Committee of the Institute from time to time. During the year, 210 candidates were offered admission to various programmes, including affiliated programmes. The total strength of students on the rolls of the Institute, excluding the joint programmes and affiliated programmes, was 290 as of March 2019, and 443, including the affiliated programmes.

We trained 14 PhD students, 95 research/technical personnel other than PhDs (including DM, MCh, PDCC, PDE, Diplomas, Nursing), 150 in affiliated programmes (CMC-Vellore, NIE-Chennai, IIPH-Delhi, IITM-K, Trivandrum) and 22 in MTech/MPhil/MPH Projects. Apart from these structured courses, the Institute also contributed substantially to manpower generation through Workshops/Conferences/Popular Lectures/Awareness Camps/Seminars and Exhibitions.

Affiliated Programmes with other Centres included Master of Public Health in Epidemiology, Master of Science Bio-engineering and PhD in Biomedical Sciences and Public Health. The participating Centres were the National Institute of Epidemiology, Chennai, Christian Medical College, Vellore, IITMK Trivandrum, and the Indian Institute of Public Health, New Delhi. The joint programmes with CMC Vellore and IIT Madras included MTech in Clinical Engineering and PhD.

The involvement of the faculty, including clinicians, in R & D was reflected in 23 research projects that were ongoing during the year, 21 of which were Nationally-funded and 2 Internationally-funded. 233 research articles were published and 21 patent applications besides 3 Design Registrations were filed. It is deeply gratifying that the Faculty of the Institute were co-authors of as many as 10 articles in the prestigious journal, Lancet.

The Institute was witness to several important events. The Annual Convocation of the 34th batch of graduates for the year 2018 was held on 5 May 2018. Shri Natarajan Chandrasekaran, Chairman, TATA Sons & Group was the Chief Guest and Dr M R Rajagopal, Chairman, Pallium India, was the Guest of Honour at the event. The 3rd Technology Conclave took place on 24 March 2019 and was presided over by the Hon'ble President of the Institute, Dr V K Saraswat, in the presence of Dr C Balagopal, Founder and Former Managing Director, Terumo Penpol Ltd. who offered felicitations. The Industry Innovators Meet was held on 24 March 2019 with brainstorming sessions on orthotics and rehabilitation, in vitro diagnostics, regeneration technologies, 3D bioprinting and smart materials. The event, which focused on developing products for use in patients, brought together clinicians, representatives from the medical device industry and scientists from the Biomedical Technology Wing. The Institute organized 20 Workshops and Conferences for the dissemination of knowledge among different sections of society.

It is a matter of pride that the Institute won the National Intellectual Property Award 2019 in the category of "Top Indian R & D Institution/Organization for Patents & Commercialization". The National Intellectual Property Awards are given to outstanding innovators, organizations/companies once a year on the occasion of the World Intellectual Property Day by the World IP Organization, CII and the Department for Promotion of Industries and Internal Trade, Ministry of Commerce and Industry, Government of India. The Award is a tribute to our Faculty and a testimony to their admirable adherence to the mandate of the Institute. Smt Padmaja Devi won the Florence Nightingale Award of the Government of India for 2018 for outstanding nursing services. This was the second consecutive year that a representative from the nursing staff of the Institute was a recipient of the coveted Award for outstanding nursing service. Dr K Shivakumar, Division of Cellular and Molecular Cardiology, received the Prof Kukhreja Oration Award of the International Academy of Cardiovascular Sciences in recognition of his outstanding work on the molecular basis of cardiac fibrogenesis. Dr Arun K M, PhD Scholar, received the AWSAR Award of DST. The Department of Cardiovascular and Thoracic Surgery received an award from the Government of Kerala for its leading role in the "Hridayam" Programme that aims at the care of children with congenital heart disease. Thirty one awards were won by students and faculty in various conferences. Among post-doctoral students, 25 received the Best Paper and Best Poster awards last year at national and international conferences. The scholarships and awards received by our students are always a source of immense pride for us. We laud these commendable achievements.

The Institute raised a revenue of Rs 123.11 Crores during the current financial year, which constituted 85% of the grant-in-aid received from the Department of Science and Technology. We thank DST for the financial support of Rs 151.74 Crores and Rs 45.00 Crores for the construction of the Swasthya Suraksha Block under PMSSY. The total Extramural Research funding received by the Institute from all sources amounted to Rs 20.57 Crores, including Research Projects supported by DST and SERB at a total cost of Rs 4.02 Crores. Twenty three ongoing research projects during the year were funded by DST and SERB, out of which 8 were initiated during 2018-19. In addition, a sum of Rs 10 Crores was directly credited to the account of CPWD by the Ministry of Health and Family Welfare, Government of India, under PMSSY for the construction of the new Super-speciality Block.

I would like to express our gratitude to the Government of India for its support to all our developmental activities. We are thankful to Prof Ashutosh Sharma, Secretary, Department of Science and Technology, for consistently guiding us along and readily extending a helping hand anytime help is sought. We place on record our immense gratitude to the former President of the Institute, Shri K M Chandrasekhar, who guided us at a critical juncture in our history and contributed immensely to the growth of the Institute in the recent past.

Even as the Institute moved ahead resolutely toward achieving its objectives, the state of Kerala was inundated in one of the worst natural calamities in recent history. Hundreds of lives were lost or devastated. At an hour of dire need, the Institute stood with the rest of the country, despatching teams of doctors to the affected areas and providing medicines, essential supplies and financial aid to give succour to the hapless flood victims who had lost home and hope.

While the future holds out great promise, the tasks before us are complex, compelling and firmly grounded in our fundamental commitment to health care. As this report reflects, the past 12 months have strengthened the foundation for our future as an organisation and firmed up our resolve to surge ahead in our chosen path. Each of us continues to be proud of what we have accomplished in spite of the real-world challenges that we face. Let us tread the road ahead with the joy of a job well done and the hope of doing even better to achieve more difficult targets in the days to come.

ASHA KISHORE



..... Highlights of the Year

INFRASTRUCTURE DEVELOPMENT

◆ **Launch of the Swasthya Suraksha Block, Combinational Devices Block, Regional Technical Resource Centre for Health Technology Assessment and Data Centre**

Dr Harsh Vardhan, Hon'ble Union Minister for Science and Technology, Environment, Forest and Climate Change, and Earth Sciences, formally launched four major initiatives of the Institute at a function held on 23 June 2018 – 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 Data Centre. The unstinted support of the Ministry of Science and Technology, through DST, and the Ministry of Health and Family Welfare, Government of India, was critical in the materialization of these projects.

◆ **IT Up-gradation Programme**

The IT Up-gradation at the BMT Wing was initiated by the Network Services Section to meet the augmented needs of research and development activities.

◆ **Nucleic Acid Amplification Testing Laboratory**

The Nucleic Acid Amplification Testing Laboratory was launched in the Department of Transfusion Medicine.

CONTRIBUTIONS TOWARD NATIONAL MISSIONS

1. “Make in India”

◆ **Commercial Launch of Technologies**

Two of the technologies developed at the Institute were commercially launched during the Technology Conclave on 24 March 2019

- Vein Viewer System, developed by SCTIMST and manufactured by M/s Agappe Diagnostics Ltd., Kochi
- DRIPO Infusion Monitor, developed by Evelabs Technologies, incubated at TIMed, SCTIMST

◆ **Transfer of Medical Device Technologies**

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



- Paracorporeal Left Ventricular Assist Device to M/s Meril Lifesciences Pvt. Ltd.
- Prothrombin Time/ International Normalized Ratio (PT/INR) monitoring device to M/s Agappe Diagnostics Ltd.
- Tuberculosis screening device to M/s Agappe Diagnostics Ltd.
- Injectable hydrogel for cartilage repair to M/s Phraction Scientifics Ltd.
- Lint-free absorbent wound dressing to M/s Phraction Scientifics Ltd.
- SCTAC2010: Human serum albumin-conjugated anticancer drug formulation to M/s Eightoaksbio Pvt. Ltd.

◆ **Relicensing of Technologies**

The following technologies were relicensed to industrial partners:

- Hydrocephalus shunt to M/s Phraction Scientifics Ltd.
- Calcium sulfate cement to M/s Prevest Denpro Ltd.
- Calcium phosphosilicate cement to M/s Prevest Denpro Ltd.
- Polyvinyl alcohol sponge to M/s Konikkara Industries

◆ **Co-development**

- Implantable Cardioverter Defibrillator development was initiated with the industrial partner M/s Shree Pacetronics

◆ **Technical Research Centre for Biomedical Devices**

- 34 mission mode R&D projects aimed at developing medical device technologies were underway
- 6 technology tie-ups were initiated with various medical device industries

◆ **Technology Business Incubator (TIMed)**

- TIMed supported 7 resident incubatees during the year
- DRIPO, an infusion monitoring device developed by Evelabs, a start-up incubating at TIMed, was launched during the 3rd Technology Conclave
- TIMed disbursed seed funds to 4 incubatees under NIDHI Seed Support Scheme of DST
- NIDHI PRAYAS Scheme for supporting early stage innovators to move from idea to prototype stage was rolled out at TIMed



- A 2000 sq ft ISO Class 7 Clean Room Facility for medical device manufacturing was completed and made available to start-ups
- TIMed hosted a national level pre-prototype Workshop by TISS, Mumbai, as part of the Social Innovation Immersion Programme of BIRAC
- TIMed partnered with Villgro on a nationwide iPITCH 2018 start-up discovery event and actively participated in several national events to promote its visibility
- TIMed held Talk@TIMed on various topics of interest to start-ups and organized other Workshops in association with ecosystem partners such as TIE Kerala, Kerala Start-up Mission and ISBA

2. “Skill India”

◆ Industry-Institute Partnership Cell

- The Industry-Institute Partnership Cell (IIPC), which was set up as part of the Technical Research Centre Programme, conducted 4 training programmes in collaboration with various departments of the Institute

3. “Digital India”

- e-payment kiosk of the Hospital Wing, funded by the Ministry of Electronics and Information Technology, was formally inaugurated

4. “Swachh Bharat”

- Swachhata Pakhwada was observed from 1-15 May 2018. During this period, the Institute conducted various programmes to instill the spirit of recycling and environmental conservation. Swachhata Hi Seva was observed with a prayer meeting and cleaning of the campus on Gandhi Jayanti.
- The Institute banned the use of single use plastic items in the campus as part of the “Beat Plastic Pollution” theme of World Environment Day 2018

NETWORKING WITH OTHER INSTITUTIONS

◆ The Institute executed following MoUs with government departments, institutions and industries to facilitate networking:

- With the Wake Forest Institute for Regenerative Medicine, North Carolina, USA, for academic co-operation
- With the Indian Council of Medical Research, for co-operation and collaboration in planning and conducting validation through clinical trials of various medical devices, biomaterials and in vitro diagnostics devices/kits developed by the Institute



- With the National Centre for Cell Science for collaborative research for the development of 3D liver construct using iPSCs differentiated into hepatocytes
- With M/s Tata Consultancy Services for undertaking, promoting, facilitating and fostering joint R & D projects in the Health Care Technology domain and related areas
- With the International Institute of Information Technology, Hyderabad, to facilitate collaboration in academic, scientific research and technical fields in the broad area of Neuroanatomy and Human Brain Atlas
- With the National Institute of Technology, Calicut, to take part in the joint research initiative titled “Development of a computer algorithm to aid in managing anticoagulation in patients requiring oral anticoagulant drugs”
- With the Department of Biotechnology (DBT) for a National Multicentric Study funded by the latter titled “Aadar Dementia Science Program”
- With the DBT for a 3-year project titled “To model the effects of mutations of HCN channels in neuronal excitability and impact of GABABR on GIRK and HCN mutations using neurons”
- With Meat Products of India to facilitate exchange of scientific and technological information and animal tissues, leading to application of mammalian-derived organs/tissue for biomedical device development
- With M/s Shree Pacetronix for the development of implantable defibrillator
- With the International Advanced Research Centre for Powder Metallurgy and New Materials for collaborative research in areas of mutual interest
- With the Ministry of Health, Government of Kerala, for SCTIMST guidance in developing Congenital Heart Surgery Programmes in various Government Medical Colleges in Kerala
- With the University of Central Lancashire, UK, for the project titled “Improving Stroke Care in India” (IMPROVISE)”
- With the Ayurveda College, Government of Kerala, and Triveni Nursing Home for the project titled “Ayurvedic treatment in the rehabilitation of ischemic stroke patients in India: A randomised controlled trial (RESTORE)”

◆ Expression of Interest

To enhance Technology Transfer, an Expression of Interest was invited from the medical device industry and start-ups for different products



NEW INITIATIVES

◆ Implementation of Code Blue

The Emergency Medical Response Programme, “Code Blue”, was formally implemented to cater to patients with acute cardiorespiratory arrest

◆ Centre of Advanced Research and Excellence in Heart Failure

The Department of Cardiology was selected as one of the 10 National Centres of Advanced Research and Excellence (CARE) in Heart Failure and was provided a funding of Rs 5 Crores for a period of 5 years. Eight research projects were identified under this initiative, which included a National Heart Failure Biobank, assessment of economic impact and quality of life in heart failure and developing a point-of-care device for estimating brain natriuretic peptide.

◆ Yoga Initiative

In connection with the International Yoga Day 2019, a Committee was constituted for promotion of a healthy lifestyle, and a practice session in yoga and meditation was initiated

◆ Flood Relief Management by the Institute

During the floods in Kerala, the Institute provided both medical and material relief to the flood victims by organizing medical teams and providing medicines, essential supplies and financial aid

RESEARCH PROJECTS/PUBLICATIONS/PATENTS

◆ Number of Research Projects ongoing during the year: 23

- Nationally-funded: 21
- Internationally-funded: 2

◆ Number of Research Publications: 233

◆ Patents

- Granted: Nil
- Applications Filed: 21
- Design Registrations Filed: 3



HUMAN RESOURCE DEVELOPMENT/TRAINING

- ◆ PhD: 14
- ◆ Research/Technical Manpower trained other than PhDs (DM, MCh, PDCC, PDF, Diplomas, Nursing): 95
- ◆ Manpower trained against affiliated programmes (CMC-Vellore, NIE-Chennai, IIPH-Delhi, IIITM-K, Trivandrum): 150
- ◆ MTech/MPhil/MPH Projects guided: 22
- ◆ Apart from these structured courses, the Institute also contributed substantially to manpower generation through Workshops/Conferences/Training Programmes/Popular Lectures/Awareness Camps/Seminars and Exhibitions inside and outside the Institute

EVENTS/CONFERENCES/WORKSHOPS

◆ Annual Convocation

The Annual Convocation of the 34th batch of graduates for the year 2018 was held on 5 May 2018. Shri Natarajan Chandrasekaran, Chairman, TATA Sons & Group was the Chief Guest and Dr M R Rajagopal, Chairman, Pallium India, was the Guest of Honour for the event.

◆ Technology Conclave

The 3rd Technology Conclave took place on 24 March 2019 and was presided over by the Hon'ble President of the Institute, Dr V K Saraswat, in the presence of Dr C Balagopal, Founder and Former Managing Director, Terumo Penpol Ltd., Dr Asha Kishore, Director, SCTIMST, and Dr Harikrishna Varma, Head, BMT Wing. Two technologies were commercially launched during the event: Vein Viewer System and DRIPO Infusion Monitor. Technology Transfer of 6 new technologies and relicensing of 4 technologies were announced during the event.

◆ Industry Innovators Meet

The Industry Innovators Meet was held on 24 March 2019 with brainstorming sessions on the following topics: orthotics and rehabilitation, in vitro diagnostics, regeneration technologies, 3D bioprinting and smart materials. It was a convergence of clinicians, representatives from the medical device industry and scientists from the BMT Wing. The brainstorming focused on developing products for use in patients.

- ◆ Workshop on **Biological Safety and Efficacy Evaluation of Medical Devices** was conducted during 24-26 September 2018 with industry participation



- ◆ **International Congenital Heart Disease Awareness Week** was observed from 7-14 February 2019 by the Departments of Cardiology and Cardiovascular and Thoracic Surgery in association with the Nursing Services Division. A Continuing Nursing Education programme on complex congenital heart diseases and patient interactive sessions were organized.
- ◆ The Departments of Cardiology and Cardiovascular and Thoracic Surgery jointly organized the **Chitra Fontan Summit 2019** on 10 March 2019, focusing on congenital heart diseases
- ◆ **Brain Conn 2018**, a Workshop on brain connectivity and a Conference on brain-computer interface, was organized on 28-30 December 2018 by the Department of Imaging Sciences and Interventional Radiology
- ◆ **Essentials of Stroke Care**, an International Stroke Conference was held on 17-18 November 2018 in collaboration with the University of Central Lancashire, UK
- ◆ Dr Biju Soman organized a Workshop on “**Geographic Information System (GIS) in Public Health for Healthcare Professionals and Researchers using QGIS and R software**” on 21-22 November 2018 at the University Kuala Lumpur, Royal College of Medicine, Perak
- ◆ A special training for SC/ST candidates on “**Analytical Instruments for Research**” was conducted by IIPC on 24-25 January 2019 at the BMT Wing
- ◆ The Hon'ble Vice-chairman of the National Commission for Scheduled Castes, New Delhi, visited the Institute on 12 February 2019 to review the implementation of the Rule of Reservation, including service safeguards provided to Scheduled Caste employees.
- ◆ **Events were organised in connection with:**
World Heart Day 29 September 2018; International Epilepsy Day 28 February 2018; World Antibiotic Awareness Week 12-18 November 2018; World Multiple Sclerosis Day 9 June 2018; World Blood Donor Day 14 June 2018; National Voluntary Blood Donation Day 1 October 2018; National Science Day 28 February 2019
- ◆ **Hindi Fortnight, Vigilance Awareness Week and Rashtriya Ekta Diwas were observed**
- ◆ **Conferences attended by Staff and students: 228**
- ◆ **Number of Conferences/Workshops organized by the Institute: 20**

AWARDS

- ◆ **National Florence Nightingale Award - 2018**

Dr Padmaja Devi S S, Deputy Nursing Superintendent, was awarded the “National Florence Nightingale Award - 2018” by the Hon'ble President of India for meritorious service in Nursing



◆ Prof Kukhreja Oration Award

Dr K Shivakumar, Division of Cellular and Molecular Cardiology, received the Prof Kukhreja Oration Award of the International Academy of Cardiovascular Sciences in recognition of his outstanding work on the molecular basis of cardiac fibrogenesis

◆ AWSAR Award

Dr Arun K M, PhD Scholar, received the AWSAR Award of the Department of Science and Technology, India

◆ Government of Kerala Award

The Department of Cardiovascular and Thoracic Surgery received an award from the Government of Kerala for its leading role in the “Hridyam” Programme aimed at the care of children with congenital heart disease

◆ Awards won by students and faculty in conferences: 31

CSR FUNDS RECEIVED

- ◆ The Board of Directors of Tata Elxsi Ltd. contributed a sum of Rs 60 Lakhs for treatment of patients from financially weaker sections
- ◆ The Bharat Petroleum Corporation Ltd. contributed Rs 28.62 Lakhs toward establishment of a Dialysis Unit
- ◆ M/s PM Foundation, Kochi, contributed Rs 8 Lakhs for treatment of patients from financially weaker sections

REVENUE GENERATED BY THE INSTITUTE

- ◆ Revenue generated by the Institute during the current financial year was Rs 123.11 Crores, which constituted 85% of the grant-in-aid received from the Department of Science and Technology, 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 the previous years



FINANCIAL SUPPORT FROM DST

- ◆ **Total grant received: Rs 196.74 Crores (as against Rs 205.02 Crores for 2017-18)**
 - Revenue Grant: Rs 134.41 Crores
 - Capital Grant: Rs 17.33 Crores
 - Construction of new Super-speciality Block: Rs 45.00 Crores
- ◆ **Total Extramural Research Funding received by SCTIMST from all sources: Rs 20.57 Crores**

DST and SERB contribution:

- Funding for Adhoc Research Projects: Rs 4.02 Crores
- In addition, a sum of Rs 10 Crores was directly credited to the account of CPWD from the Ministry of Health and Family Welfare, Government of India, under the PMSSY Scheme for construction of the new Super-speciality Block
- Total Number of ongoing research projects funded by DST and SERB: 23, out of which 8 were initiated during 2018-19

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 34th batch of graduates for the year 2018 was held on 5 May 2018



The Hon'ble Union Minister, Dr Harsh Vardhan, formally launched the Swasthya Suraksha Block under the Pradhan Mantri Swasthya Suraksha Yojana on 23 June 2018



Signing of MoU for collaboration on research and development in the healthcare technology between SCTIMST and Tata Consultancy Services Ltd. Mumbai on 2 August 2018



Director handed over a cheque for Rs 12 Lakhs as the first installment of the donation from the staff and students of the institute to the Hon'ble Chief Minister of Kerala on 18 August 2018 towards the Chief Minister Distress Relief Fund



Patient Awareness programme on lifestyle management, diet control and prevention of heart diseases as part of World Heart Day 2018 conducted on 29 September 2018



MoU was signed with M/s Shree Pacetronix, Madhya Pradesh for the development of implantable defibrillator on 23 October 2018



An e-payment kiosk (funded by Ministry of Electronics and Information Technology, Government of India) for the benefit of the patients was inaugurated by Dr Asha Kishore, Director, SCTIMST, on 18 December 2018



Farewell to Shri K M Chandrasekhar Held on 7 March 2019 (President from Feb 2014 to Feb 2019, Former Cabinet Secretary)



Hon'ble President of SCTIMST, Shri K M Chandrasekhar inaugurated the Nucleic Acid Amplification Testing (NAT) Laboratory in the Department of Transfusion Medicine on 4 January 2019



Commercial launch of DRIPO infusion monitor, developed by Evelabs Technologies, incubated at TIMed, SCTIMST by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Commercial launch of Vein Viewer System, developed by SCTIMST and manufactured by M/s Agapte Diagnostics Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Technology Transfer of paracorporeal Left Ventricular Assist Device to M/s Meril Lifesciences Pvt. Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of paracorporeal Left Ventricular Assist Device by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Technology Transfer of PT/INR Monitoring device to M/s Agappte Diagnostics Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of PT/INR Monitoring device by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Technology Transfer of TB screening device to M/s Agappte Diagnostics Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of TB screening device by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Technology Transfer of Injectable hydrogel for cartilage repair, & Lint-free absorbent wound dressing to M/ s Phraction Scientificals Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of Injectable hydrogel for cartilage repair, & Lint-free absorbent wound dressing by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Technology Transfer of SCTAC2010: Human serum albumin-conjugated anti-cancer drug formulation to M/s Eightoaksbio Pvt. Ltd. (received by SCTIMST R&D Team representative) by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of SCTAC2010: Human serum albumin-conjugated anti-cancer drug formulation by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of Hydrocephalus shunt for relicensing the technology to M/s Phraction Scientifics Ltd. of the by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of Poly Vinyl Alcohol sponge for relicensing the technology to M/s Konikkara Industries by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of Calcium sulfate cement for relicensing the technology to M/s Prevest Denpro Ltd. by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Felicitation of the R&D team of Calcium phospho-silicate composite granules for relicensing the technology to M/s Prevest Denpro Ltd by the Hon'ble president of the Institute, Dr V K Saraswat during The Technology Conclave held on 24 March 2019



Release of "NEW CHITRA TECHNOLOGIES: A LEAP TO THE FUTURE" during The Technology Conclave held on 24 March 2019



Dr K Shivakumar, Division of Cellular and Molecular Cardiology, received the Prof Kukhreja Oration Award of the International Academy of Cardiovascular Sciences in recognition of his outstanding work on the molecular basis of cardiac fibrogenesis



Dr Padmaja Devi S S, Deputy Nursing Superintendent, was awarded the “National Florence Nightingale Award - 2018” by the Hon’ble President of India for meritorious service in Nursing



The Hon’ble Vice-chairman of the National Commission for Scheduled Castes, New Delhi, visited the Institute on 12 February 2019

HOSPITAL WING





HOSPITAL ADMINISTRATION

Activities

The annual statistics of hospital services for the year are displayed in Figures 1-7. During the year, various services in Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences and Interventional Radiology registered 18623 new patients (Figure 1). A total of 12371 patients were admitted for treatment, including surgical and interventional procedures (Figure 1). It was observed that patients

newly registered and admitted to the hospital steadily increased every year. Outpatient Department (OPD) services registered 165333 patients for review in various Departments, including Specialty Clinics (Figure 2). The Institute provided free treatment to 1.85% of the patients and subsidized treatment to 43.21% based on socioeconomic background. The bed turnover increased, while the average length of stay remained at 6, which indicated stretching of the facilities to accommodate the increasing patient load in the hospital

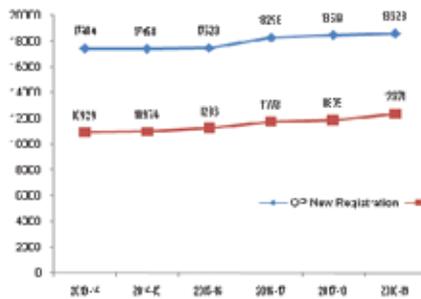


Figure 1. New registrations and admissions

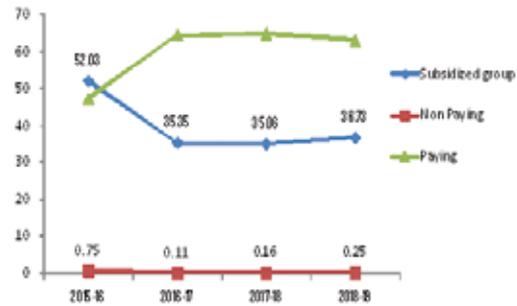


Figure 4. Paying, non-paying and subsidized treatment for outpatients

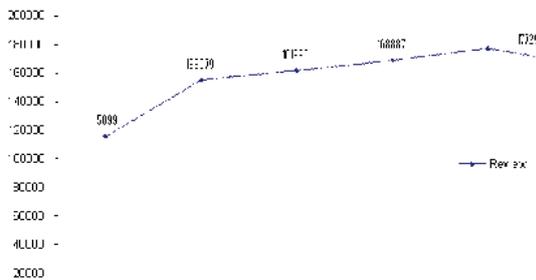


Figure 2. Review Patients

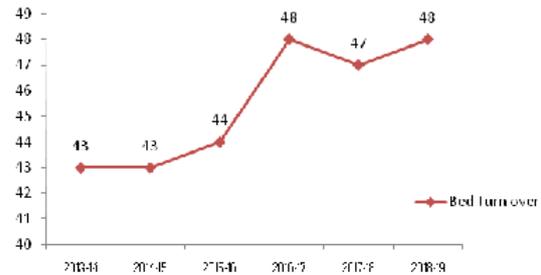


Figure 5. Bed turnover

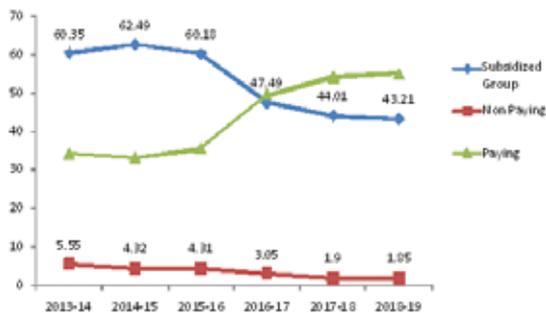


Figure 3. Paying, non-paying and subsidized treatment for inpatients

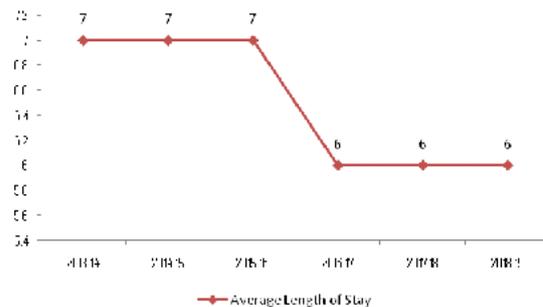


Figure 6. Average length of hospital stay

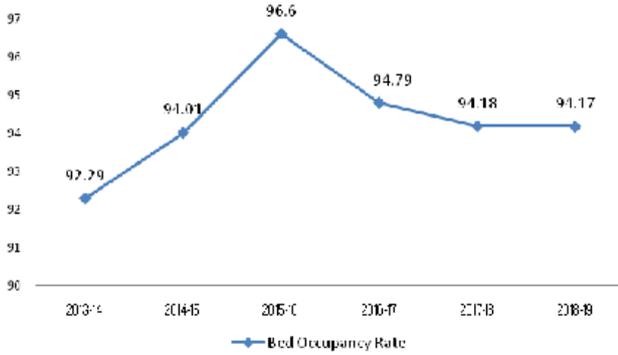


Figure 7. Bed occupancy rate

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	3188	45865
2	CGHS	161	4392
3	Karunya	2461	0
4	CHIS PLUS	2679	0
5	Thalolam	266	0
6	Prime Minister's Relief Fund	31	0
7	Rashtriya Arogya Nidhi	81	0
8	PM Foundation	38	0
9	Sneha Santhwanam	0	18
Total		8905	50275

Other activities included:

1. Flood Relief Management by the Institute

During the recent floods in Kerala, the Institute provided both medical and material relief to the flood victims. Medical teams from SCTIMST visited the flooded areas of Aluva and

Pathanamthitta from 20-28 August 2018. The Institute provided medicines and essential supplies to the victims in the flood relief camps at Aluva and Pathanamthitta. Consumables/ disposables were also issued from the Main Store for the medical team. Medicines were issued from the Pharmacy to the District Collectorate, Trivandrum and medical teams.

The Institute issued old polythene bags to Trivandrum Corporation authorities on request during the floods. The staff of the Institute contributed clothes, medicines and other items needed in the flood relief camps was handed over to the District Collectorate, Trivandrum.

A health campaign was conducted at Aranmula in Pathanamthitta District in connection with flood relief activities by Nursing Services Division on 18 September 2018.

- The Central Sterile Services Department (CSSD) of the Institute provided 6 months training to the employees of the Directorate of Medical Education, Government of Kerala.
- The Institute received a revolving fund of Rs 30,00,000 from Rashtriya Arogya Nidhi for the treatment of patients living below poverty line and suffering from major life-threatening diseases.
- Swachhata Pakhwada was observed from 1-15 May 2018. The Institute conducted various programmes in relation to this event from 3 - 9 May 2018.
- Swachhata Hi Seva on Gandhi Jayanthi Divas was observed by organizing a prayer meeting with Swachhata Shapath followed by cleaning of Kumarapuram Quarters Campus.
- Vigilance Awareness Week was observed with the theme "Eradicate Corruption-Build a New India" from 29 October - 3 November 2018.
- Rashtriya Ekta Diwas was observed on 31 October 2018.
- In connection with the International Yoga Day 2019, a Committee was constituted to promote a healthy lifestyle. A practice session in yoga and meditation was initiated for staff and students.



New Initiatives

1. The Institute stopped the use of single use plastic items in the campus as part of “Beat Plastic Pollution” theme of World Environment Day 2018
2. An e-payment kiosk for the Hospital Wing funded by the Ministry of Electronics and Information Technology, Government of India, was inaugurated by the Director on 18 December 2018
3. The Emergency Medical Response Programme “Code Blue” was inaugurated by the Director on 4 February 2019
4. The Clinical services were boosted by introduction of: (i) pass system to bystanders in OPD for crowd management (ii) token system in ECHO room, blood collection room and IS & IR (iii) verification system for socioeconomic assessment of patients and (iv) cost-analysis of all procedures in the hospital with cost consultant and Dr Padmaja Devi S S, Deputy Nursing Superintendent

Awards and Honours

Dr Padmaja Devi S S, Deputy Nursing Superintendent was awarded the “National Florence Nightingale Award - 2018” for the meritorious service in Nursing by the Hon'ble President of India on 12 May 2018 at Rashtrapathi Bhavan.

Staff

Hospital Administration

Dr Kavita Raja, Medical Superintendent

Dr Rahul D Nambiar, Administrative Medical Officer

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

Nursing Services

Dr Padmaja Devi SS, Deputy Nursing Superintendent

Ms Valsala Kumari C, Nursing Officer - A

Ms Gracyamma Bridget, Senior Nursing Supervisor

Ms Sara Sherly George, Senior Nursing Supervisor

Ms Hepzibah Sella Rani J, Senior Nursing Supervisor

Physical Medicine and Rehabilitation

Dr Nitha J, Assistant Professor

Central Sterile Services Department

Ms Prasannakumari K, Senior Ward Sister

Infection Control Unit & Biomedical Waste Management

Ms Shiny Biju, Infection Control Nurse

Construction Wing

Col (Rtd) Vijayan Pillai K, Construction Engineer

Security & Safety

Mr Anil Kumar B S, Security and Safety Officer - B

Dietary

Ms Leena Thomas, Senior Dietician - B

Ms Jyothi Lekshmy S, Deputy Dietician - A

Laundry

Mr Umesh Sankar S, Laundry Supervisor - B

Medical Social Work

Ms Rosamma Manuel, Junior Scientific Officer and in-charge OPD Services

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 are an essential component in modern health care management. The Department continued to have 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 related to 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 materials 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 in tele-consultations
6. Processing and issuance of various certificates, insurance claims 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	18623
Admissions	12371
Reviews	165333
Bed Occupancy Rate	94.17%

Bed Turnover Rate	48 discharges per bed
Average length of stay	6 days
Records released for study/research	13549
Certificates processed/issued	6835
Insurance Claims processed	429
Records scanned and uploaded	69196
Electronic Medical Records processed	146438

Geographic Distribution of Patients

	Out Patient		In Patient	
Kerala	15015	80.7%	10092	81.71%
Tamil Nadu	2832	15.22%	1593	12.90%
Karnataka	44	0.24%	22	0.18%
Andra Pradesh	30	0.16%	16	0.13%
Maharashtra	56	0.30%	51	0.41%
Other states of India	575	3.09%	531	4.30%
Outside India	55	0.30%	46	0.37%
Total	18607	100%	12351	100%

Staff

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

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 provides essential services for patient management in the wards, operating theatres, outpatient departments and other supporting Divisions of the Hospital Wing.

Activities

The Division participated in the organization of many national and state level conferences in 2018-19. Several members of the staff actively engaged in attending conferences and getting up-to-date knowledge in their fields of interest. The staff members were called upon as resource persons and faculty in regional and state-level conferences and training programmes.

The Division played an important role in the flood relief activities of the Institute with 4 ward sisters, 22 staff nurses and 12 unit helpers joining the medical teams deployed to the flood affected areas. The nursing community contributed relief materials worth Rs 50,000 which was handed over to the sub-collector on behalf of the Institute.

The Division also participated in the rehabilitation of flood victims in a programme organized on 18 September 2018. Eight nursing staff joined the programme. Kitchen appliances (gas stoves, mixer grinders, pressure cookers, nonstick cookware, induction cookers and mop units) were distributed to 36 families. A table-top grinder and Rs 3000 was donated to Sabari Balashramam, Aranmula. The other activities of the campaign were: (i) health talks on nutrition, alcoholism, cigarette smoking, health hygiene and communicable diseases (ii) group discussions on identifying and living with the problems of old age (iii) health status assessment (blood pressure and blood sugar monitoring, wound dressing) by nurses and directing problem cases to Primary Health Centre for detailed checkup and (iv) visits to flood-affected houses.

Events organized

1. The conference “Essentials of Stroke Care” was

organized in collaboration with the Comprehensive Stroke Care Programme, SCTIMST and the University of Lancashire, UK, on 17-18 November 2018 in Trivandrum.

2. Training on “Patient Safety for Nurses” was held in two batches on 29 June and 8 September 2018 at SCTIMST with 57 and 46 participants, respectively.
3. The state level conference, “Updates in Neuro Critical Nursing 2018” was held at AMCHSS Auditorium, SCTIMST on 28 July 2018.
4. A training programme “Intensive Training in Infection Control for Staff Nurses at SCTIMST” was held from 1 July - 1 August 2018 at SCTIMST and 158 nurses underwent training in the programme.
5. State level conference on “Single Ventricle Palliation in Congenital Heart Surgery: Nursing Updates” was organized on 10 March 2018 at SCTIMST.
6. The Division celebrated the ‘International Congenital Heart Disease Awareness Week’ in association with Departments of Cardiology and Cardiovascular and Thoracic Surgery from 7-14 February 2019. Patient interactive sessions with health talks by doctors, nurses and social workers were arranged.

Awards and Honours

Mr Rathish Rajan, Staff Nurse from NMICU, won second prize in quiz competition at SINNCON at Jaipur in December 2018.

Staff

Mrs Valsalakumari C, Nursing Officer

Mrs Padmajadevi S S, Deputy Nursing Superintendent

Mrs Gracyamma Bridget, Senior Nursing Supervisor

Mrs Sara Sherly George, Senior Nursing Supervisor

Mrs Hepzibah Sella Rani J, Senior Nursing Supervisor



DEPARTMENT OF ANAESTHESIOLOGY

The Department of Anaesthesiology has two Divisions: Division of Cardiothoracic and Vascular Anaesthesiology and Division of Neuroanaesthesia.

DIVISION OF CARDIOTHORACIC AND VASCULAR ANAESTHESIOLOGY

The Division of Cardiothoracic and Vascular Anaesthesia is involved in three major areas of work in the Institute: clinical, academic and research.

Activities

Clinical activities

The Division provided anaesthesia for cardiothoracic and vascular cases in four adult and two pediatric operating rooms, three catheterisation labs, two DSA labs, two MRI suites and one CT room. Anaesthetic cover was given for both diagnostic and therapeutic procedures. The Division focused on high-quality invasive and non-invasive peri-procedural care which included intraoperative transesophageal echocardiography, percutaneous tracheostomies, bedside transthoracic echocardiography and lung ultrasound, ultrasound-guided vascular cannulations and regional nerve blocks and highly effective intravenous and neuraxial pain relief practices.

The list of procedures and surgeries covered during the year is summarized in the Table below:

Location	Number of Surgeries/Procedures
Adult cardiac surgery operating theatres	1511
Congenital heart surgery operating theatres	918
Cardiology catheterisation labs	592
Radiology - CT, MRI and DSA labs	179
Total	3200

By the virtue of the expertise in the field of perioperative care, the cardiac anaesthesia team provided round-the-clock critical care services in the various intensive care units of the hospital namely cardiac surgical ICU, congenital heart ICU and cardiac medical ICU.

Academic activities

All working Saturdays were exclusively dedicated to well-structured departmental academic activities which included introductory classes, symposia, seminars, practice guidelines and pro-con sessions, systematic review and meta-analysis sessions, problem-based learning discussions, journal clubs and case presentations. Further, thesis and project details were discussed. The faculty members delivered many invited lectures at various national conferences and workshops.

Research activities

The faculty and residents were actively involved in various research projects. They presented their research work at various conferences.

Product Development

The Division was involved in the clinical trial of Chitra Vein Viewer in adult and pediatric patients.

New Initiatives

1. The All India Institute of Medical Sciences (AIIMS), Delhi, sent their first batch of DM Cardiac Anaesthesia senior residents for two-week observership training in both adult and pediatric cardiac anaesthesia, intensive care and intra-operative echocardiography. Eight senior residents visited the Division during the year.
2. Near-infrared spectroscopy (NIRS) is a monitoring technique to assess the cerebral oxygenation by using electrodes placed over skull. NIRS monitoring was initiated during congenital heart surgical procedures.
3. A videolaryngoscope with full set of blades and flexible intubating video endoscope for advanced airway management was procured.



Events organized

Dr Thomas Koshy, Professor Senior Grade, was the organising chairperson of the RAA online Advanced Transesophageal Echocardiogram and Simulation Workshop at Chennai in January 2019.

Awards and Honours

1. Dr Thomas Koshy, Professor Senior Grade, was awarded FRCP by the Royal College of Physicians of Edinburgh, UK.
2. Dr Thomas Koshy was nominated to the Post Graduate (Super specialties) Board of Studies of Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai, in 2018

DIVISION OF NEUROANESTHESIA

Neuroanaesthesia Division has three major areas of work in the Institute: clinical, academic and research.

Activities

Clinical activities

The Division was mainly involved in the perioperative anaesthetic management of patients with neurological illness presenting for neurosurgery as well as neuroradiological interventional procedures in the Radiology suite. In addition, various diagnostic procedures like MRI and CT scans were also carried out under anaesthesia when needed.

The neuroanaesthesia team provided round-the-clock services in various intensive care units of the hospital, namely Neurosurgical ICU, Neuromedical ICU, Interventional Radiology ICU, and Acute Stroke Unit. The team was involved in the airway, ventilation and hemodynamic management of patients in the ICUs. The doctors performed various invasive procedures like percutaneous tracheostomy, invasive lines including plasmapheresis, and anaesthesia services for muscle and skin biopsies. They were actively involved in the preprocedural management of acute stroke patients in the Stroke Unit, Interventional Radiology Suite as well as in the operation theatre.

The Division conducted outpatient services, Pre-Anaesthesia Clinic everyday where patients were

examined for fitness for anaesthesia for diagnostic procedures like MRI and neurosurgery.

The list of procedures and surgeries covered during the year is summarized in the Table below:

Location	Number of Surgeries/ Procedures
Neurosurgery operating theatres	1546
Neuroradiology Suite	256
MRI under general anaesthesia/sedation	310
Patients on ventilator – CT and MRI	400
Skin and muscle biopsies	25
Total	2537

Academic activities

The academic activities of the Division were well-executed during the year and included didactic lectures, clinical case discussions, journal clubs, and pro and con sessions. In addition, practical sessions on various airway gadgets, awake craniotomies, intra-operative echocardiography, intra-operative evoked potential monitoring, and transcranial Doppler were some of the highly specialized areas in which teaching was conducted. Interactive academic sessions between allied neurospecialities were also conducted regularly.

Research activities

The faculty and residents were actively involved in various research projects, both funded and non-funded. They presented their research projects at various national and international conferences.

1. A project proposal on “Development of autonomic function monitor for pain detection” was awarded internal funding of Rs 2.5 Lakhs. Dr S Manikandan and Mr Manoj, were the investigators for the project. The hardware for the monitor was completed and the software development continued.
2. Dr Ajay Prasad Hrishi received a funding of Rs 7.5 Lakhs from the Technology Development



Fund of the Institute for the project “Design and development of cerebral microdialysis device and methodology for estimation of cerebral metabolites”.

Product Development

1. An institute-funded project for the development of flexible arm for ultrasound probe for central venous cannulation continued. The device will help in freeing the arms of the operator while inserting the central venous lines and keeps the ultrasound probe stable to improve the success rate of these procedures. The preliminary model of the device was designed and further refinement of the device continued.
2. Drippo Infusion Device (Evelab) was developed in TiMED, SCTIMST. The device is aimed to facilitate intravenous infusion of fluids to patients where the drop rate of fluids can be accurately calculated. Dr S Manikandan was involved in the refinement of the product and preclinical testing at BMT Wing. The clinical evaluation of the product is ongoing at the Hospital Wing. The clearance for the clinical application was submitted to the Institute Ethics Committee (IEC). Following the IEC approval, the product will be tested in neurosurgical operation theatres and ICUs.

New Initiatives

1. The ‘Code Blue’ Programme was initiated by the Division in the hospital for patients who sustain cardiorespiratory arrest.
2. Intra-operative monitoring of spinal cord integrity during spinal cord surgeries and vertebral column instrumentation is a major challenge. The Division initiated the spinal cord monitoring by D wave monitoring using an indigenous technique. Newer electrodes will be developed using the experience gained from this technology.
3. Near-infrared spectroscopy monitoring was initiated during brain surgery and various neuroradiological procedures.
4. Home Ventilatory Therapy for patients requiring longterm mechanical ventilation as in neuromuscular diseases was established. It was a

part of neuro-rehabilitative process in which the relatives of the patients were taught to provide mechanical ventilation at home and taking care of other needs of these patients. During the year, a significant number of patients were managed with home ventilation.

5. The Division conceptualised the Programme of Ultrasound Training for anaesthesiologist for ICU management of patients and the process of fund acquisition was initiated.

Events Organized

1. Dr Ajay Prasad Hrishi conducted a Workshop on “Focussed Neurological examination in Neurocritical Care” at ISNACC 2019 in February 2019 at Artemis Hospital, Gurgaon.
2. Dr S Manikandan conducted a Workshop on “Transcranial Doppler in Neurocritical Care” at Amrita Institute of Medical Sciences, Kochi, in October 2018.
3. Dr S Manikandan conducted a Workshop on “EEG monitoring in Neurocritical Care” organized by ISSCM, Mumbai, at the annual conference of Indian Society of Critical Care at Mumbai in February 2019.

Awards and Honours

1. Dr Ajay Prasad Hrishi won the KPR Young Anesthesiologist Award instituted by the Indian Society of Anesthesiologists for the year 2018.
2. Drs Sashmita and Soniya, residents, were awarded the second prize in the quiz competition held at ISNACC 2019 in February 2019 at Gurgaon.
3. Dr Ajay Prasad Hrishi did an observership in Intraoperative Neuromonitoring and Pain at Nara Medical University, Nara, Japan, from 18- 23 March 2019.
4. Dr Ajay Prasad Hrishi represented the Institute in the meeting by KNOS, chaired by the Additional Chief Secretary, Government of Kerala, for brain death identification and certification in the transplant centres.



Staff

Faculty

Dr Thomas Koshy, Professor Senior Grade and Head of the Department

Dr Rupa Sreedhar, Professor Senior Grade

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

Dr Saravana Babu M S, Assistant Professor

Technical

Mr Binu Thomas, Senior Scientific Assistant

Mr Shibu V S, Senior Technical Assistant

Mr Baiju Bavura S, Senior Technical Assistant

Mr Tiny Babu, Technical Assistant - B

Mr Pradeep S L, Technical Assistant - B

Mr Sumesh T M, Technical Assistant - B

Mr Damodara Sarma E, Technical Assistant - B

Ms Archana S, Technical Assistant - A

Mr Manju R S, Technical Assistant - A



DEPARTMENT OF BIOCHEMISTRY

The Department of Biochemistry comprises two sections - Research Laboratories and Central Clinical Laboratory.

The research laboratories study the molecular basis of disease processes affecting the vascular system leading to neurological and cardiovascular disorders. Four main areas are under investigation: (1) Nitrite signaling in hyperglycemia is via mitochondrial fission in myoblasts, (2) study of mechanism and regulation of amyloid β clearance by peripheral macrophages, (3) the molecular basis of MTH1 activation in glioma, the role of IDH1 mutation and (4) exosomal microRNA and proteins in Parkinson's disease.

The Central Clinical Laboratory undertakes laboratory diagnostics in areas of biochemistry, hematology, and clinical pathology.

Activities

Clinical Services

The Department is equipped with fully automated state-of-the-art equipment including Dade-Behring/Siemens RXL, Aspen A1c HPLC Analyzer LD 500, Mindray 5-part Hematology analyzer-BC 5180 & BC 5000, Gem Premier 3000-ABG analyzer, CobasU 411 (Roche) urine analyzer, and Amax (Germany) coagulation analyzer.

The Central Clinical Laboratory performed a total of 9,96,818 investigations during the year, which was marginally higher than the previous year. The tests performed are summarized in the Table below:

Investigation	Number
Arterial Blood Gas	24736
General Chemistry	434935
Hematology & Coagulation	379822
CSF, Urine, Stool	156693
Neurochemistry	48
Plasma Amino Acids	584
Total	9,96,818

Research Programmes

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

1. Nitrite signaling in hyperglycemia is via mitochondrial fission in myoblasts

The ongoing research work relating to hyperglycemia is the investigation of the effects of nitrite treatment on myoblasts under normoglycemia and hyperglycemic conditions. Supplementation with nitrite reduced the phosphorylation levels of endothelial Nitric oxide synthase (eNOS) under normoglycemia. Hyperglycemia also had a similar effect, but nitrite did not further reduce the phospho-eNOS levels. Nitrite exposure also reduced the phosphorylation levels of the mitochondrial fission protein, Drp1 under normoglycemia. Under hyperglycemia this effect was more pronounced. The above results indicate that nitrite is activating eNOS and Drp1, thereby augmenting nitric oxide signaling and mitochondrial fission/replication. The supplementation of nitrite decreased the expression of uncoupling protein3 (UCP3) and enhanced the expression of Adenine Nucleotide Translocase (ANT1) during normoglycemia, but not in hyperglycemia. This showed that nitrite has the ability to alter the mitochondrial membrane potential through its effect on mitochondrial permeability transition pore (Figure 8). Altogether, the results showed that nitrite supplementation had different effects on myoblasts in normoglycemic and hyperglycemic conditions.

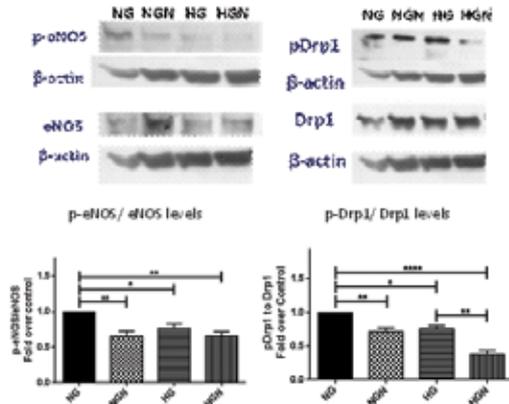


Figure 8. Nitrite signaling in hyperglycemia

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

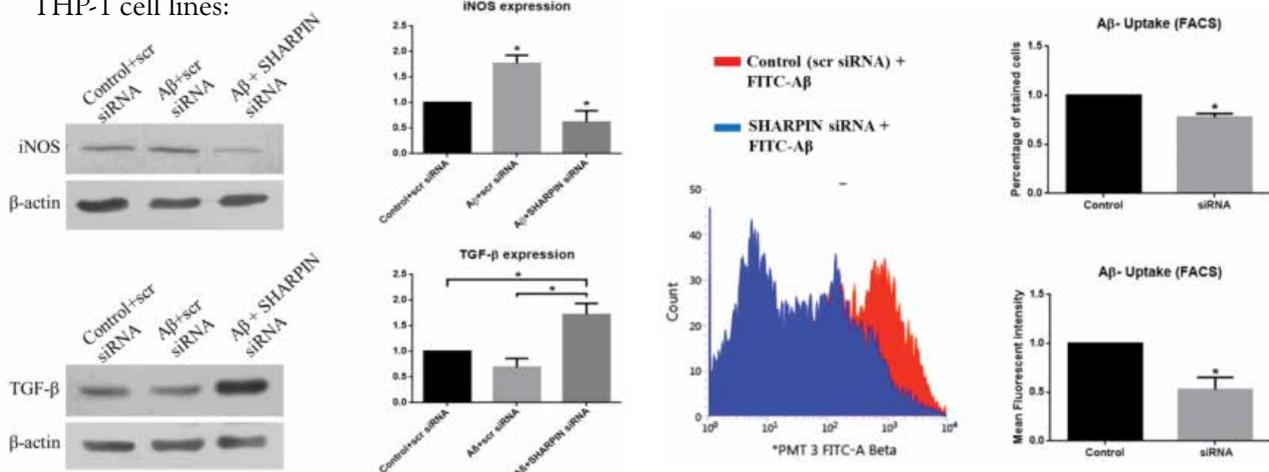
A β accumulation-associated inflammatory activation of macrophages in the brain and the peripheral circulation plays a major role in causing neuronal cell death, leading to the pathogenesis of Alzheimer's disease (AD). Although several studies have shown a correlation between inflammatory mediators and phagocytic receptor expression by immune cells, the underlying mechanisms that promote pro-inflammatory conditions in the AD brain remain elusive. Using differentiated THP-1 macrophages as an in vitro model, we identified increased expression of SHARPIN (Shank-

associated RH domain-interacting protein), a ubiquitinating protein that leads to the activation of the redox-sensitive transcription factor, NF- κ B, in response to A β -induced oxidative stress. This protein was found to regulate the expression of NLRP3, a major regulator of inflammatory cytokine production, leading to the activation of a pro-inflammatory signaling cascade, causing inflammation-mediated neuronal apoptosis. Using differentiated SHSY5Y neurons, we also observed reduced apoptosis of neurons when the cells were treated with conditioned media from SHARPIN-knockdown macrophages in presence of A β , suggesting that the A β -mediated neuronal apoptosis is primarily through damage induced by A β -mediated inflammatory mechanisms. The findings implicate SHARPIN in regulating A β -phagocytic receptor expression in macrophages affecting phagocytosis and thus directly or indirectly inducing A β -mediated macrophage polarization to pro-inflammatory M1-phenotype. Further, an association between SHARPIN expression, macrophage phagocytic ability and inflammation was analyzed in AD patient-derived macrophages in comparison with age-matched control subjects (Figure 9). In summary, our study demonstrated a novel role for SHARPIN in the regulation of macrophage response to A β in the setting of AD.

3. The molecular basis of MTH1 activation in glioma, the role of IDH1 mutation

MTH1 expression in human glioma tissue was

THP-1 cell lines:





SHSY5Y cell lines:

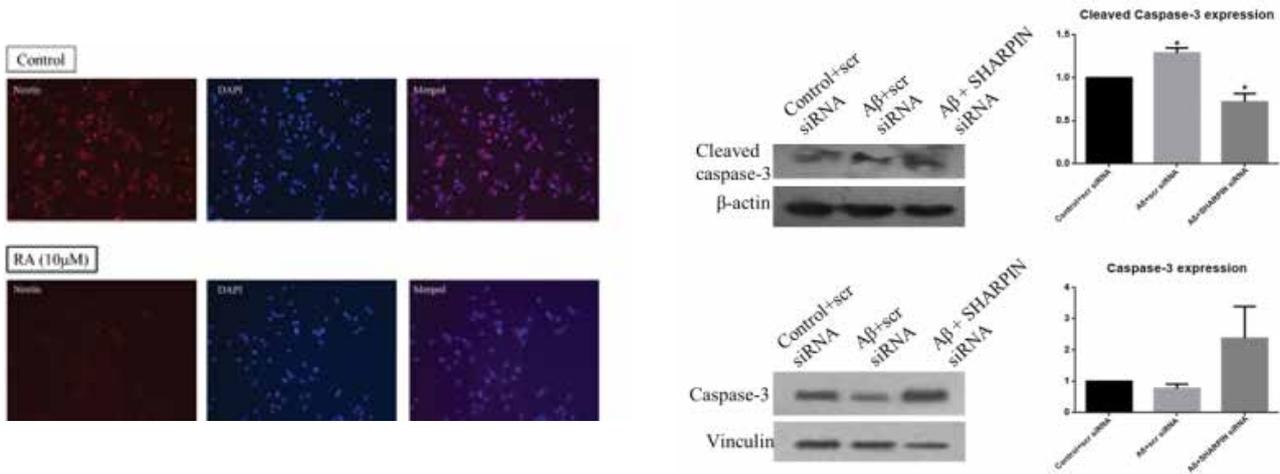


Figure 9. Role for SHARPIN in the regulation of macrophage response to amyloid β

found to be independent of glioma grades both at RNA as well as protein levels (Figure 10). MTH1 was also found to be essential for glioma survival when the protein was inhibited by MTH1 siRNA in U87 and U251 human glioblastoma cell lines. MTH1 inhibition showed an increase in DNA damage and apoptosis markers. Increased ROS level was found in mutant IDH1 (mIDH1) expressing cells when labeled with the fluorescent probe DCFDA. Western blot analysis showed that MTH1 expression was upregulated in mIDH1 expressing U87 as well as U251 cells, thus showing a correlation between MTH1 and mIDH1. Cells also showed increased migration in mutant IDH1 expressing cells and the number of migrated cells was less when mIDH1 was inhibited with mutant IDH1-specific inhibitor. subspecies.

4. Exosomal miRNA and protein profiling in Parkinson's disease patients

There is a growing need for the identification of robust non-invasive biomarkers for Parkinson's disease (PD) diagnosis and monitoring the disease progression. The aim is to derive a set of differentially expressed exosomal miRNA and protein panels as disease indicators among Indian PD patients using high throughput sequencing and proteomics approaches. Isolation of exosomes from human plasma was standardized in the laboratory using differential ultracentrifugation. The homogeneity of isolated exosomes was analyzed by

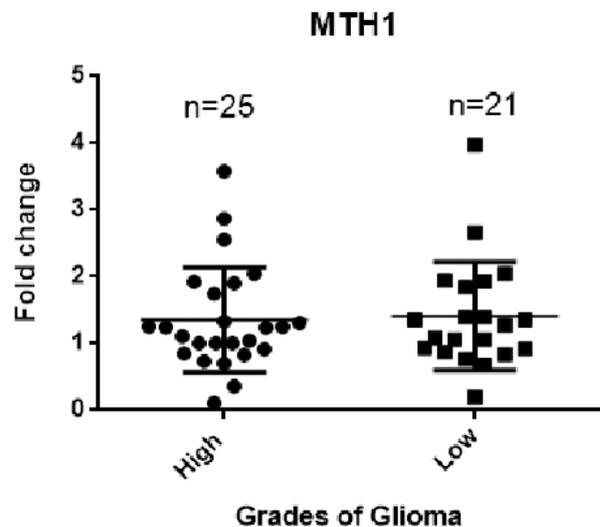


Figure 10. MTH1 expression in high and low grade gliomas

Transmission Electron Microscopy (TEM) and the specificity was checked using exosomal membrane protein specific antibodies (CD63) by Western blot. The presence of brain-derived exosomes was confirmed by Western blot using antibody against brain specific exosomal marker, L1CAM (CD171).

New Initiatives

New assays for determining total iron, ferritin, iron binding capacity, Trop T, NT ProBNP and D-dimer were introduced in the Central Clinical Laboratory.



Events Organized

The Department organized a talk by Prof Ram H Nagaraj, Professor, University of Colorado, USA, on 21 November 2018.

Staff

Faculty

Dr Jayakumari N, Professor and Head of the Department (till 31-05-2018)

Dr Srinivas G, Scientist F and Acting Head (from 01-06-2018)

Dr Madhusoodanan U K, Assistant Professor

Dr Cibin T R, Assistant Professor (from 01-06-2018)

Technical

Thomas T A, Scientific Officer (Lab)

Jayasree K K, Scientific Officer (Lab)

Dr Geetha M, Scientific Officer (Lab)

Vijayalekshmi L, Junior Technical Officer (Lab)

Radhakrishnan B, Junior Technical Officer (Lab)

Sreenivas N C, Junior Technical Officer (Lab)

Sumitha K C, Technical Assistant (Lab) - B

Santhosh Kumar R, Technical Assistant (Lab) - A

Sheeja M, Technical Assistant (Lab) - A

Sreedevi V S, Technical Assistant (Lab) - A

Dr Deepa D, Technical Assistant (Lab) - A

Sreekala Balan P, Technical Assistant (Lab) - A

Manju G Nair, Technical Assistant (Lab) - A

Sarita Gopakumar, Technical Assistant (Lab) - A

Sunitha S, Technical Assistant (Lab) - A

Siju K S, Technical Assistant (Lab) - A

Divya T Nair, Technical Assistant (Lab) - A



DEPARTMENT OF CARDIOLOGY

The Department of Cardiology is nationally renowned with state-of-the-art patient care, research and academic programmes. The training programmes include DM Cardiology, Post-Doctoral Fellowship and Post-graduate Diploma in Cath-Lab Technician (DCLT) with 6 DM trainees, 2 fellows and 3 cath-lab technical trainees. The Department continued to have one of the largest numbers of indexed journal publications in the specialty across the country. During the year, the Department conducted various Workshops, and initiated new research programmes. The sub-specialties of the Department: Adult Cardiology and Interventions, Electrophysiology and Paediatric Cardiology continued to set new benchmarks in patient care.

Activities

The main activities of the Department included:

1. Comprehensive Heart Failure Intervention Programme
2. Neonatal ICU organization
3. Cardiac Transplant Programme
4. Neonatal Clinics
5. Fetal Heart Disease Evaluation
6. Ventricular Tachycardia Ablation strategies
7. Channelopathy Evaluation Programme
8. Device Clinics

The Department was selected as one of the ten national Centres of Advanced Research and Excellence (CARE) in Heart Failure and was provided a funding of 5 Crores for a period of five years. Eight research projects were identified under this initiative. They included National Heart Failure Biobank (first in the country), assessment of economic impact and quality of life in heart failure, developing a point-of-care (POC) device for estimating brain natriuretic peptide and genetic studies on hypertrophic cardiomyopathy.

The Department continued to develop the Transcatheter Aortic Valve Replacement (TAVR) using both balloon-expandable and self-expandable valves. The indigenous TAVR system got approved

by the DCGI. It was also part of the new indigenous device development trials like MyVal.

A state-of-the-art Fresenius dialysis machine and RO water purification system installed in Cardiology ICU helped many patients.

ADULT CARDIOLOGY AND INTERVENTIONS

The Division performs about 800 coronary interventions yearly, thereby maintaining its position as a major coronary intervention Centre. Complex coronary interventions like left main interventions and rotablations were routinely performed. Coronary interventions were guided by the state-of-the-art technologies like intravascular ultrasound (IVUS), optical coherence tomography (OCT) and fractional flow reserve estimations (FFR). Resting Flow Cycle Ratio (RFR), a new method to assess the coronary flow reserve was initiated. Alcohol septal ablation for hypertrophic cardiomyopathy, structural heart disease interventions like device closure of paravalvular leaks, stenting of aortic coarctation and percutaneous closure of congenital and acquired defects like ruptured sinus of Valsalva (RSOV) were also performed.

The interventions performed by the Division during the year are summarized in the Table below:

Procedures	Number
Coronary angioplasty	728
Coronary angiogram	1343
Cardiac catheterization	217
Balloon Mitral Valvotomy	50
Atrial Septal Defect device closure	19
Transcatheter aortic valve implantation	6
PDA device closure	5
RSOV Device closures	1
Device closure of valve leaks	3
Alcohol septal ablation	3
Balloon aortic valvotomy	3
Pericardial aspiration	7
Total	2385



CARDIAC ELECTROPHYSIOLOGY

The Division functioned as one of the best interventional Electrophysiology Centres in the country for management of cardiac arrhythmias and sudden cardiac death. The Division performed more than 350 ablations and electrophysiology procedures during the year, one of the largest in the country. The Division continued using the 3D electro anatomical mapping systems, CARTO 3 and Ensite Velocity to aid complex ablation procedures. The number of device implantations (including implantable cardioverter defibrillators and cardiac resynchronization devices) was close to 350. Nearly 2000 patients were followed-up in the Device Clinic. The Clinic was upgraded to better cater to the patients and maintain a database of the device-related cases. The focus of the Division continued to be on expanding the expertise in ventricular tachycardia ablations. The request from the Asia Pacific Heart Rhythm Society (APHRs) for an additional seat for Postdoctoral Fellowship in Electrophysiology was under process. The publications in indexed medical journals in the last 5 years were above 150. This is arguably the highest from any single international Centre in this speciality. The editorial office of the indexed medical journal, Indian Pacing and Electrophysiology (Elsevier Publishers) is also located in the Division.

The Division conducted regular electro-anatomical ablation Workshops that were attended by electrophysiologists across the country interested in developing these programmes at their institutions. The projects to improve the knowledge base and innovate with newer treatment strategies continued. The Division is the National co-ordinating Centre for a nationwide Channelopathy Registry to catalogue the various causes of inherited abnormalities of cardiac ion channel functions that predispose to sudden cardiac death at a young age.

The cardiac electrophysiology procedures performed during the year are summarized in the Table below:

Procedures	No.
3D electro anatomical mapping and ablation:	98
<i>Atrial tachycardia and flutter</i>	

<i>Ventricular tachycardia – outflow tracts</i>	
<i>Ventricular tachycardia – Fascicular VT</i>	
<i>Ventricular tachycardia – Scar-related</i>	
<i>Ventricular tachycardia – Others</i>	
Conventional mapping and ablation:	262
<i>Ablation of SVT – AVNRT</i>	
<i>Ablation of SVT – AVRT</i>	
<i>Electrophysiological study</i>	
Device implantation procedures:	349
CRT	32
ICD	60
Pacemakers and others	257
Total	709

Paediatric Cardiology

The Division is the most sought-after hub of care for congenital heart diseases in the state. Paediatric Cardiology, along with the Congenital Heart Surgery Division of Cardiac Surgery serves as the nodal center of the Hridayam Programme of the Government of Kerala to support children with congenital heart diseases.

The Division offers fetal echocardiography and follow-up of high-risk fetuses with structural heart diseases and cardiac dysrhythmias. The Division performs device closure of atrial septal defects, ventricular septal defects and patent arterial ducts with multimodality imaging with minimal radiation exposure to the child. The Division works in close harmony with Congenital Heart Surgery Division of Cardiac Surgery for hybrid interventions, comprehensive post-operative care and long-term rehabilitation of children with complex congenital heart diseases.

A number of complex cardiac interventions including ductal stenting, coarctation angioplasty, pulmonary artery and pulmonary venous angioplasty were performed during the year.



The procedures performed in the Division during the year are summarized in the Table below:

Procedure	No.
Device closure of Atrial Septal Defect	119
Device closure of Ventricular Septal Defect	12
Device closure of Patent Ductus Arteriosus	93
Balloon Pulmonary Valvotomy	41
Balloon Aortic Valvotomy	11
Balloon Atrial Septostomy	13
Patent Ductus Arteriosus stenting	9
Juvenile Balloon Mitral Valvotomy	2
Coarctation stenting angioplasty (balloon/stent)	10
Pulmonary artery angioplasty (balloon/stent)	15
Vascular coiling procedures	6
Pulmonary vein intervention	2
BT shunt stenting	2
Coronary AV fistula device closure	1
Cardiac catheterization	159
Total	495

Product Development

The Departmental collaborative projects with other Divisions of the Hospital and BMT Wings continued. The following devices were under development:

1. Atrial septal defect device
2. Pulmonary valve
3. Automatic Implantable Cardioverter Defibrillator

Research Programmes

The main research programmes of the Department were:

I. Registries

1. National Heart Failure Registry
2. Kerala Heart Failure Registry

3. Trivandrum Heart Failure Cohort
4. Congenital Heart Diseases Registry (CHRONIK)
5. MACE Registry
6. AF Registry

II. Prospective clinical trials

7. MyVal trial on TAVR
8. ISCHEMIA trial – stable coronary artery disease
9. Heart failure trials
10. VT ablation using 3D
11. Electrical Remodeling in CRT
12. His bundle pacing
13. Epicardial ablations in VT
14. Pulmonary hypertension
15. Long term outcomes of congenital heart diseases
16. Telemedicine evaluation

III. Community-based trials

17. Premature coronary artery disease
18. Diabetes prevention

Events Organized

1. 'Back to Basics' - A simulator based coronary intervention training programme was conducted on 19 January 2019 at SCTIMST.
2. The Departments of Cardiology and Cardiovascular and Thoracic Surgery (CVTS) together organized the Chitra Fontan Summit 2019 on 10 March 2019 at Hotel Hyacinth, Thiruvananthapuram.
3. Congenital Heart Disease Awareness Week: Patient and public interactive forums were held from 7-14 February 2019 and were co-ordinated by the Departments of Cardiology and CVTS and the Nursing Services Division.
4. Continuing Nursing Education Programme on Complex Congenital Heart Diseases was organized on 9 February 2019 along with the Department of CVTS and the Nursing Services Division.
5. The Department organized the World Heart Day public interactive forum on 29 September 2018 in Trivandrum.



6. A Paediatric Cardiology Workshop with Dr Joseph Vettukattil as the external faculty was conducted on 19-20 December 2018 at SCTIMST.

Awards and Honours

1. Dr Ajitkumar V K continued to serve as Member of Biotechnology Industry Research Council, Ministry of Science and Technology, Government of India.
2. Dr Ajitkumar V K was President Elect for the Society for Coronary Imaging and Physiology.
3. Dr Ajitkumar V K was selected Editorial Board Member for The Cardiologist, Jomard publishers, Germany and Madrige Journal of Cardiology.
4. Dr Ajitkumar V K continued as Editorial Board Member of the Indian Pacing and Electrophysiology Journal.
5. Dr Narayanan Namboodiri continued to serve as the honorary Editor-in-Chief of Indian Pacing and Electrophysiology journal.
6. Dr Narayanan Namboodiri continued to serve as sub-committee member of Guidelines and Writing Group, Asia Pacific Heart Rhythm Society since January 2016.
7. Dr Narayanan Namboodiri continued to serve as sub-committee member, Basic and Translational Research, Asia Pacific Heart Rhythm Society since January 2016.
8. Dr Narayanan Namboodiri served as the Vice-chair of Asia Pacific Heart Rhythm Society and a lead author for the expert consensus document on 'Catheter ablation of ventricular arrhythmias' led by Heart Rhythm Society, European Heart Rhythm Association, Asia Pacific Heart Rhythm Society and Latin American Heart Rhythm Society, the international apex associations of Cardiac Electrophysiology in 2019.
9. Dr Narayanan Namboodiri was an invited member of Scientific Publications and Document Writing Committee on 'Arrhythmic risk in neuromuscular disorders' led by Heart Rhythm Society.
10. Dr Narayanan Namboodiri continued as the Vice-president of Kerala Heart Rhythm Society for the second consecutive year.

11. Dr Narayanan Namboodiri continued to serve as nominated healthcare member of Janmaithri Police, Medical College Police Station by the Co-Ordination Wing, Janamaithri Police Mission, Government of Kerala.

12. Dr Narayanan Namboodiri continued to serve as honorary member of Karunya Benevolent Fund Approval Committee, Trivandrum district.

13. Dr Abhilash SP served as the Chief Editor of Kerala Journal of Cardiology, the official publication of Indian College of Cardiology, Kerala chapter.

Staff

Faculty

Dr Ajit Kumar V K, Professor Senior Grade and Head of the Department

Dr Sivasankaran S, Professor Senior Grade

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, Additional Professor

Dr Krishna Kumar M, Assistant Professor

Dr Deepa S Kumar, Assistant Professor

Dr Arun Gopalakrishnan, Assistant Professor

Dr Mukund A Prabhu, 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 AND THORACIC SURGERY

The Department of Cardiovascular and Thoracic Surgery (CVTS) has 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 Paediatric Cardiac Surgery continued its neonatal and infant complex surgical programmes. The Department continued to excel in all the three subdivisions with more complex and challenging procedures being undertaken successfully. The ECMO services were used in more than 10 patients (Figure 11) and the Department completed 100 homograft implantations during the past year. With staff support from the National Health Mission, the Division of Paediatric Cardiac Surgery was able to help nearly 100 more children.

Activities

The Department continued to provide state-of-the-art care in the whole spectrum of cardiovascular and thoracic surgery, with a total of 2158 surgeries and 28,050 outpatient cases in all three sub-specialities together. The year also saw an increase in the number of complex procedures (Figure 12) and planned re-operations. Work continued in 4 research projects. 3 new projects with external and TDF funds were initiated during the year. The Department organized 5 Continuing Medical Education programmes and participated in international and national conferences. A Patient Interaction Programme was organised along with the Department of Cardiology during the Congenital Heart Disease Awareness Week in February 2019. The Department celebrated the Women's Day uniquely by performing an open heart surgery by an all-women team, announcing the capabilities of our colleagues to the world (Figure 13).

Research Programmes

1. A new project entitled "Evaluation of intermediate-term cardiac and neurodevelopmental outcomes of children undergoing corrective arterial switch for

complete transposition of great arteries" funded by National Health Mission was initiated with Prof Baiju S Dharan as the Principal Investigator.

2. Two other projects initiated were: development of a multi-layered wrap-knitted dacron annuloplasty band and a study on the role of alginate-dialdehyde gelatin hydrogel in the prevention of post-surgical adhesion.

Product Development

The Department participated in the following projects:

1. The development of a centrifugal pump for cardiopulmonary bypass was initiated and two animal trials were completed
2. Complete mitral annuloplasty ring
3. Approval was obtained for animal trial of the left ventricular assist device

New Initiatives

1. An MoU was signed with the Ministry of Health, Government of Kerala, on 13 August 2018, for SCTIMST's guidance in developing Congenital Heart Surgery Programmes in various Government Medical Colleges in Kerala. Several teams of professionals including doctors, nurses and technicians from Government Medical Colleges of Calicut and Trivandrum were trained in the Division of Paediatric Cardiac Surgery.
2. A Paediatric Cardiac Intensive Care observership and training programme was initiated for senior residents in Neonatology and Pediatric Intensive Care from PGI, Chandigarh, and JIPMER, Pondicherry.

Events Organized

1. The Congenital Heart Disease Awareness Week 2019 was conducted from 7-14 February 2019 at the AMCHSS Auditorium along with the Department of Cardiology and Nursing Services Division (Figure 14).



2. The Departments of Cardiology and CVTS together organized a CME on Congenital Heart Diseases on 9 February 2019 at the AMCHSS Auditorium and the Chitra Fontan Summit 2019 on 10 March 2019 at Hotel Hycinth, Thiruvananthapuram.
3. Sree Chitra Paediatric Cardiac Update was organized by the Department along with faculty from The Children's Hospital, Brisbane, Australia, and Alder Hey Children's Hospital, UK, on 24 March 2019 at Hotel SP Grand Days, Thiruvananthapuram.

Awards and Honours

The Department received an award from the Government of Kerala for its leading role in the 'Hridayam' programme aimed at the care of children with congenital heart disease.



Figure 11. Baby on ECMO

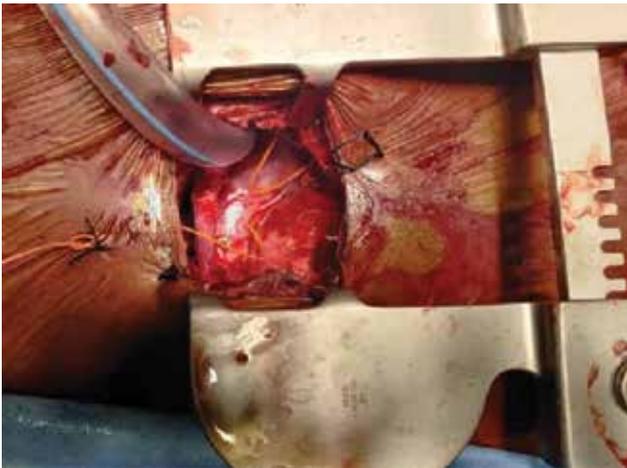


Figure 12. Minimal access aortic valve replacement



Figure 13. All-women team performing open heart surgery on Women's Day 2019



Figure 14. Congenital Heart Disease Awareness Week 2019



Staff

Faculty

Dr Baiju S Dharan, Professor and Head of the Department

Dr K Jayakumar, Professor Senior Grade

Dr Vivek V Pillai, Additional Professor

Dr Varghese T Panicker, Additional Professor

Dr Sabarinath Menon, Associate Professor

Dr Bineesh K R, Assistant Professor

Dr Sudip Dutta Barua, Assistant Professor

Dr Sowmya Ramanan, Assistant Professor

Dr P Shivanesan, Assistant Professor

Technical

Ms Beegum Thaslim, Junior Scientific Officer

Ms Maya L, Perfusionist - B

Mr Sujith V M, Perfusionist - B

Mr Don Sebastian, Perfusionist - A

Mr Shanu P S, Perfusionist - A

Mr Rijesh S R, Perfusionist - A

Mr Sujesh S, Perfusionist - A

Transplant Co-ordinator

Ms Beena B Pillai, Transplant Co-ordinator - A



DIVISION OF CLINICAL ENGINEERING

Technology is an integral part of the health care industry and the Division of Clinical Engineering (DCE) is absolutely vital to the efficiency, productivity and safety of the hospital. Clinical engineering is designed to not only manage contracts, but also effectively maintain the medical equipment and technology devices in a facility. The Division assists in daily operations of a healthcare facility and is responsible for implementing and managing technology-based projects from beginning to end. This is demonstrated by implementing procedures that involve a thorough assessment of medical devices related to patient safety, ensuring regulatory compliance and providing solutions to technology-related issues, routine maintenance and inventory checks, and maintaining accurate and up-to-date records. Our dedicated engineering team not only ensures smooth functioning of electrical, electronic and mechanical equipment of the institute, but is also instrumental in technology assessment and acquisition, equipment lifecycle cost analysis, upgrades and replacement planning and resource optimization.

Activities

The Division ensured proper equipment management by promoting the use of standard-based approach to impart a safer, more efficient and high-quality management of all medical equipment. For assuring safe and effective care of patients, DCE took part in the selection of suitable equipment to support the services of the Institute and organized teaching and training programmes on medical equipment to staff. DCE assessed the need for regular technical support of medical equipment and strategies for appropriate calibration, inspection, maintenance and repair services.

Clinical Engineering experts performed many activities that directly involved the various stages of equipment lifecycle such as pre-purchase evaluations, equipment recommendations, purchasing assistance service, incoming inspections, service equipment, contract management, user training, regular preventive

maintenance, performance testing, calibrations, breakdown work, equipment installations, replacement recommendations, biomedical networking and user-error tracking.

The Division was actively involved in the planning and design of the new hospital project and provided necessary technical inputs to CPWD engineers for the designing of electrical and air conditioning systems.

Services

During the year, the Division successfully managed more than 10000 work requests registered through the computerised complaint management system summarized in the Table below. This included testing and certification of the newly installed equipment, maintenance and repair of the existing equipment and infrastructure facilities and modification of the electrical and air conditioning systems. The Division also monitored and documented the activities of company service engineers that were executed during warranty and service contract period.

Subdivision	Complaints attended
Air conditioning	1185
Communication	635
Electrical	2206
Electronics	4999
Mechanical / Fitting	1404
Medical Gas Line	448
Office equipment	18
Total	10895

New Equipment Installations

The Division was responsible for ensuring proper installation of all the equipments and accessories worth more than 11 Crores during the year. Major equipments installed costing 15 Lakhs and above are



indicated in the Table below:

Sl. No.	Equipment	Approximate cost per equipment
1	Surgical Operating microscopes (Leica)	Rs 2 Crores
2	Heart Lung Machine (HL20)	85 Lakhs
3	Operating theatre table	30 Lakhs
4	Ultrasound Doppler system (Mylab)	30 Lakhs
5	Transcranial Magnetic Stimulator (BISTIM 2)	30 Lakhs
6	128 Channel Video EEG system (Natus QUANTUM 128 CH)	30 Lakhs
7	Sorin's Stockert 3T heater cooler unit - 2 numbers	24 Lakhs
8	Rapid PCR machine for Microbiology	20 Lakhs
9	Lab system EP recorder cum stimulator	20 Lakhs
10	Head rest skull clamp system - 2 numbers	20 Lakhs
11	ICU ventilators - 2 numbers	15 Lakhs
12	Supporting items required for the DSA cath lab	35 Lakhs
13	CR 30 XM Digitiser - 2 numbers	24 Lakhs
14	Hybrid Haemodialysis machine (Fresenius)	15 Lakhs
15	Defibrillators- numbers	5 3 lakhs

Events Organized

"HEATS" (Hospital Equipment Awareness Training Series) for imparting advanced technical training on

various medical equipment continued its endeavour. This year DCE organized 11 Workshops, the details of which are given below:

HEATS-31	Heartstart XL + Philips defibrillator	16 July 2018
HEATS-32	DFM 100 Philips defibrillator 3	September 2018
HEATS-33	SLE 6000 ventilator	9 October 2018
HEATS-34	Veineux AR 100 portable vein viewer	17 October 2018
HEATS-35	Esaote portable ultrasound system - Mylab Gamma	4 January 2019
HEATS-36	Fresenius hybrid hemodialysis machine	23-25 January 2019
HEATS-37	Sunoptic light source	12 February 2019
HEATS-38	Fluke defibrillator analyser	7 March 2019
HEATS-39	Carl Zeiss trinocular research microscopes	12-14 March 2019
HEATS-40	D500 mediana defibrillator	12 March 2019
HEATS-41	Fluke electrical safety analyser	22 March 2019

Staff

Shaj Upendran, Engineer F and Acting Head

Manoj G S, Engineer C

Anoop Jose, Engineer C

Vishal V P, Engineer B

Shali SS, Engineer B

Ganesh P, Junior Engineer (Electrical)



DIVISION OF CELLULAR AND MOLECULAR CARDIOLOGY

The Division of Cellular and Molecular Cardiology has for long aimed at undertaking basic and translational research in the field of cardiovascular biology. The current focus is on critical molecular regulators of myocardial tissue response to injury and remodelling that could be therapeutically targeted to prevent or delay the initiation and progression of heart failure. During the past year, the Division provided guidance to four PhD students, a project assistant and the Principal Investigator of a DST-supported project under the Women Scientists' Scheme (WOS-A). One student was awarded PhD during the year. The Division initiated collaborative research with other departments of the Institute even as collaborative research with the Laboratory of Cardiovascular Science, NIA/NIH, USA, and the UCSD, USA, made good progress.

Activities

Research Programmes

1. Molecular mechanisms in cardiac fibroblast growth

Excessive collagen deposition by myofibroblasts following myocardial injury promotes tissue fibrosis that compromises cardiac function. Exploration of mechanisms underlying collagen gene expression in cardiac myofibroblasts is therefore an important clinical goal. Over the past few years, this laboratory has focused on the role of Discoidin Domain Receptor 2 (DDR2), a collagen-specific receptor tyrosine kinase, as a key determinant of cardiac fibroblast growth in response to mitogenic stimulation, especially Angiotensin II that is a potent regulator of cardiac fibroblast growth and function in a setting of cardiac injury.

2. Exploration of the mechanisms underlying collagen $\alpha 1$ type I in cardiac fibroblasts

A combination of gene silencing and overexpression approaches, electrophoretic mobility shift assay and gene promoter-binding assays showed that DDR2 acts via ERK1/2 MAPK-

dependent TGF- $\beta 1$ signaling and AP-1 activation to transcriptionally enhance the expression of collagen-binding Integrin- $\beta 1$ in Angiotensin II (Ang II)-stimulated cardiac fibroblasts. The link between DDR2 and Integrin- $\beta 1$ was also observed in Spontaneously Hypertensive Rats and DDR2-knockout mice. Further, Integrin- $\beta 1$ was found to increase α -Smooth Muscle Actin (α -SMA) expression by a mechanism involving ILK/Akt signaling. A major achievement was the finding that α -SMA transcriptionally up-regulates collagen type 1 expression in Ang II-stimulated cardiac fibroblasts and delineation of the underlying mechanisms. These observations uncover a hitherto unknown role of α -SMA in the regulation of collagen gene expression and demonstrate the functional coupling of the two distinct cellular processes of collagen production and phenotypic transformation of interstitial fibroblasts into an active state, preparatory to a reparative role post-injury.

3. A role for DDR2 in the relative resistance of cardiac fibroblasts to apoptosis

Ang II was found to enhance anti-apoptotic cIAP2 expression in cardiac fibroblasts via DDR2-dependent ERK1/2 MAPK and SRF transcription factor activation, resulting in the transcriptional up-regulation of the cIAP2 gene. A series of experiments showed that Ang II protects cardiac (but not pulmonary) fibroblasts against oxidative stress-induced apoptosis via DDR2-dependent cIAP2 expression.

A role for DDR2 in G1-S transition in mitogen-stimulated cardiac fibroblasts, gene knockdown and overexpression studies revealed that DDR2 regulates key elements of the cardiac fibroblast cell cycle such p27, Skp2, Foxo3a and Rb via ERK1/2 MAPK and SRF activation to promote G1-S transition upon mitogenic stimulation.

Considered in tandem, DDR2 appears to emerge as a "master switch" in cardiac fibroblasts. Its predominant localization in fibroblasts and its



regulatory role in cardiac fibroblast function identify it as a potential drug target in the control of adverse structural and functional remodeling of the myocardium post-injury.

4. Transcriptional and translational regulation of periostin and its interaction with DDR2 in cardiac fibrosis

During the year, investigations were initiated to explore how a crosstalk between DDR2 and periostin may regulate cardiac fibrogenesis.

5. Regulation of progenitor cell function in the heart by Angiotensin II

Cell-based therapy for myocardial injury, though promising, has not been very successful. Ang II, upregulated following myocardial infarction, induces myocyte apoptosis and tissue fibrosis, and Ang II inhibitors are seen to protect the injured heart. Investigations were initiated to determine whether Ang II induces cardiac progenitor cell apoptosis and impairs their cardioprotective paracrine secretions, and to probe the underlying mechanisms (Figure 15).

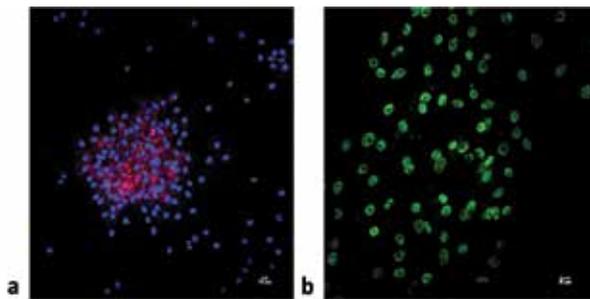


Figure 15. Fluorescent images of a) *c-Kit* +ve and b) *GATA* +ve progenitor cells isolated from atrial appendages of rat heart. *c-Kit*, a cell surface marker protein, is stained red and nuclei of cells are counter-stained blue. *GATA*, a transcription factor, is localized in the nuclei of cells and is stained green.

New Initiatives

Dr Neethu Mohan initiated collaborative research with Dr Vivek Pillai of the Department Cardiovascular and Thoracic Surgery on the ‘Regulation of progenitor cell function in the heart by Angiotensin II’.

Events Organized

The Division organized talks by Professor Jeffrey Robbins, Director, Molecular Cardiovascular Biology,

Cincinnati, and Professor Sakthivel Sadayappan, University of Cincinnati, USA, on 24 January 2019.

Awards and Honours

Dr Shivakumar received the Prof Kukhreja Oration Award of the International Academy of Cardiovascular Sciences in February 2019 in recognition of his outstanding work on the molecular basis of cardiac fibrogenesis (Figure 16).

Faculty

Dr K Shivakumar, Scientist G (Senior Grade) and Head of the Department

Dr Neethu Mohan, Scientist D



Figure 16. Dr Shivakumar receiving the Prof Kukhreja Oration Award

Technical

Remani K, Junior Technical Officer (Lab)

Hima V M, Technical Assistant (Lab) - A



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 monitoring, management, maintenance, and new cabling work
4. Tuning and backup activities of 18 higher end servers and maintenance
5. Tender publishing, online recruitment of staff and students
6. Updation and maintenance of all portals (Blood Donor, Vendor, Pension, CSC, Patient), Dspace, and e-learning
7. OMR evaluation, Form changes for recruitment (SSC, JSC) and academic admissions
8. Report generation for auditors, IT Committee, and DST
9. Hardware and software maintenance of servers, storage, PCs, routers, switches, scanners and printers 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 equipments integrated to EMR and surveillance
13. Training for staff and students
14. General help to staff and students on IT-related issues

Major equipment purchased

The Division purchased 15 PC DELL OPTIPLEX 3060 SFF XCTO costing Rs 10,35,205.91

New initiatives

1. Project implementation related to grant received from Ministry of Electronics and Information Technology for infrastructure upgradation
2. Inauguration of state-of-the-art Data Centre by Hon'ble Minister of Science and Technology, Dr Harsh Vardhan on 23 June 2018
3. Installed servers, storage for backup of data for disaster recovery at BMT Wing by replicating data from Hospital to BMT and vice versa
4. New intranet responsive website launched, supporting all device screens
5. Modules for 7th pay fixation and arrear calculation for academic staff, students and pensioners with individual statement view
6. Developed software and implemented online service requests for Medical Illustration
7. Started a new software module integrated with EMR for recording joint meeting decisions (Joint Cardiac Meet)
8. Installed payment kiosk for patients which is integrated with investigation requests, EMR and e-payment
9. New software implemented in Accounts Section, BMT Wing for staff advance, advance settlement and JV posting
10. Online application for academic student recruitment was implemented with login facility for each applicant. The software facilitates upload of relevant certificates, admit card download, marking selection, rank list preparation, selection order issue, online fee payment and joining report submission.



11. New software module for issuing entry pass to patients was implemented at Informaton Desks 1 and 2.
12. Online software for submission of technical and commercials for medicine tender
13. Launched cloud storage, project management software for all staff and students
14. Launched web-based application for staff to view personal information, duty roster etc.
15. Launched web-based application for file tracking at Hospital and BMT Wings
16. Launched web-based tool boxes for conducting surveys
17. Installation of new PC (15 numbers) in various Sections
18. Upgraded email software to version 18.5
19. Developed 'Do It Yourself' software for recording the vitals of patients at home mainly for Heart Failure Patients and games for Cogitive Rehabilitation
20. Technical evaluation and finalization of the tender for PACS upgradation, surveillance and Tablets for EMR

Staff

Dr Geetha G, Scientist G

Mr Suresh Kumar B, Engineer E

Mr Rejith L R, Programmer - B

Saji K S, Programmer - A

Manoj M, Technical Assistant (Computer Programmer) - B

Anish R, Technical Assistant (Computer Programmer) - B

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

Haseena L, Technical Assistant (Computer Programmer) - A



DEPARTMENT OF IMAGING SCIENCES AND INTERVENTIONAL RADIOLOGY

The Department of Imaging Sciences and Interventional Radiology (IS&IR) offers diagnostic and interventional procedures in neurological and cardiovascular diseases. Diagnostic services include Magnetic Resonance Imaging (MRI 1.5 and 3T), Computed Tomography (CT), ultrasound and X-ray studies. 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 Cath Lab are involved in the management of neurovascular disorders. The newly installed Single Plane Cath Lab focuses on peripheral interventions. Quality management practices coupled with a strong multidisciplinary co-operative direction have contributed to the achievement of less than 1% morbidity and mortality. NIC, which was started 5 years back, has contributed significantly in improving the patient outcome, postgraduate training and research activities in the field of interventional radiology. NIC was incorporated in the hospital services after the successful completion of the project in 2016. The newly inaugurated Single Plane Cath Lab has improved the patient waiting period and helped start new interventions.

Activities

The diagnostic imaging procedures performed during the year are summarized in the Table below and Figures 17-22.

Procedure		Total
X-Ray	Outpatient	21372
	Portable	14882
	Total	36254
Ultrasound		4083
CT		6920
MRI		6517



Figure 17. Distribution of total intervention procedures in 2018-19

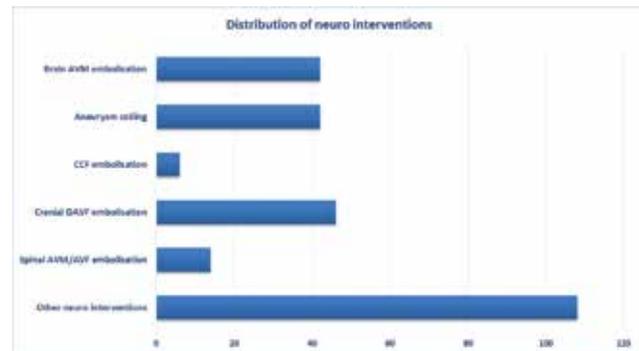


Figure 18. Distribution of neuro-intervention procedures in 2018-19

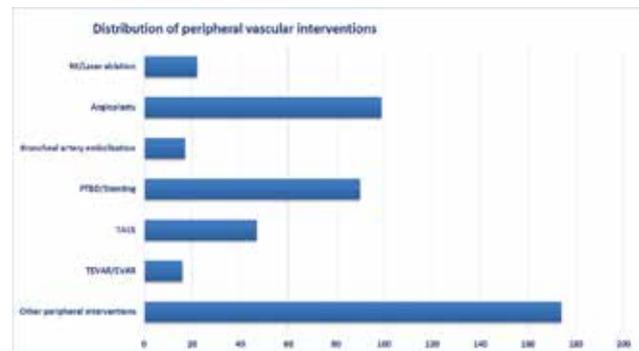


Figure 19. Distribution of peripheral vascular procedures in 2018-19

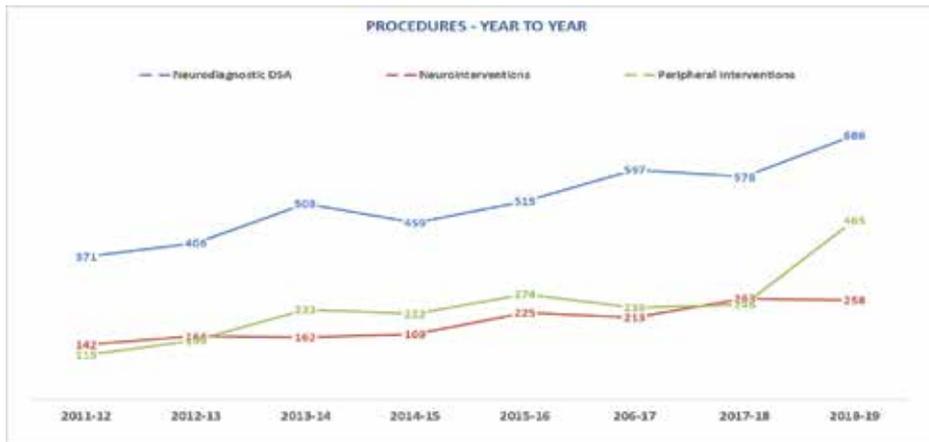


Figure 20. Trend of procedures in the Department from 2011-12 to 2018-19

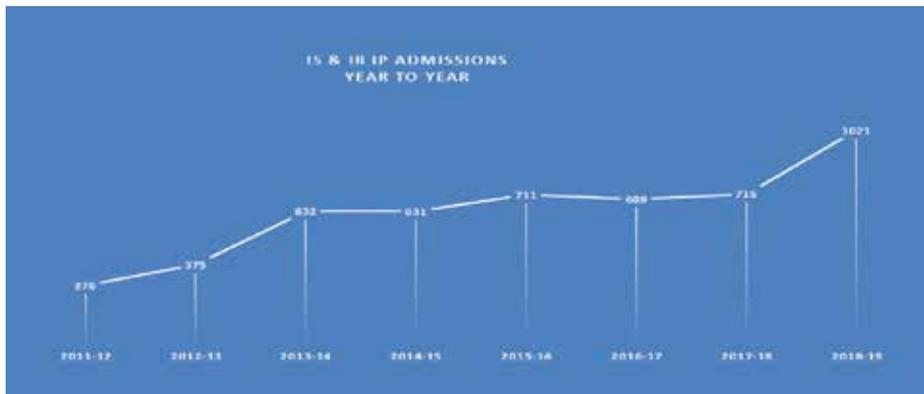


Figure 21. Admissions in the Department from 2011-12 to 2018-19



Figure 22. Trend of outpatient visits in the Department from 2011-12 to 2018-19



During the year, the NIC reported mortality and morbidity rates of <1% and hospital acquired infection rate of <1%. The average length of hospital stay was 3 days.

Product Development

1. The Chitra Vein Viewer Technology, developed by collaboration between Prof Bejoy Thomas of the Department and the BMT Wing was transferred to M/s Agappe Diagnostics Pvt. Ltd. in October 2018.
2. An Indian Patent was filed for the polymeric liquid embolic system with inherent radio-opacity developed by Dr Jayadevan and team.

New Initiatives

The following new interventional procedures were initiated in the Department during the year:

1. Radiofrequency ablation and percutaneous acetic acid injection for hepatocellular carcinoma
2. Portal vein embolization for increasing liver functional capacity
3. Transjugular liver biopsy
4. Direct intrahepatic portosystemic shunt (DIPPS) for treatment of portal hypertension
5. Fenestrated graft Thoracic Endovascular Aortic Repair (TEVAR)
6. Dialysis fistuloplasty with feeder embolization of early draining vein with thrombectomy
7. Pedal angioplasty with SAFARI technique for infrapopliteal angioplasty
8. Percutaneous hepatic vein angioplasty with stenting
9. Perforator sclerotherapy for varicose veins
10. Plug occlusion of portosystemic shunts
11. Retinoblastoma chemoembolization.

Events Organized

1. **CMR Made Easy 2018 Workshop** - The Department conducted a Workshop in Cardiac Imaging 'CMR Made Easy 2018' on 8-10 October 2018. The Workshop was conducted in collaboration with Royal Brompton College, London. 20 selected candidates from all over India took part in the Workshop which was first of its kind in India with foreign collaboration



Figure 23. CMR Made Easy 2018 Workshop

(Figure 23)

2. **Brain Conn 2018** - Brain Conn 2018, a Workshop on brain connectivity and Conference on brain-computer interface (BCI) was organized on 28-30 December 2018 (Figure 24). The Programme was organized with a vision to equip the neuroscientists in India with hands-on experience in brain connectivity analysis by mastering CONN Toolbox. The Programme



also opened new avenues to more sophisticated BCI techniques. The major highlight was the association of prominent international subject experts as key resource persons with expertise in fMRI and EEG research. Dr Sheeba Arnold Anteraper, who is working with developers of CONN and is the Senior Programmer at the McGovern Institute and an expert supervisor in the premier training Workshops organised by Martinos Center for Biomedical Imaging, USA, was the chief speaker. Renowned BCI experts like Dr Ranganatha Sitaram, Associate Professor and Director of Brain Machine Interfaces and Neuromodulation Laboratory, Pontifical Catholic University of Chile, and Dr Vinod A Prasad, Professor and Dean - Industry Collaboration and Sponsored Research, IIT Palakkad, handled sessions for the conference (Figure 25). The



Figure 24. Dr Sheeba Arnold with the Department faculty and Workshop participants



Figure 25. Dr Ranganatha Sitaram, Vajra Faculty at the Department and Dr Vinod Prasad, IIT Palakkad, delivering their lectures at the Brain Conn 2018

Programme received pan-India participation and the feedback was encouraging.

3. **Back to Basics in Neuroradiology 2018** - Back to Basics in Neuroradiology, the Continuing Medical Education Programme organized by the Department under the aegis of Indian Society of Neuroradiology was held on 12-13 May 2018.
4. **Visit of DST VAJRA Faculty** - Dr Ranganatha Sitaram, Director, Center for Brain-Machine Interfaces and Neuromodulation, Associate Professor, Institute for Biological and Medical Engineering, Schools of Engineering, Biology & Medicine, Pontificia Universidad Católica de Chile was awarded the Vajra Faculty to the Department for the work entitled “Functional Near Infra-red Spectroscopy based Brain-Computer Interface for enabling self-controlled mobility for paraplegics”. The first visit of VAJRA faculty to the host institute was from 28 December 2018 to 26 January 2019. The faculty delivered a keynote presentation for the “National Conference on Brain Computer Interfaces- Brain Conn 2018”. The programme was conducted with support from SERB for improving the expertise in the discipline of Brain Computer Interface and Brain Connectivity, as lack of this hinders research advancements in this field. The VAJRA faculty invested a lot of time to discuss the projects with PhD scholars, research associates and research fellows of the Department.

Awards and Honours

1. Dr Arun K M, PhD scholar was awarded the AWSAR Award by the Department of Science and Technology, India.
2. Dr Vinayagamani S, resident, secured first prize for the poster entitled “Quantitative susceptibility weighted imaging (SWI): a novel imaging biomarker to predict disease activity in multiple sclerosis”, at ICTRIMS, Kochi, in July 2018.
3. Dr Vinayagamani S and Dr Sabarish S S, residents, secured the first prize in ‘The Grand ISNR-ABCNR Jeopardy Quiz’ at the 20th



Annual Conference of the Indian Society of Neuroradiology in November 2018 at New Delhi.

4. Dr Somnath Pan, resident, won the best poster award for the poster entitled “Hemimegalencephaly – Review of MR imaging features” at the 38th Annual Conference of IRIA, Kerala Chapter in March 2019 at Kottayam.
5. Dr Ajay Alex, resident, secured first prize for the poster entitled “Role of MRI in Endomyocardial Fibrosis” at the IACI Annual Congress in October 2018 at New Delhi.

Staff

Faculty

Dr C Kesavadas, Professor and Head of the Department
Dr Bejoy Thomas, Professor
Dr T R Kapilamoorthy, 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



DEPARTMENT OF MICROBIOLOGY

The Department is involved in:

1. Providing accurate and quick reports on all specimens sent to the laboratory
2. Consultant clinical microbiology service such as antibiotic stewardship
3. Outbreak investigation and containment using microbiological methods
4. Maintaining the viral culture facility
5. Training MD and MSc Microbiology students as observers and as apprentice trainees, respectively
6. liaising with Hospital Infection Control Unit and
7. Supporting research activities of all Wings of the institute.

Activities

Clinical Services

1. Bacteriology and Mycology: There were 17 cases of infective endocarditis. The important causative agents identified were: viridans group streptococci (mitis/sanguinis/cristatus/gemella, n=6), Mycobacterium abscessus (n=2), Candida parapsilosis (n=2), and one each of Streptococcus gordonii, Streptococcus gallolyticus, MRSA, Enterococcus faecalis, Enterococcus faecium, and Aspergillus fumigatus. There were 4 cases of brain abscess due to Listeria monocytogenes, Cryptococcus neoformans, Streptococcus intermedius and anaerobic streptococci and anaerobic GNB. Additionally, there was one case of mycotic aneurysm due to Salmonella enteritidis. An additional finding this year was cases of exacerbation of heart failure due to pneumococci (n=4) and Moraxella catarrhalis (n=3) (Figure 26)

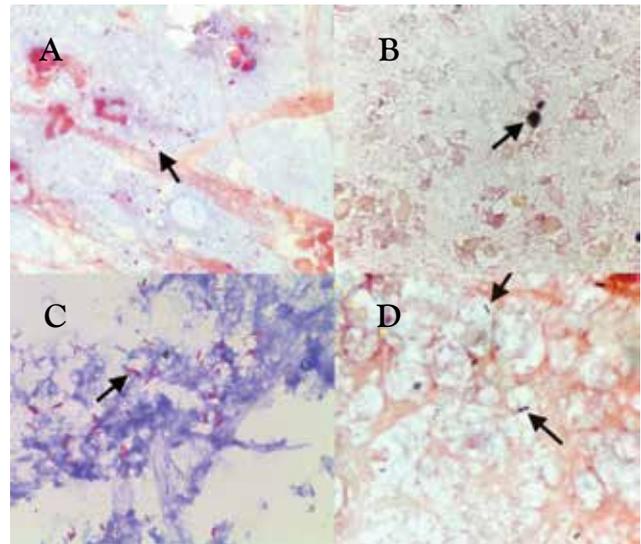


Figure 26. A: *Moraxella catarrhalis* from sputum (Gram staining), B: *Cryptococcus neoformans* from brain tissue (Gram staining), C: *Mycobacterium abscessus* from blood (ZN staining), D: *Listeria monocytogenes* from brain abscess pus (Gram staining)

2. Mycobacteriology: Mycobacterial culture was performed with conventional Lowenstein Jensen medium. Culture yielded four positive cases for Mycobacterium species (3 MTB complex and 1 Atypical mycobacterium).
3. Serology: Nephelometer (Agappe Diagnostics) installed in 2016 was utilized for providing rapid results for ASO, CRP, RF, C3 and C4. Total samples received during the year: RF: 908, ASO: 199, CRP: 1779, TPHA: 298, RPR: 45, Widal: 9, Brucella: 35, Malaria:8, C3&C4: 2.
4. Viral serology: Automated VIDAS (Enzyme Linked Immunofluorescent Assay) and ARCHITECT - Abbott Diagnostics (Chemiluminescence Linked ImmunoAssay) combined were maintained, calibrated and utilized to provide rapid results for HIV, HBsAg, HCV, TFT and Procalcitonin. Hepatitis B antibody titre was measured for health care personnel using ARCHITECT systems to assess their immune protection levels post-vaccination and after health care accidents



like needle-stick injuries. Total samples processed during the year : HIV -10786, HBsAg-10777, HCV-10774, Procalcitonin-1827, and TFT- 8077. Various rapid card tests like Tridot were also used for confirmation and emergency purposes.

5. Molecular diagnostics: The new tests introduced attracted samples from other hospitals like Government Medical College, Trivandrum, RCC, Sree Gokulam Medical College and SUT hospital.
 - a. BioFire FilmArray Multiplex PCR System: 47 tests were performed using three different panels - Respiratory (n=28), Meningitis/Encephalitis (n=15) and Blood culture ID (n=4). Major pathogens identified included Influenza A virus (H1 and H3), Parainfluenza virus 1, HSV1, Listeria monocytogenes, Mycoplasma pneumoniae, Adeno virus and Rhino/Enterovirus.
 - b. CE- IVD approved standard PCR tests for viral encephalitis (n=72) and tropical fever agents (n=43) using respective panels. Major pathogens identified were HHV7, HSV1, EBV, VZV, and Rickettsia
 - c. TB PCR- 60 samples were tested of which 4 were positive for Mycobacterium tuberculosis complex.
 - d. Brucella PCR- 32 samples were tested
6. Homograft Valve Bank: Total valves harvested during the period: 34, homografts implanted - 25 (16 aortic and 9 pulmonary)

Research Programme

IMRVI Impact of Measles-Rubella Vaccination on Immunity in collaboration with ICMR.

New Initiatives

BioFire FilmArray Multiplex PCR System (Figure 27) for syndrome-based molecular diagnosis of infections was launched

Events Organized

1. World Antibiotic resistance Awareness Week (WAAW) was observed from 12-18 November 2018 (Figure 28). Activities included delivery of public awareness messages as FM broadcast, posters and role-play by the nursing staff and medical social workers, Myth buster quiz and antibiogram presentation to create awareness among the doctors.



Figure 27. BioFire FilmArray

2. National CME on “Infection Prevention and Control in a Super specialty Setting: Facing the Future” conducted on 22-23 March 2019 (Figure 29).
3. Guest Lecture on “Syndromic Diagnosis in Infectious diseases” by Dr Rajalakshmi, ID



Specialist, KIMS, and launch of BioFire FilmArray at SCTIMST - 24 October 2018

Staff

Faculty

Dr Kavita Raja, Professor and Head of the Department

Dr Dinoop K P, Assistant Professor (from August 2018)

Dr Jyothi E K, Scientist C (from August 2018)

Technical

Sujatha, Scientific Officer

Soja Rani, Scientific Assistant

Reeja Rani D C, Technical Assistant (Lab) - B

Cinta Rose, Technical Assistant (Lab) - A

Smitha M, Technical Assistant (Lab) - A

Sudha Chandran R, Technical Assistant (Lab) - A



Figure 28. World Antibiotic resistance Awareness Week



Figure 29. CME on “Infection Prevention and Control in a Super specialty Setting: Facing the Future”



DEPARTMENT OF NEUROLOGY

The Department comprises multiple subsections that provide specialized and comprehensive care to patients with various neurological disorders. The Department conducts General Neurology Outpatient Clinics daily from Monday to Friday as well as weekly Specialty Clinics for review of patients under different subsections.

During the year, a total of 50122 outpatients were seen in General Neurology which included 43292 reviews and 6830 new registrations, and 14432 patients were seen in Specialty Clinics. The inpatient number was 3791, bed strength was 60 and the bed occupancy rate was 100% (Figure 30). There were 31 mortalities with a mortality rate of 0.82% during this period.



Figure 30. Outpatient and inpatient care in Neurology Department in 2018-19

The faculty and students participated in many national and international conferences and received several prestigious awards during the year. The Department continued to pursue major research projects and produced notable publications. The Department conducted many patient outreach programmes including the Athiyanoor Clinic outreach programme. The activities of the various subsections of Neurology during the year are enumerated in the individual sections.

Neurology Intensive Care Unit

Activities

The distribution of cases in the Neurology ICU during the year is summarized in the Table and Figure 31:

Neurological condition	Number
Status epilepticus	49
Super refractory status epilepticus	6

Myasthenia gravis	6
Meningitis	14
Chronic Tubercular	7
Pyogenic	5
Aseptic	0
Carcinomatous	1
Chronic non-infective	1
Acute stroke including intracerebral bleed	29
Cerebral venous sinus thrombosis	4
Central nervous system demyelination	27
Motor neuron disease	4
Guillain-Barre syndrome	18
Chronic inflammatory demyelinating polyradiculoneuropathy	5



Viral encephalitis	4
Autoimmune encephalitis	13
Rasmussen's encephalitis	6
Cruetzfeldt-Jakob disease	1
Metabolic Encephalopathy	11
Others	103
Total	294
Mortality	15 (5%)

Among various neurological conditions, status epilepticus was the leading cause for admission to the

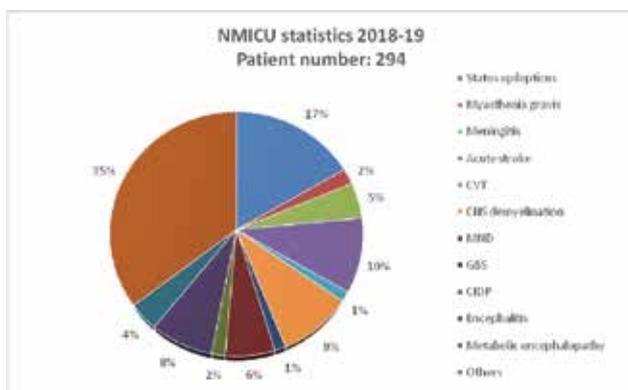


Figure 31. Neurology ICU Statistics

NMICU (16% of the total admissions). Out of the 15 patients expired, 7 had status epilepticus (with other medical complications) due to autoimmune/viral encephalitis, febrile infection related epilepsy syndrome (FIRES) or static encephalopathy.

Compared to the preceding year, there was a marginal increase in the number of patients (291 vs 294) as indicated in the Table below:

Neurological condition	Number of admissions		
	2016-17	2017-18	2018-19
Status epilepticus	26	44	49
Super refractory status	11	6	6
Myasthenia gravis	7	18	6

Meningitis	19	24	14
Chronic Tubercular	10	11	7
Pyogenic	2	3	5
Aseptic	2	3	0
Carcinomatous	3	3	1
Chronic non-infective	2	4	1
Acute stroke including intracerebral bleed	8	22	29
Cerebral venous sinus thrombosis	4	2	4
Central nervous system demyelination	13	25	27
Motor neuron disease	3	3	4
Guillain-Barre syndrome	3	15	18
Chronic inflammatory demyelinating polyradiculoneuropathy	3	4	5
Viral encephalitis	1	8	4
Autoimmune encephalitis	5	13	13
Rasmussen's encephalitis	3	2	6
Cruetzfeldt-Jakob disease	1	3	1
Metabolic Encephalopathy	17	25	11
Others	21	77	103
Total	145	291	294
Mortality	10 (6.9%)	7 (2.4%)	15 (5%)

New Initiatives

The Neurocritical Care Patient Management Conference (PMC) was initiated for a streamlined, interdisciplinary collaboration for critically ill neurological patients.

Events Organized

Many conferences were organized by the individual subdivisions of the Department. Dr Emilio Perucca,



the renowned epileptologist, visited the Department on 7 April 2018 and delivered a lecture on the pharmacology and interactions of antiepileptic drugs. Prof Bindu T Desai, retired faculty from California and previous Head of the Department of Neurology at SCTIMST, visited on 17 February 2019 and interacted with the students and faculty on 'End of life care' in neurological diseases.

Awards and Honours

1. Dr Gopikrishnan U, resident, secured the first prize in the national round and Dr Vysakha K V, resident, was the winner of the South zone of Torrent Young Scholar Award in 2018.
2. Dr Gopikrishnan U and Dr Vysakha K V, residents, were the first prize winners of the 'Emerging brain quiz' held at Medical College, Trivandrum in October 2018.
3. Dr Nandini Mitta, resident, was awarded first prize for the paper 'Clinical characteristics and long-term outcome of surgery in patients with hypothalamic lesions and refractory epilepsy' at KAN Midterm Meeting on 21 October 2018 at Kochi.
4. Dr Poornima Narayanan Nambiar, resident, secured second prize for the paper 'EEG as a prognostic marker in autoimmune encephalitis' at KAN Midterm Meeting on 21 October 2018 at Kochi.
5. Dr Nandini Mitta was awarded travel bursary of Rs. 25000/- from the institute to attend the Asia Pacific Stroke Conference, Jakarta 2018 for presenting the paper 'Sex differences in risk factor profile, clinical presentation, stroke subtype and outcome in acute ischemic stroke'.
6. Dr Poornima Narayanan Nambiar, resident, was awarded second prize in the Star paper award category for 'Utility of MRI in autoimmune encephalitis – use and misuse' during the 20th Joint Annual Conference of Indian Epilepsy Society and Indian Epilepsy Association (ECON 2019), on 8-10 March 2019 at New Delhi.

7. Dr Sudhakar K, resident, won the best poster award for the poster 'Emergency epilepsy surgery for management of super-refractory status epilepticus' at KAN Midterm Meeting on 21 October 2018 at Kochi.
8. Dr Udit Umesh Saraf, resident, was awarded the Young Investigator Award for presentation of his paper 'Comparison of risk factors, treatment and outcome in patients with symptomatic intracranial atherosclerotic disease in India and the United States' at the World Stroke Congress in October 2018 at Montreal.

The activities of the various subsections of Neurology are enumerated below.

COGNITION AND BEHAVIOURAL NEUROLOGY SECTION

The Cognition and Behavioural Neurology Section (CBNS) provides clinical services to persons with cognitive problems in disorders like dementia, epilepsy, stroke and autoimmune disorders. It conducts a Memory and Neurobehavioral Disorders Clinic every week. 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 care givers. The Section also carries out clinical and basic research in the field of dementia, cognition and behaviour.

The designated activities include (i) conducting a Memory and Neurobehavioural Clinic every week that caters to patients with MCI and dementias (ii) comprehensive assessment of patients with cognitive problems admitted to the Institute (iii) counseling of caregivers of patients with dementia along with psychosocial support and (iv) research activities on structural and functional neuroimaging in dementias as well as development and validation of neuropsychological batteries.

Activities

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



Activity	Number
Speech and language evaluation	3311
Speech therapy	543
Audiometric evaluations	340
Videofluoroscopy	69
Neuropsychological testing	1937
IQ assessments	284
Counseling sessions	739
Memory & Neurobehavioral Clinic attendance	775
New patients with dementia	81

Research Programmes

1. The ongoing study on the effect of yoga on neuropsychological functions and brain connectivity networks in mild cognitive impairment (MCI) and cognitively normal subjects investigates resting state, structural connectivity and neuropsychological impact of mindfulness meditation among patients with MCI subjected to a harmonized protocol post-randomization into meditation arm versus standard care.
2. The Dementia Science Programme is aimed at assessing the incidence, prevalence, risk and intervention analysis of dementia and basic research and is funded by the DBT.

New Initiatives

The Dementia Science Programme under the aegis of DBT-NBRC-INCLIN Trust was initiated and MoU was signed. The first part of the grant was released to start the activities.

Events Organized

A programme was organized by CBNS in association with ARDSI on World Alzheimers Day on 27 September 2018.

Awards and Honours

Ms Manju Mohan P, Speech Therapist, received first prize in oral presentation for the paper titled, “Animacy effects in novel word learning” at the 11th Kerala State Branch, Indian Speech and Hearing Association on 15-16 September 2018.

COMPREHENSIVE CARE CENTRE FOR MOVEMENT DISORDERS

The Comprehensive Care Centre for Movement Disorders (CCCMD) at SCTIMST is involved in clinical care, teaching and training, and research on the clinical, genetic and pathophysiological aspects of movement disorders. They generally result from disease processes affecting the basal ganglia and their connections to other areas like the cerebellum and the cerebral cortex. Parkinson’s Disease (PD) is one among the common movement disorders. The CCCMD provides comprehensive medical and surgical care to patients affected with various movement disorders, trains neurologists from various parts of India in the state-of-the-art management of movement disorders, conducts PhD programmes and engages in basic science, clinical and biomedical research.

Activities

During the year, the Centre provided comprehensive clinical services to a large number of patients with movement disorders from all over the country. The Centre was involved in several externally-funded research projects (including those with international collaboration) and R&D projects in collaboration with the Biomedical Technology Wing of the Institute. One of the research fellows successfully completed his course and was awarded PhD for the work done on the protective role of poly-amines against manganese-induced toxicity in dopaminergic cells. A new PhD student joined the programme and has started her work on the identification and characterization of neuronal-derived circulating exosomal microRNA and protein cargoes in patients with Parkinson’s disease. Considering the increase in the number of patients approaching the Centre for clinical care and the increasing number of clinical procedures undertaken, the number of Post-Doctoral Fellowship seats was increased to two. Two multicentre collaborative projects (one of them, with international



collaboration) received provisional approval from funding agencies and the final approval is expected in the coming year. Five articles were published in scientific journals and books and invited lectures were delivered in several international and national scientific conferences, by the faculty of the Centre. Dr Sabine Meunier, researcher from Pitié-Salpêtrière Hospital, Paris, France, visited the Centre as part of the ongoing collaborative research projects.

The clinical activities of CCCMD included the weekly Movement Disorders Review Clinic, Botulinum Toxin Injection Clinic and the Movement Disorders Surgical Programme. The Motor Physiology Laboratory under the CCCMD conducted electrophysiological investigations in patients with movement disorders. Around 600 patients with various movement disorders were referred to the CCCMD from all over India and got newly registered in the past year. The Movement Disorders Review Clinic had 3040 review consultation visits by already registered patients. 30 patients sought consultation through the e-consultation system launched last year. 520 botulinum toxin injection sessions were undertaken by the fortnightly Botulinum Toxin Injection Clinic. 21 deep brain stimulation and related surgical procedures (like replacement of stimulator) were performed; the number is less than the previous year as DBS surgeries in the initial part of the year because of unavailability of stereotactic frame (Figure 32). Around 55 Deep Brain Stimulation programming sessions were done on patients on follow-up. The Motor Physiology Laboratory conducted around 246 sessions of electrophysiological studies.

Research Programmes

The CCCMD is involved in research pertaining to the basic science, clinical and genetic aspects of movement disorders and several research projects are ongoing.

An international multicentre collaborative study on the genetics of Parkinson's Disease was conceived during the year with SCTIMST as the co-ordinating nodal centre in India. This study, titled "Genetic Architecture of Parkinson's disease in India" would be the first genome-wide association (GWA) study from the Indian subcontinent. The study is to be funded by the Michael J Fox foundation, USA, which has accepted the proposal in principle and the final

budgetary aspects are under review. Three other nodal centres (All India Institute of Medical Sciences, New Delhi; Nizams Institute of Medical Sciences, Hyderabad and NIMHANS, Bangalore) and more than 15 sub-centres across the country will participate to recruit around 10000 patients with Parkinson's Disease and an equal number of healthy volunteers needed for the study. The genetic analysis of the participating subjects will be done by the international collaborator, the Department of Genetic Epidemiology at the University of Tubingen, Germany. The study is expected to provide valuable information on the genetic predisposing factors underlying PD in India.

A second collaborative study titled "Exploring the human gut microbiome, metabolome and alpha-synuclein in health and Parkinson's Disease (PD) – a window to the gut microbiota-brain axis alterations in PD" was planned. The pre-proposal of the study was approved by ICMR and the final proposal was accepted for pilot testing. The proposal aims to explore the variations in the gut flora of patients with PD compared to healthy volunteers and examine how these variations could impact the pathogenesis of PD. Gut dysbiosis is currently a research hotspot in PD.

A research project funded by the SATYAM Program of the DST explores the physiological basis of the salutary effects of Yoga on the neural control of movements. This study also aims to examine the beneficial effects of Yoga in patients with PD. Another project, funded by the ICMR aims at a longitudinal follow-up of the cognitive functions in patients with PD to detect the trend of decline over time. A third project funded by the Department of Biotechnology, Government of India, examines whether estimation of iron levels in various parts of brain by MRI- based techniques can differentiate Parkinson's Disease from other neurological disorders with a similar clinical picture (Atypical Parkinsonism) (Figure 33). Apart from these research projects funded by external funding agencies, the Centre conducts many internally-funded/ non-funded projects as well. A transcranial magnetic stimulation-based study examines the relationship between cerebellum and the loss of depotentiation of motor cortex synapses that occur in dyskinetic PD patients, another functional MRI (fMRI) based study explores the connections between cerebellum and basal ganglia structures (Figure 34). Other ongoing



studies explore various clinical aspects of movement disorders, like the effects of subthalamic nucleus DBS on non-motor fluctuations in Parkinson's Disease, relationship between apraxia of eye lid opening and DBS, the cognitive outcome of DBS surgery, clinical profile and diagnostic sub-types of Progressive Supranuclear Palsy (a degenerative disease causing parkinsonism and having a more aggressive clinical course than Parkinson's Disease).

Many of the research projects completed during the year or the previous year resulted in several high-impact publications. The results of a collaborative study done with the University of Tübingen, Germany (funded by the Michael J Fox foundation, USA) aimed at elucidating the genetic perturbations underlying Parkinson's Disease in the Indian population was published in the high-impact international journal *Movement Disorders*. The study described four novel variants in the LRRK2 gene in our population with PD. Another article published in the high impact journal *Cerebral Cortex* addressed the pathomechanisms underlying the condition called writer's cramp which is a 'task-specific' dystonia. In this condition, muscles which are unwanted or unintended also get activated during the task of writing, resulting in abnormal posturing/tremors of the hand while writing. In the transcranial magnetic stimulation

based study funded by the Dystonia Medical Research foundation, USA, in patients with different types (those with and without a phenomenon called mirror dystonia) of writer's cramp, the already known pathomechanisms 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. A third publication in the international journal *Cell Biology and Toxicology* involved the results of research conducted in cellular and animal models and showed that the polyamine "spermine" protects dopamine secreting neurons from damage caused by manganese, this could have important implications in PD pathogenesis. The publication in *Movement Disorders Clinical Practice* discussed that there could be genetic correlates to impulsivity in patients with PD, related to polymorphisms in dopamine receptor gene.

Product Development

The CCCMD, collaborating with the Biomedical Technology Wing of the Institute and external collaborator (Bhabha Atomic Research Centre), was engaged in the development of a low cost and efficient Deep Brain Stimulation system for Movement Disorders.



Figure 32. Deep Brain Stimulation surgery for Parkinson's Disease using MRI-based stereotactic and micro-electrode recording guidance

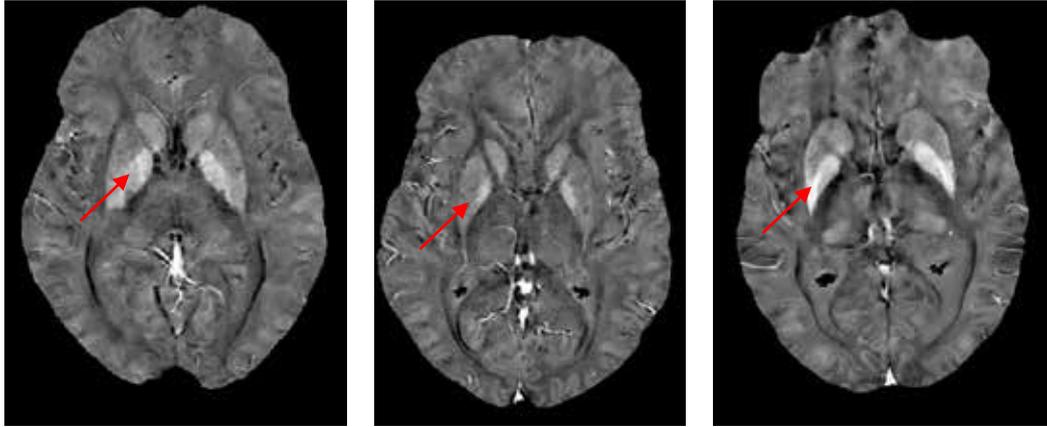


Figure 33. Research project funded by the Department of Biotechnology aims to differentiate various Parkinsonian disorders by quantitatively estimating the iron content of certain areas in the brain called basal ganglia. The project uses the novel technique, “quantitative susceptibility mapping”. Arrowheads point to areas with different iron content in patients with different Parkinsonian disorders.

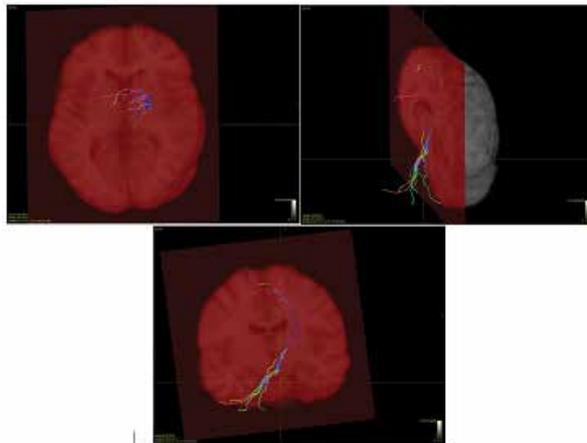


Figure 34. A functional MRI and Diffusion Tensor Imaging-based project explores the connections between cerebellum and basal ganglia

COMPREHENSIVE CENTRE FOR SLEEP DISORDERS

The Comprehensive Centre for Sleep Disorders (CCSD) is a subsection of the Department of Neurology engaged mainly in clinical care of patients with sleep disorders on an outpatient basis. The Centre performs diagnostic studies and prescribes treatment including Continuous Positive Airway Pressure (CPAP) titration to the patients. In addition, the Centre also engages in clinical research on sleep disorders in patients.

Activities

The Centre conducts weekly sleep outpatient clinics where new and review patients are seen, investigations are planned, and treatment initiated. Interdepartmental consultations from Cardiology and Surgical specialties are also managed. A two-bedded sleep laboratory with facilities for performing diagnostic polysomnography, CPAP titration and multiple sleep latency tests are available.

The summary of the clinical services delivered during the year are indicated in the Table below:

Activity	Number
Sleep outpatient clinic attendance	686
Polysomnography - diagnostic	120
CPAP titration studies	50
Multiple sleep latency test	4

Research Programmes

One extramural funded study, ‘Can obstructive sleep apnea affect perioperative outcomes in patients undergoing cardiovascular surgery?’ initiated in August 2017 in collaboration with Departments of Anaesthesiology and Cardiovascular and Thoracic Surgery continued.



New Initiatives

Cognitive behavioural therapy was initiated for chronic insomnia patients in collaboration with Clinical Neuropsychologist.

COMPREHENSIVE STROKE CARE PROGRAMME

The aim of the Programme is to provide comprehensive care for patients with stroke. It is a 11-bedded unit with 7 ICU beds. The major services include intravenous thrombolysis for acute ischemic stroke patients, mechanical thrombectomy for acute patients with major vessel occlusion, decompressive hemicraniectomy for malignant strokes, haematoma evacuation in haemorrhagic strokes, Moyamoya revascularization surgeries and carotid endarterectomy and stenting for stroke prevention. The Stroke Team includes neurologists, neurosurgeons, vascular surgeon, interventional radiologists, cardiologists and neuroanaesthetists. The Programme provides comprehensive rehabilitation to stroke survivors by a team involving speech therapist, physiotherapist, occupational therapist, stroke nurse and medical social worker. A Stroke helpline is available through which emergency acute case gets referred to the Institute.

Activities

Stroke Clinic is conducted every Friday from 10 AM to 2 PM where the stroke survivors are reviewed and followed up. As a part of secondary prevention, the team is committed to providing education regarding the symptoms and risk factors of stroke and the importance of medical adherence for the patient as well as the primary care givers. A patient management conference is held every Friday by a multidisciplinary team that includes neurologists, neurosurgeon, vascular surgeon, cardiologist and interventional radiologists. The team discusses the most challenging cases and takes consensus decisions regarding the treatment plan of patients.

The clinical activities during the year are summarised in the Table below:

Areas / Procedures	Number
Stroke Clinic attendance	3316
ICU admissions	457

Carotid endarterectomy	37
Carotid stenting	9
IV thrombolysis	30
Mechanical thrombectomy	37
Moyamoya revascularization	19
Decompressive hemicraniectomy	10
Haematoma evacuation	13

Ms Soumya Krishnamoorthy joined as PhD scholar and Dr Arun K joined as Wellcome DBT Fellow in Comprehensive Stroke Care Programme.

Research Programmes

1. The study titled “Improving Stroke Care in India” (IMPROVISE) was initiated in November 2018 in collaboration with the University of Central Lancashire, UK. Its aim is to develop and explore the feasibility and acceptability (staff, patients and carers) of delivering these evidence-based interdisciplinary care bundles for the management of stroke in Stroke Unit. It is a multicentre study including CMC Ludhiana, AIIMS Delhi, and SCTIMST.
2. A project titled “Improvement of Secondary Stroke Prevention by Primary Health Care Approach” funded by Directorate of Health Services, Ministry of Health and Family Welfare, Government of Kerala was started in December 2017 and completed in December 2018. The final report of the project was submitted on 31 January 2019.
3. A study titled “Ayurvedic treatment compared to conventional physiotherapy in the rehabilitation of ischemic stroke patients in India: A randomised controlled trial (RESTORE)” funded by Indian Council of Medical Research was initiated in November 2018. SCTIMST is the national co-ordinating Centre for this project and Dr P N Sylaja is the National principal investigator for the study. It is a multicentre study including CMC Ludhiana, AIMS Kochi, and SCTIMST



4. Secondary Prevention by Structured Semi-Interactive Stroke Prevention Package in India Study (SPRINT Study): This study aims to use structured semi-interactive stroke prevention package to reduce the risk of recurrent strokes, myocardial infarction and death in patients with sub-acute stroke after one month. It was initiated in May 2018 and funded by Indian Council of Medical Research.
5. A project titled “Understanding phenotypes in Moyamoya disease by resequencing 17q25ter region- An imaging genomics approach study” was initiated in January 2018 and funded by Wellcome Trust DBT.

New Initiatives

1. During the year, the Stroke Programme was actively involved in community intervention in stroke prevention in collaboration with Directorate of Health Services, Government of Kerala. Health workers, palliative care nurses and ASHA workers of all rural health blocks of Trivandrum district were trained in stroke care and secondary prevention of stroke in the community. In addition, training programmes were conducted for primary care physicians of all rural health blocks of Trivandrum district. The Comprehensive Stroke Care Programme collaborated with the Government of Kerala in starting the Stroke Unit in General Hospital, Trivandrum, which was inaugurated on 16 February 2019.
2. A MoU was signed between University of Central Lancashire, UK, and SCTIMST for the project titled “Improving Stroke Care in India (IMPROVISE)”.
3. A MoU was signed between Ayurveda College, Government of Kerala, Triveni Nursing Home and SCTIMST regarding the project titled “Ayurvedic treatment in the rehabilitation of ischemic stroke patients in India: A randomised controlled trial (RESTORE)”.

Events Organized

1. A two-day international conference on ‘Essentials of Stroke Care’ in collaboration with the University of Central Lancashire (UCLAN), United Kingdom, funded by the National Institute of Health Research, UK, was organised at the Residency Tower Hotel, Thiruvananthapuram, Kerala, on 17-18 November 2018 (Figures 35 and 36). The objective was to improve the knowledge and skills of health professionals including physicians, nurses, physiotherapists, speech therapists and occupational therapists in the management of patients with stroke. The course co-ordinators for the event were Prof Dame Caroline Watkins from UCLAN and Prof P N Sylaja from SCTIMST. The resource persons’ panel for the conference comprised 12 international and 20 national stroke experts.
2. A training programme was conducted for the junior public health nurses, palliative care nurses and ASHA workers in 23 rural health blocks of Trivandrum district. The programme focussed on giving them training in acute stroke care, secondary prevention, risk factor control and home care of stroke survivors. During the year, 1000 health workers were given training over 12 sessions.
3. Two training programmes were conducted on stroke management for primary health care physicians in primary and community health centres of Trivandrum district.
4. A Workshop was conducted on stroke rehabilitation for physiotherapists aimed at all the physiotherapists working in the Government Hospitals under the Directorate of Health Services in Kerala.

Awards and Honours

1. Dr P N Sylaja, Professor, was awarded the Fellow of European Stroke Organization in 2018.
2. Dr P N Sylaja was awarded Honorary Clinical Professor of School of Nursing, University of Lancashire, UK.



3. Dr P N Sylaja was selected as the Technical Consultant for the stroke care activities in Kerala and was felicitated at a meeting by the Health Minister of Kerala on 29 May 2018.
4. Dr Sapna Erat Sreedharan, Associate Professor, received travel grant for the Asia-Pacific Stroke Conference 2018.
5. The abstract submitted by Ms Soumya Krishnamoorthy, PhD student, titled “Increased levels of serum Apolipoprotein B in symptomatic intracranial atherosclerotic disease” was selected for the top 10 Young Investigator Award at the World Stroke Congress 2018 held at Montreal, Canada.
6. The abstract submitted by Dr Arun K, Wellcome DBT Fellow in the Stroke Programme, titled “Prevalence of aortic arch plaque in cryptogenic ischemic stroke and prediction of outcome” was selected for the top 10 Young Investigator Award at the World Stroke Congress 2018 held at Montreal, Canada.



Figure 35. Faculty of the International Conference on ‘The Essentials of Stroke Care’, Thiruvananthapuram, November 2018



Figure 36. Inauguration of the International Conference on the ‘Essentials of Stroke Care’ by Her Royal Highness Aswathy Tirunal Gowri Lakshmi Bayi



NEUROMUSCULAR DIVISION

The Neuromuscular Division under the Department of Neurology caters to two broad groups of disorders: (a) the Neuromuscular disorders which include anterior horn cell diseases, neuropathies, inflammatory myopathies, genetic muscle diseases including muscular dystrophies and neuromuscular junction disorders (b) Acquired central nervous system demyelinating disorders like multiple sclerosis and neuromyelitis optica spectrum disorders. The patient care services include a weekly Neuromuscular Clinic and monthly Multiple Sclerosis Clinic. The team also routinely caters to the care of neuromuscular and multiple sclerosis admitted in the neurology wards and intensive care unit.

Academic activities include training of Post-Doctoral Fellows and Diploma in Neurotechnology students. The Division had one Post-Doctoral Fellow who completed training on 31 December 2018. The consultants and fellow participated in various national and international conferences as faculty and delegates.

Activities

The Neuromuscular Clinic functions on Tuesday of every week. During the year, the clinic recorded 1501 patient visits. A patient management conference focussing on rehabilitation of patients with significant physical disability was conducted every Tuesday afternoon. The session was attended by neurology consultants, physiatrist, speech therapist, occupational therapist, medical social worker, postdoctoral fellow and neurology residents.

The Multiple Sclerosis (MS) Clinic functions on the second Tuesday of every month and specifically addresses the disease-modifying therapy, rehabilitation needs and social problems in multiple sclerosis and related demyelinating diseases. During the year, 70 patient visits were made to the MS Clinic.

The studies conducted in the Electrophysiology Laboratory during the year are summarized in the

Table below:

Study	Number
Nerve conduction studies	1282
Electromyography	729
Repetitive nerve stimulation	135
Blink reflex studies	18
Single fibre EMG	25
Visual evoked potential	361
Brainstem auditory evoked potential	145
Somatosensory evoked potential	105

The specialized procedures performed in the Department during the year are summarized in the Table below:

Procedure	Number
Therapeutic plasma exchange	79 exchanges (16 patients)
Muscle biopsy	51
Nerve biopsy	27
Skin biopsy	17
Thymectomy (for Myasthenia gravis)	3

Research Programmes

1. A new study “Estimation study for reduction in transport of referral cases to tertiary hospitals by use of mobile-enabled telemedicine system in remote hospitals”, a TiMED Pilot Study for feasibility with E-Health, Government of Kerala, was initiated in April 2018 with Prof Muralidharan Nair as the Principal Investigator. The study continued with General and District Hospitals.
2. The project entitled “Structural and functional correlates of cognitive dysfunction in multiple sclerosis” funded by Cognitive Science Research Initiative of the Department of Science and Technology initiated in June 2017 continued to recruit patients and controls for neuropsychological testing and multimodality MRI.



3. EXTEND study, extension phase for the Daclizumab High Yield process in relapsing remitting multiple sclerosis was a phase III trial for Daclizumab in relapse prevention in multiple sclerosis. The study was completed in December 2018.
4. Newly initiated intramural projects included clinical studies on congenital myasthenic syndromes, Hirayama disease and mitochondrial myopathy. Two new post-graduate student projects initiated were longitudinal study of motor unit number estimation in anterior horn cell diseases and study of pregnancy outcome in myasthenia gravis.



Figure 37. Panel addressing questions from the forum on the World Multiple Sclerosis Day 2018 patient outreach programme

Events Organized

1. Prof Muralidharan Nair was the organizing president of the 4th ICTRIMS, Indian Committee for Treatment and Research in Multiple Sclerosis, on 14-15 July 2018 at Kochi. The conference was attended by 150 delegates and 10 international speakers of repute. The Neuromuscular Division actively participated in the meeting
2. A patient outreach programme was held on the occasion of the World Multiple Sclerosis Day on 9 June 2018 (Figure 37). The programme was attended by 27 patients and 25 caretakers. Sessions included a motivational talk by Prof Abraham Kuruvilla and talks on management of fatigue, psychological problems, swallowing difficulty and injection problems in multiple sclerosis.
3. A Medical Writing Workshop was organized on 23 March 2019 by Prof Muralidharan Nair as Chair of the Research Forum.

Awards and Honours

Dr Muralidharan Nair, Professor Senior Grade, officiated as MCI Inspector for Coimbatore Medical College for DM Neurology Course in January 2019 and NBE Inspector to Dr BD Sharma PGIMS, Rohtak, for DNB in Neurology in November 2018.

PAEDIATRIC NEUROLOGY DIVISION

The Comprehensive Care Centre for Neurodevelopmental Disorders (CCCND) under Paediatric Neurology completed one year of functioning in August 2018. The Centre has successfully established assessment and therapy services, including psychology, speech therapy, occupational therapy and physiotherapy for children with various neurodevelopmental disorders including autism.

Clinical services are offered in the Division of Pediatric Neurology both on outpatient and inpatient basis. The Division also conducts an Autism Clinic on every first and third Saturdays. Comprehensive management of children diagnosed with Autism spectrum disorders and other neurodevelopmental disorders is offered through the Clinic.

The Staff contribute their clinical expertise to patients at National Institute of Speech and Hearing (NISH), Trivandrum. The team from SCTIMST visits NISH every Monday to examine the children with autism and other neurodevelopmental disorders.



Patient Management Forum is held regularly twice a month in the Autism Clinic. Pediatric Neurology meetings are convened twice a month for discussing complicated cases.

Activities

During the year, there were 215 admissions and 776 new cases registered at CCCND. The distribution of cases is summarized in the Table below:

Diagnosis	Number
Autism spectrum disorders	137
Intellectual developmental disorders	316
Social communication disorders	56
Motor disorders	633
Learning disorders	141

A total of 192 cases were seen in the Autism Clinic out of which 90 were new cases. The clinical services included speech and language therapy, IQ assessment, occupational therapy, behavioural therapy, sensory integration, physiotherapy, virtual gaming and activities of daily living training.

Research Programmes

1. The project “Evaluation of intermediate-term - cardiac and neurodevelopmental outcomes of children undergoing arterial switch operation for complete transposition of great arteries” funded by National Health Mission in collaboration with the Departments of CVTS and Cardiology continued.
2. The ongoing intramural projects included: the validation of the Malayalam translation of broad autism phenotype questionnaire, assessment of the autistic traits in parents of children with ASD and a study on the barriers in implementing home training programmes in ASD.

Events Organized

1. The second Scientific Advisory Committee meeting of CCCND was held on the 29 March

2019. The meeting was chaired by the Director, Dr Asha Kishore (Figure 38). The meeting was attended by the experts from the field of autism including child and adolescent psychiatrists, neurologists and geneticists. The current activities and the future plans of the CCCND were discussed.



Figure 38. Scientific Advisory Committee meeting of CCCND on 29 March 2019

2. A Health Education Programme was conducted at Vakkom Grama Panchayat on 15 October 2018. The meeting was attended by the President, Vice-president, Secretary, other office bearers of the Vakkom Panchayat, the anganwadi teachers, parents and children with special needs.

R MADHAVAN NAYAR CENTRE FOR COMPREHENSIVE EPILEPSY CARE

R Madhavan Nayar Centre for Comprehensive Epilepsy Care (RMNCEC) provides comprehensive care for all types of adult and paediatric epilepsies to patients from all parts of India and the neighboring 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 the Centre is as follows: (1) to provide comprehensive medical, surgical, psychosocial and occupational care for patients with epilepsy with a special 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) under the subsection of Kerala Registry for Epilepsy in Pregnancy (KREP) to address issues pertaining to women with epilepsy

Activities

During the year, the Centre completed 2200 epilepsy surgeries to become the first and only Centre in India to have completed more than 2000 epilepsy surgeries.

The activities of the Centre are summarized in the Table below:

Activity	Number
Video EEG monitoring	1377
Intracranial monitoring	8
Epilepsy surgery	114
Intraoperative electrocorticogram	92
WADA test	15
Cortical stimulation and mapping	3
Epilepsy clinic attendance	7570
Epilepsy ward admissions	310
Electroencephalogram (outpatient)	4846

The special activities included 12 Clinics conducted at PHC Changaramkulam in collaboration with Alamcode Panchayat Committee and monthly Clinics for women with epilepsy conducted at the Women and Children Hospital, Thycaud, Trivandrum.

Two video EEG machines and one portable EEG machine was installed.

Two Postdoctoral Fellows completed training in epilepsy in December 2018 and a new Fellow joined in January 2019.

Research Programmes

1. The following projects in KREP continued during the year:

- Cognitive, behavioural and language function in children of women with epilepsy with exposure to antiepileptic drugs in collaboration with the Centre for Child Development (CDC), Trivandrum
 - 12 - 18 year follow-up of children of women with epilepsy funded by ICMR
2. Analyzing functional connectivity networks in drug-resistant epilepsy is a SERB- funded project that is scheduled to be completed in April 2019.

New Initiatives

1. Stereo EEG-based intracranial monitoring and resection in MRI-negative extratemporal epilepsy was initiated
2. Co-registration of MRI and PET was initiated
3. Arterial Spin Labelling was standardized and regularly applied as a tool in the pre-surgical evaluation of epilepsy

Events Organized

1. International Epilepsy Day was celebrated in RMNCEC on 28 February 2018. It was attended by more than 150 people with epilepsy, their parents, doctors of the institute and various health care providers from the hospital. On the occasion, a drawing competition was organized for children with epilepsy where 13 children participated. Distinguished guests including Dr Sriram Venkatraman IAS (Director of Employment and Training, Kerala State), Prof Muralidharan Nair, and Prof Sanjeev V Thomas graced the occasion. Children with epilepsy performed different cultural programmes on the occasion. Dr George Vilanilam and Dr Ajith Cherian delivered speech on epilepsy and public awareness.
2. Epilepsy School was conducted in August 2018 in Trivandrum under the aegis of RMNCEC (as an initiative of Indian Epilepsy Association and Society) which was attended by 120 Neurologists and trainees from all over India.



3. A one-day training programme for young neurologists on how to conduct and maintain a Registry of Epilepsy and Pregnancy was conducted under the guidance of Prof Sanjeev V Thomas.

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
Therapists

Awards and Honours

Dr Ashalatha Radhakrishnan, Professor, was awarded Fellow of Royal College of Physicians (Glasgow) in August 2018.

Staff

Faculty

Dr Sanjeev V Thomas, Professor (Senior Grade) and Head of the Department
Dr Muralidharan Nair, Professor (Senior Grade)
Dr Abraham Kuruvilla, Professor (till 30 November 2018)
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

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

2018-19 was a year of consolidation as well as achievement for the Department of Neurosurgery which continued its pursuit of excellence. During the move forward, the mission of the Department remained unchanged - to provide world-class neurosurgical care, advance neurosurgical knowledge through research and innovation and ensure the best academic environment for neurosurgical education.

Activities

The Department recorded an increase in the number of patients seeking surgical care. More than 1500 surgeries were performed, and the surgical spectra ranged from surgeries for surface gliomas, complex neurovascular and skull base surgeries to high-end functional neurosurgeries. With a minimum of 2-3 epilepsy surgeries and one surgery for movement disorder every week, the Department performs the highest number of functional neurosurgeries in the country.

Nearly fifty percent of the surgical patients belonged to states other than Kerala which is a matter of pride as patients from distant parts of the country seek and reach this centre for advanced neurosurgical services.

The Neurosurgical Residency Training Programme once again received full accreditation with all the final year residents successfully completing their residency programme and performing exceptionally well in the exit examination. The Residency Training Programme is central to the teaching mandate; success in this area is recognized by the ability to attract top-notch medical school applicants from across the country and is considered as one of the most sought after neurosurgical programmes in the country. Neurosurgery observers from several teaching institutes in Kerala and Tamil Nadu visited the Department during the year.

Major equipment procured last year included Leica Microscopes for the operation theatres, high-end operating tables, stereotactic frame and microsurgical instruments.

Research Programmes

Two new projects funded by the Technology Development Fund were initiated during the year:

1. Evaluation of fibrous mesh sheets as scaffolds for increasing the area of neovascularisation in Moyamoya disease.
2. Development of skull base buttress device for the closure of osteodural defects.

New Initiatives

Notable new innovations were made in the following areas of neurosurgery:

1. Hybrid vascular surgery: endovascular combined with open vascular procedures for complex arteriovenous malformations and spinal arteriovenous fistulas
2. Complex spinal stabilization procedures for spinal pathologies
3. Expansion of the repertoire of cerebrovascular and skull base surgeries by performing an increasing number of complex neurovascular procedures including microvascular anastomosis for cerebral perfusion and endoscopic skull base surgeries for complex skull base tumours
4. There was an exponential increase in the proportion of patients undergoing neuromonitoring. The nerve function is now routinely preserved in posterior fossa schwannomas. Spinal congenital malformations also undergo de-tethering under neuromonitoring.



Awards and Honours

1. Dr George C Vilanilam, Additional Professor, was conferred Fellowship of the Royal College of Surgeons – Edinburgh (FRCS-Neurosurgery) by examination at the Diploma ceremony of the Royal College on 15 September 2018 at Hong Kong.
2. Dr George Vilanilam was selected for the International League against Epilepsy (ILAE) Leadership Development Programme on 21-26 June 2019 in Bangkok.
3. Dr Prakash Nair, Assistant Professor, won second prize for Flash Presentation at Skull Base Con 2018 at Ludhiana.
4. Dr Ganesh Divakar, Assistant Professor, was selected for a week-long training programme in Japan in collaboration with Association for Overseas Technical Co-operation and Sustainable Partnerships (AOTS).
5. Dr Mathew Abraham was appointed by the Government of Kerala as an expert in the Brain Death Committee to make comprehensive brain death assessment protocol.
6. Dr Easwer H V, Professor, was appointed as a member of a Committee headed by Dr M R Rajagopal, renowned Palliative Care Specialist,

by the Department of Health and Family Welfare, Government of Kerala, for creating guidelines for advanced directives for end-of-life care for the people of Kerala.

7. Dr Easwer H V was invited as visiting faculty for the PhD programme and the forthcoming Master's programme in Biotechnology affiliated to the UNESCO-Regional Centre for Biotechnology (a National University established through an Act of Parliament), Rajiv Gandhi Centre for Biotechnology, Trivandrum, India.

Staff

Faculty

Dr Mathew Abraham, Professor and Head of the Department

Dr Easwer H V, Professor

Dr Krishnakumar K, Professor

Dr George C Vilanilam, Additional Professor

Dr B Jayanand Sudhir, Assistant Professor

Dr Prakash Nair, Assistant Professor

Dr Tobin George, Assistant Professor

Dr Ganesh Divakar, Assistant Professor



DEPARTMENT OF PATHOLOGY

The Department has a central role at the Institute, providing laboratory and autopsy services, participating in academic activities and carrying out research on the diagnosis and causation of neurological and cardiovascular diseases.

Activities

The Department provided surgical, cytology, immunopathology and autopsy services pertaining to neuropathology, cardiovascular and thoracic pathology to the Clinical Departments.

The clinical services provided by the Department during the year are summarized in the Table below:

Category	Number
Neurosurgical biopsies	1055
Cardiovascular and thoracic biopsies	383
Muscle biopsies	67
Frozen sections	374
Cytology	27
Paraffin blocks	5059
Immunohistochemistry	3925
Immunopathology	5700

New Initiatives

Five immunology tests were introduced during the year:

- Immunoblots for: ANA profile, paraneoplastic neurological syndromes and Ganglioside profile.
- Indirect immunofluorescence tests for: anti-glutamate receptor (type NMDA) and anti-VGKC-associated proteins.

Awards and Honours

1. Dr Rajalakshmi P was awarded the International Travel Scheme by SERB to participate in the 19th International Congress of Neuropathology (ICN 2018) at Tokyo, Japan, 23-27 September 2018, and present a poster entitled “Multifocal central nervous system demyelination in a 40 year old: is it paraneoplastic?”
2. Dr Rajalakshmi P, Assistant Professor, Department of Pathology received third prize for the poster entitled “Glioblastoma with primitive neuronal component: a clinicopathological study” during the 4th Annual Conference of Neuropathology Society of India (NPSICON 2019) at PGIMER, Chandigarh, 15-17 February 2019.

Staff

Faculty

Dr Deepti A N, Associate Professor and Acting Head

Dr Rajalakshmi P, Assistant Professor

Dr Divya MS, Scientist C (from October 2018)

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



PAIN CLINIC

Patient management decisions at the Comprehensive Multidisciplinary Pain Clinic are taken on a broad based consensus arrived at by the Pain Clinician Team, comprising speciality departments of the institute. The services provided in the Clinic (Figure 39) include: outpatient Clinic on Fridays with the facilitation of the following highly skilled interventional procedures:

1. Regenerative Prolotherapy: Platelet-Rich Plasma (PRP) therapy using the patients’ own blood component for regenerative and healing therapy
2. Trans-foraminal fluoroscopy-guided injections
3. Trigger point injections
4. Musculoskeletal infiltrations
5. Ultrasound-guided sacroiliac and other joint interventions, musculoskeletal infiltrations
6. Selective dorsal root ganglia radiofrequency ablation (ultrasound-guided) and nerve and ganglion ablations
7. Facet joint interventions (fluoroscopy- guided)
8. Epidural steroid and anaesthetic injections

Activities

During the year, 803 patients were catered to in the Clinic and Intervention suites, the details of which are provided in the Table below:

Procedure	Number
Direct referrals	21
Review patients and in-house referrals	649
Regenerative autologous PRP prolotherapy interventions	98
Minor interventions (transforaminal epidural and nerve block injections)	12

Major interventions (Gasserian ganglion radiofrequency ablation)	12
Trigger point and musculoskeletal infiltrations	8
Inpatient admission intervention	2
Special consultation	1
Total	803

Research Programme

A clinical study in collaboration with Department of Transfusion Medicine as MD Transfusion Medicine thesis in “Autologous platelet-rich plasma for regenerative prolotherapy in chronic musculoskeletal pain” by Dr Vinu Rajendran was successfully completed.

New Initiatives

1. Regenerative Prolotherapy was initiated in collaboration with the Department of Transfusion Medicine. It was routinely performed with the patients’ own platelet-rich plasma in chronic pain conditions including osteoarthritis, rheumatoid arthritis and bursitis. This therapy, using autologous therapy (patients’ own platelets) for chronic degenerative joint and musculoskeletal non-cancerous pain conditions, being administered as a point-of-care, affordable, tailored to patients’ needs, along with physical rehabilitation and supportive therapies was first of its kind in India.
2. New Specialized Care from the Pain Clinic Team was initiated exclusively for geriatric patients with chronic musculoskeletal non-cancerous pain conditions, with funding from Kusuma Trust, UK. The process for Health Ministry Screening Committee (HMSC) procedures, TAC and IEC clearance as per Institutional protocols were initiated.



3. Preclinical studies for regenerative therapies in pain with osteoarthritis in collaboration with Dr Prabha D Nair, Division of Tissue Engineering and Regeneration Technologies, BMT Wing, was initiated.
4. Basic sciences studies and development of new point-of-care kits for Platelet Rich Plasma (PRP) separation was initiated in collaboration with Drs Renjith Nair and Anugya Bhat, Division of Thrombosis Research, BMT Wing.

Faculty

Dr Rupa Sreedhar, Professor (Senior Grade), Department of Anaesthesiology and In-charge, Pain Clinic

Dr Subin Sukesan, Associate Professor, Department of Anaesthesiology, co-In-charge, Pain Clinic

Dr Easwer H V, Professor, Department of Neurosurgery

Dr Nitha J, Assistant Professor and Head of Physical Medicine and Rehabilitation



Figure 39. Procedures performed in Pain Clinic



DEPARTMENT OF TRANSFUSION MEDICINE

The Department improved its service and academic activities during the year. There was an increase in the work output of the Department in terms of increasing blood collection, component preparation and patient support. The Department started Nucleic Acid Amplification testing on all donated blood units.

Activities

Clinical Services

During the year, 7652 units of blood was collected entirely from voluntary blood donors, of which 6193 units were collected from 187 outdoor blood donation camps and 1459 units from in-house collection. A total of 14643 units of blood were cross-matched (13201 units for in-house patients and 1442 units for outside patients) of which 7261 units were transfused (6205 for in-house patients and 1056 for outside patients). In 32847 samples, blood grouping was performed (30562 for in-house patients and 2285 for outside patients). 7652 units of blood collected were processed into various blood components: 7645 units of packed red cells, 7555 units of fresh frozen plasma, 2623 units of platelets and 1575 units of fresh plasma. 38 single donor platelets were prepared by apheresis method. 102 units of Platelet-Rich Plasma was prepared for Pain Clinic under Regenerative Medicine Programme. 13 therapeutic plasma exchanges were performed at Neurology ICU for neurological conditions.

Academic

One MD Transfusion Medicine student graduated from the Department. There were regular seminars by postgraduate students on various topics of Transfusion Medicine and journal clubs by academic staff and students.

Research Projects

1. A project titled "Evaluation of Red Cell Distribution Width as a predictive biomarker to assess the presence of coronary artery disease" was initiated with by Dr Sathyabhama S as the Principal Investigator.

2. A comparative study of performance evaluation of 3rd Generation ELISA kits with Enzyme Linked Immunofluorescence Assay for the detection of markers of HIV in donor blood was initiated.

New Initiatives

1. The Department started Nucleic Acid Amplification testing on all donated blood units from January 2019. The facility was inaugurated by the Hon'ble former President of Institute, Shri K M Chandrasekhar (Figure 40)



Figure 40. Nucleic Acid Amplification Testing Facility

2. Fully-automated Immunoematology equipment was installed in the Department for carrying out blood grouping, antibody screening and cross-matching techniques.
3. Platelet-Rich Plasma therapy was initiated as a regular treatment modality jointly with Pain Clinic, SCTIMST.



Events Organized

1. The Department was part of the Organizing Committee of 7th National Conference of Indian Society of Transfusion Medicine held at Kochi from 21-23 November 2018. Dr D Gupta was the Vice-Chairperson of the meeting.
2. World Blood Donor Day was celebrated on 14 June 2018 with the theme - germinate a new life. Blood donation camps were organized in and around Trivandrum and voluntary blood donation bands and packets of seeds were distributed to the blood donors.
3. National Voluntary Blood Donation Day was celebrated on 1 October 2018 (Figure 41). On this occasion, regular voluntary blood donors and voluntary blood donation camp organizers were felicitated.



Figure 41. National Voluntary Blood Donation Day

Awards and Honors

1. Dr Debasish Gupta, Professor and Head, was nominated Honorary Advisor for the upcoming Blood Bank helmed by Kerala Blood Bank Initiative.
2. Dr Vinu Rajendran, resident, won second prize under free paper section at the 7th National Conference of Indian Society of Transfusion Medicine on 21-23 November 2018 at Kochi.
3. Dr Debasish Gupta, Professor and Head, completed the Monograph on Blood Components as entrusted by Indian Pharmacopoeia Commission, Ministry of Health and Family Welfare, Government of India.
4. Dr Debasish Gupta was nominated Chairperson of the Committee for developing National Reference Standards of Blood Grouping Antisera by National Institute of Biologicals, Ministry of Health and Family Welfare, Government of India.
5. Drs Gayathri A M and Anila Mani, residents, won first prize at National level quiz contest ISTM-Transmedcon 2018 during the 7th National Conference of Indian Society of Transfusion Medicine on 21-23 November 2018 at Kochi.



Staff

Faculty

Dr Debasish Gupta, Professor and Head of the Department

Dr S Sathyabhama, Scientist G

Dr R Raj Bharath, Associate Professor (from November 2018)

Dr R Amita M, Assistant Professor (from 17 August 2018)

Technical

Ms Sheeladevi K S, Scientific Officer

Ms Sindhu P N, Scientific Officer

Mr George Paul Thaliath, Medico Social Worker - A

Ms Manju K Nair, Technical Assistant - A

Ms Preethy Prakash, Technical Assistant - A

Ms Renjini P, Technical Assistant - B

Ms Sindhu M S, Technical Assistant - B

Mr Sunil K P, Technical Assistant - B

Ms Baby Saritha G, Junior Technical Officer

Mr Sivakumar S, Junior Technical Officer

Ms Jyothi M, Senior Technical Assistant

BIOMEDICAL TECHNOLOGY WING





DEPARTMENT OF APPLIED BIOLOGY

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

The Department of Applied Biology plays a critical role in medical device development by providing medical device evaluation as per international standards like ISO 10993 for biocompatibility of medical devices and biomaterials, ASTM standards, OECD guidelines and United States Pharmacopoeia (USP). For this, many of the tests performed by the Divisions are on the quality platform as per ISO 17025 and are accredited by COFRAC of France. These tests are also available to external customers, both Indian and international medical device manufacturers. In addition, the Divisions have a strong research base, which resulted in a number of technologies transferred to industries during the Technology Conclave 2019. The Department also participates in academic programmes such as MPhil in Biomedical Technology and PhD programmes which have created progress in cutting edge research areas like 3D-Bioprinting, regenerative technologies, stem cell therapy, research in memory and learning, sleep research, material-cell-microbial interactions, biomaterial-tissue interactions and laboratory animal sciences.

DIVISION OF EXPERIMENTAL PATHOLOGY

The Division developed an innovative non-detergent/enzymatic method for preparing biomaterial-grade

scaffolds from porcine cholecyst (gall bladder) and established that this can be used as a wound-healing matrix. Research is ongoing to establish the potential of this scaffold for cardiac application, prepare various formulations of cholecyst scaffold like powder and gel, and evaluate the potential for various applications. The Division is also engaged in the histological evaluation of samples from internal and external customers.

The Division includes an accredited Histopathology Laboratory, a unique facility in the country as a COFRAC-accredited laboratory having facilities to undertake routine as well as a wide range of specialized techniques for evaluating biocompatibility of various materials as per international standards and pre-clinical evaluation of medical devices as per approved protocols.

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 a wound-healing matrix in different types of wounds. M/s. Alicorn Medical Pvt. Ltd, to whom the technology was transferred has initiated the scale up activities in TIMed for clinical trials.

Research Programmes

1. Applications of cholecyst-derived scaffold

Research on various applications of cholecyst-derived scaffold continued including the preparation of its various formulations such as powder, gel, and hybrid scaffold.

Ms Reshma S, a PhD scholar in the Division, perfected a rat model for graft-assisted (porcine cholecyst-derived scaffold) healing of myocardial infarction, with the help of Dr S Shenoy and Dr V



S Harikrishnan (Figure 1).

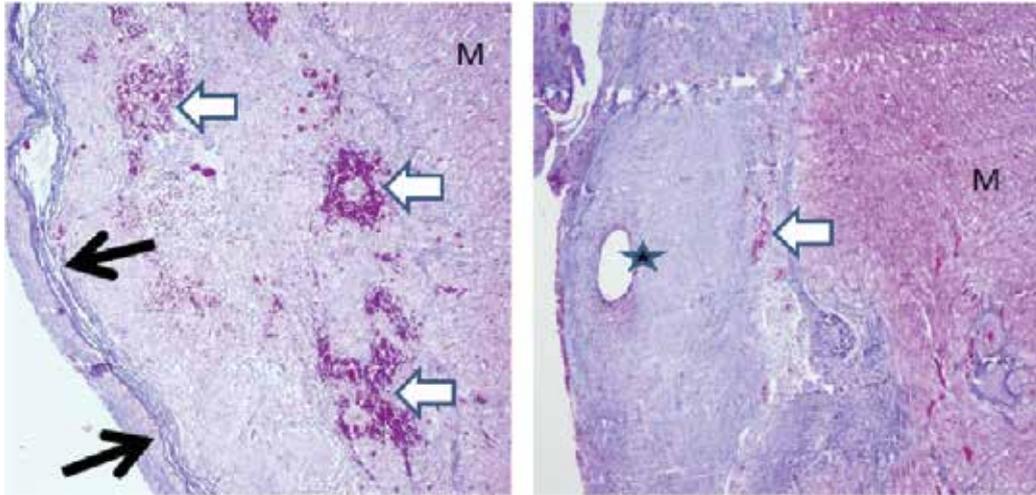


Figure 1. The photomicrograph on the left is a healing myocardial infarction, assisted by cholecyst-derived scaffold (black arrow) in comparison with unassisted healing on the right (M, unaffected myocardium). Note the differential abundance of vascular sprouts (white arrow) and the necrotic vasculature (star) in the two photographs indicating the nature of healing in these two tissues of rat collected 14 days after ligation of the coronary vasculature and the grafting (Masson's trichrome staining, original magnification, 40X)

2. Programme support on translational research on biomaterials for orthopaedic and dental applications

The Division provided histopathology evaluation for various studies:

1. Rabbit implantation study to evaluate osseous integration of sandblasted acid-etched (SLA)-titanium implants with hydroxyapatite (HA)

coating in rabbit femoral condyle (Figure 2). Implantation was carried out with the help of Dr Sachin J Shenoy, Scientist F, SCTIMST and Dr Vibha Shetty, implantologist, M S Ramaiah Dental College

2. Preclinical evaluation and commercialization of anti-snake venom (Igy); anti- hemotoxins and anti-neurotoxins project funded by the Department of Science and Technology. Animal



Figure 2. Measurement of cavity height using depth gauge (Left) and implant completely screwed into the cavity (Right)



experiments for abnormal toxicity and acute toxicity experiments continued

3. Gross and histopathological evaluation were completed for the following medical devices developed under Technology Research Council (TRC) Fund: P-8148: Alginate scaffold with recombinant growth for enhanced wound healing P-8149: Evaluation of biodegradable PLGC-fibrin hemostatic graft for skin regeneration
4. Gross and histopathological evaluation continued for the following medical devices developed under TRC Fund: P-8122: Development of centrifugal blood pump for extracorporeal cardiopulmonary bypass along with drive unit and flow meter.
5. **Biological evaluation of laser rapid manufactured Ti-porous structures**

The Laser Rapid Manufactured Ti-porous structures (LRM Ti) were synthesized using LRM technique at RRCAT, Indore. They were found non-cytotoxic and cyto-compatible based on ISO 10993 part 5, biological evaluation of medical devices. The implants were also found to be osteoinductive (supporting and inducing osteogenesis) in experiments with rat mesenchymal stem cells. The LRM Ti-porous structures were assessed in vivo as per ISO10993-6 in rabbit femur implant model and was found to support bone healing and new bone formation. The LRM Ti-porous structures were modified using electrochemical anodization to form surface nano tubules aimed at drug incorporation.

6. Development of biomimetic strontium incorporated-nanostructured ceramic coatings on Cp Titanium for orthopedic implants

In this project funded by the Department of Biotechnology, the experiments on rabbits with femur implants and histology evaluation were completed.

7. Bioresorbable nanoporous bioceramics matrices for drug delivery in osteoporosis management

In this project funded by the Department of Science and Technology, the experiments on rat calvarial defect filled with implant and histology evaluation were completed

Testing and Evaluation

The Histopathology Laboratory received 410 tissue specimens for biocompatibility evaluation as per ISO 10993-Part 6 &10. The specimens included muscle, subcutaneous tissue with implant, penile and vaginal tissue, and bone with implant (Figure 3). Preclinical evaluation specimens such as iliac artery and coronary blood vessels with stent, osteoporotic rat bone, dural substitute, corneal graft tissues, dental sockets, rabbit knee joint tissues, rat heart infarct model and skin wound healing studies were also received. 58 test reports which included accredited and non-accredited test reports, and necropsy reports were issued during the year. The Laboratory has maintained quality system for the past 16 years and successfully retained COFRAC accreditation for intramuscular, subcutaneous and bone implantation tests, and mucosal irritation tests. The Division also successfully completed the internal audit for 2018.

The Division received 4 work orders for histopathology evaluation from external customers and completed 3 of them.

The Division performed 5 autopsies with histopathology in rats as part of a research programme.

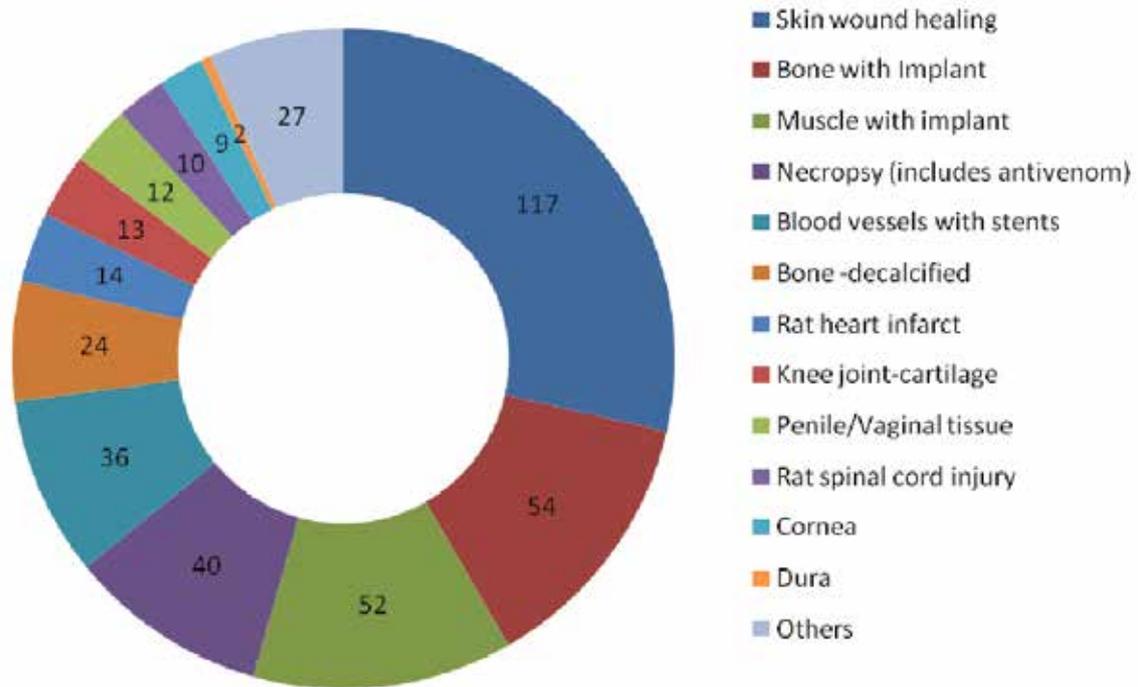


Figure 3. Summary of the specimens received for evaluation

The Division reported two metallic stent studies: covered coronary vascular stent (Figure 4A) and stent in iliac artery (Figure 4B).

valve (TC2) implanted at mitral position from a sheep 12 years post-implantation (Figure 5). There were no thromboembolic complications or vegetations.

The Division explanted a Chitra mechanical heart

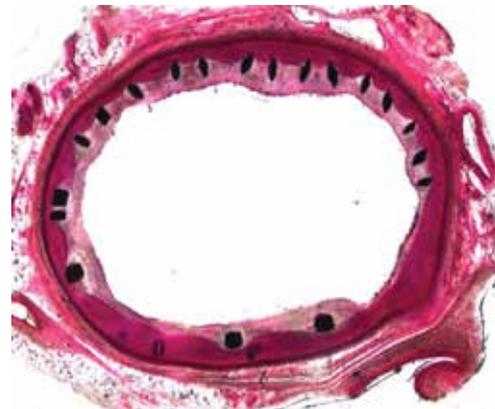
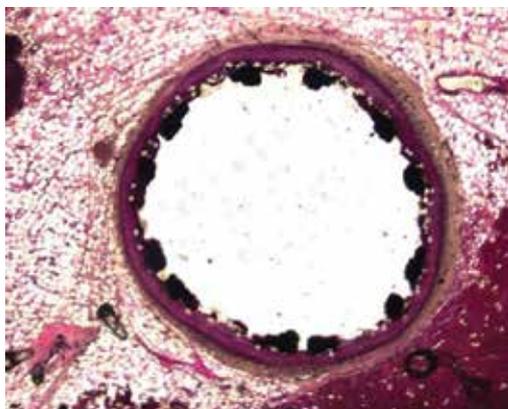


Figure 4. Covered vascular stent in pig coronary blood vessel (Left) and metal stent in pig iliac artery (Right)



Figure 5. Inflow (Left) and outflow (Right) views of Chitra mechanical heart valve (TC2) at mitral position in sheep 12 years post-implantation

DIVISION OF LABORATORY ANIMAL SCIENCE

The Division of Laboratory Animal Science (DLAS) facilitates research and testing using small laboratory animals by imparting care, welfare and management of small laboratory rodents and rabbits. The care and welfare are effected as per ISO 10993 Part-II for testing facility of which quality system is based on ISO/IEC 17025, 2005. The primary mandate of the Division 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 DLAS is CPCSEA registered and has to its credit many work procedures maintained as per international guidelines applicable to the field. The Division 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. In addition, the Division also conducted 3 training sessions for budding researchers in small laboratory animal handling, ethics and technicalities of small laboratory animal welfare assessment. They were attended by MSc and PhD scholars from across the country. The plans for upgradation of animal facility to meet international standards, and of CPCSEA licence towards adherence

to the 3Rs in biomedical research are underway. The Division takes care of the Institutional Animal Ethics Committee (IAEC), the documentation to secure sanctions for animal experimentation at the institute and compliance of the facility with CPCSEA. DLAS has a fully equipped small animal procedure room which is offered to several research groups within the institute for carrying out animal surgical experiments as well as behavioural monitoring. The Division also supports companies that work in TIMed to carry out their research with animals.

Research Programmes

Dr Harikrishnan initiated a project on development and characterisation of an animal model for spinal cord contusion injury in collaboration with University of Copenhagen, Denmark.

Testing and Evaluation

The primary mandate of the Division is to provide animals for research and testing. The details of animals supplied during the year are indicated in the Table below:

Animal	Number
Rabbits	213
Rats	816
Mice	1197



Guinea Pigs	85
Chicken	15

DIVISION OF MICROBIAL TECHNOLOGY

The Division of Microbial technology has multiple spheres of activity which contribute towards product development, research in medical device-associated infections, bacterial biofilms and role of nanoparticles in lung fibrosis, and testing services. The Division collaborated with the Division of Bioceramics for the development of antibiotic-loaded bone cement, and with Divisions of Biosurface Technology and Tissue Engineering and Regeneration Technologies in the development of wound dressing materials. The Division is also working on “targeted antibiotics” in collaboration with NIIST-CSIR, Trivandrum.

Product Development

The technology for Rapid UTI diagnostic Kit with Antibiogram was procured by M/s Agappe Diagnostics and this led to modifications in the kit with industrial feedback. The kit was expanded to include a panel of 12 antibiotics and the process is ongoing for multicentric clinical validation. M/s Agappe Diagnostics procured the test license and manufactured 1500 kits. Manufacturing batch qualification for these kits for sterility and functionality was done by the Division.

Research Programmes

The major focus of research in the Division is on understanding the trigonal interaction between bacteria, host and biomaterials to understand the driving force behind medical device-related infections and bacterial behaviour in the presence of biomaterials. PhD students and MPhil scholars work on various aspects of this fundamental problem.

1. Immunomodulation by *Pseudomonas* biofilms

Pseudomonas aeruginosa is an opportunistic pathogen able to chronically colonize the respiratory mucosa of patients with chronic obstructive pulmonary disease and bronchiectasis. The key feature of their biofilms that makes it important in the clinical scenario is the increased ability to resist antimicrobials. They resist antibiotics at concentrations 10 - 1000 times more than what is needed to kill them. In addition, they also escape the host immune mechanism. Hence, it becomes important to understand the immunomodulation by *Pseudomonas* biofilms to understand its pathogenicity and devise a method to control and cure it.

To differentiate the immunomodulatory properties, both ATCC and clinical isolates were used. A549 monolayers and 105 THP1 monocytes were exposed to planktonic *Pseudomonas*. Pro-inflammatory cytokines, interleukin-8 (IL-8), tumor necrosis factor alpha (TNF) and induced nitric oxide synthase (iNOS) gene expression were analyzed.

Monocytes were also assessed for Toll-like receptor (TLR) gene expression (Figure 6). TLR4, specific for recognition of lipopolysaccharides, and TLR9 which recognizes CpG islands in bacteria were assessed. ATCC isolates induced upregulation of TLR4 gene expression whereas TLR9 expression was not observed. On the contrary, clinical isolates reduced expressions of both TLR4 and TLR9. Electrical Cell Surface Impedance (ECIS) measurement is being looked into as a possible means of studying bacterial biofilm pathogenesis. ECIS measures barrier integrity as a function of impedance offered by a cell to the flow of current. It was observed that during the early phase of infection, the junctional integrity was reduced as detected by change in impedance.



2. Nanoparticles as inducers of pulmonary fibrosis

Idiopathic pulmonary fibrosis, which comes under the umbrella of interstitial lung diseases, is an emerging threat of unknown cause with an average life expectancy of 3 years after diagnosis. Recent studies suggest presence of increased

concentrations of nanoparticles in air because of boom in nanotechnology revolution. We suspect aerosol nanoparticles can play a significant role in inducing lung fibrosis particularly because of their ease of access to the gas exchange regions of the lung. This project is looking into the

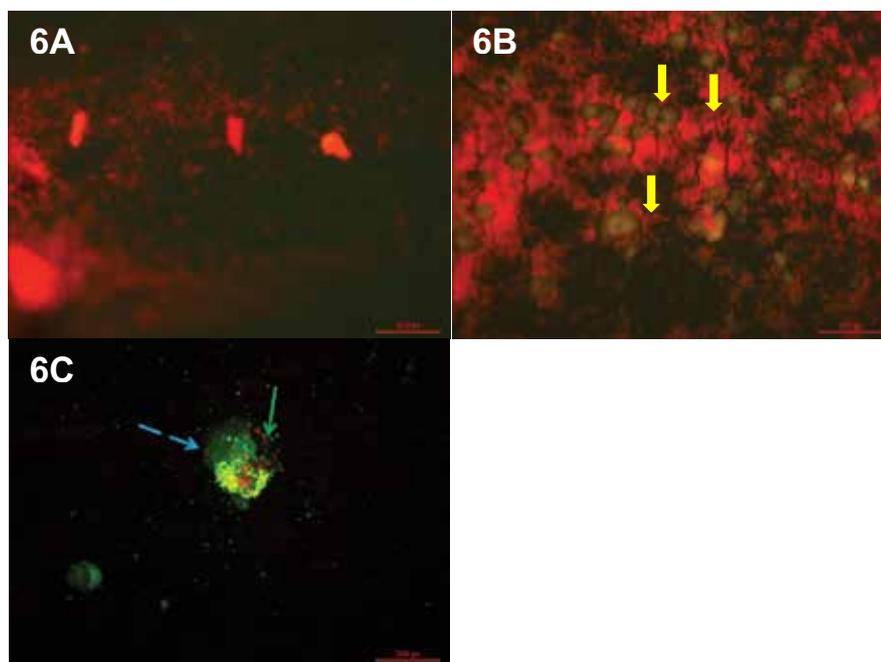


Figure 6. Acridine orange staining of monocytes exposed to biofilms of *Pseudomonas*. Acridine orange differentially stains eukaryotic cells green and bacteria red. Absence of green-coloured cells indicate absence of monocyte adhesion upon 4 hrs of exposure (6A). Post 18-hour exposure, monocyte adhesion was observed (indicated by yellow arrows) (6B). Monocyte (dashed blue arrow) with internalised *Pseudomonas* (green arrow) was also observed (6C)

fibrotic potential of various nanoparticles. The nanoparticles currently used are carbon black and diesel exhaust particles. These particles were characterized using FTIR and TEM, and the various biochemical responses elicited in A549 and fibroblast cell lines was studied. Using culture inserts, a multilayered construct comprising alveolar epithelial cells, fibroblasts and monocytes was developed to understand the cellular interactions and fibrotic potential of these particles to look for mechanism of reversal of fibrosis and rejuvenation of functional alveolar epithelium.

3. Anti-bacterial compound from *Bacillus safensis*

Working on the principle of “targeted antibiotics” to prevent rampant misuse of antibiotics and development of multiple drug resistant bacteria (the super bugs), a project entitled “Anti-bacterial compound from *Bacillus safensis* against Methicillin-resistant *Staphylococcus aureus* (MRSA)” was initiated.

4. Collaborative research with other Divisions

The Division collaborated with the Division of Bioceramics for the development of antibiotic-



loaded bone cement, and the Divisions of Biosurface Technology and Tissue Engineering and Regenerative Technologies for the development of drug-loaded wound dressing materials.

Testing and Evaluation

The Division functions on the quality platform as per ISO 17025 and a number of COFRAC-accredited tests are offered to evaluate materials/components/products developed by various investigators as part of TRC programmes and industries. The major investigations during the year were on advanced wound dressing materials both with and without drugs, bone cements as drug carriers for osteomyelitis and injectable polymers as drug carriers for different biomedical applications. The number of tests performed by the Division during the year are indicated in the Table below:

Tests	Number
Test requests received with number of samples	77 (201 samples)
Accredited test reports issued with number of samples	26 (41 samples)
Non-accredited test reports issued with number of samples	51 (106 samples)

DIVISION OF MOLECULAR MEDICINE

The Division mainly focuses on deciphering the fundamental functions of the brain like learning and memory and development of neuronal diseases. *Caenorhabditis elegans* has been identified as an excellent model system to study the neuronal basis of behaviour as it has a well-mapped nervous system. In addition to this interesting brain research, the Division also focuses on product development and a point-of-care diagnosis for pulmonary tuberculosis using loop-mediated amplification of DNA. To aid wound healing, recombinant growth factors, transforming growth factor-alpha (TGF- α) and

vascular endothelial growth factor (VEGF), were developed and incorporated in alginate matrix and preclinical evaluation was completed.

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 affordable by the general population.

TGF-alpha and VEGF are two growth factors with 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 their stability and bioactivity levels. This process also helped in reducing the cost of development of these growth factors. Preclinical results show that combination of both these growth factors has a significant effect on the healing of chronic skin wounds. Wound dressing materials incorporated with growth factors are expected to have a significant impact on the assisted healing of chronic wounds like burns and diabetic wounds. A limited clinical trial on this product will be carried out.

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

A modified LAMP reaction was developed for faster detection of pulmonary tuberculosis. The assay is cost-effective and can be carried out within 1 hour with minimum expertise in 20 patient samples at a time. A field trial in



collaboration with WHO-RNTCP and Ministry of Health, Government of India, was initiated.

Research Programmes

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

Learning and memory are one 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, is used to elucidate the neuronal connectome involved in conditional learning paradigm. One of the critical observations is 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 the alterations in the receptor levels of these neurotransmitters affect the learning paradigm. Furthermore, the studies on insulin pathway as well as imprinting suggest that learning deficiency could be linked to epigenetic factors which are critical for the development of proper circuits during early development. It is believed that there are incidences of consolidation of synapses during early development stages in the brain. In addition, neural circuits involving inter-neurons such as AIY, CEP, RID 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 our model system (Figure 7).

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 are used. As in the PD patients, worms expressing human alpha-synuclein in their dopamine neurons showed neurodegeneration as the organism ages. Moreover, dopamine neurons were found to be more sensitive to metallic salts and developed degeneration. This neurodegeneration has a significant impact on the memory pathway in the worm.

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 were interlinked. Epileptogenesis and role of NMDA receptor (NMDAR) subtypes in hippocampal neurons and astrocytes were probed using electrophysiology. Blocking NMDAR was found to alter the signal spikes in brain slices.

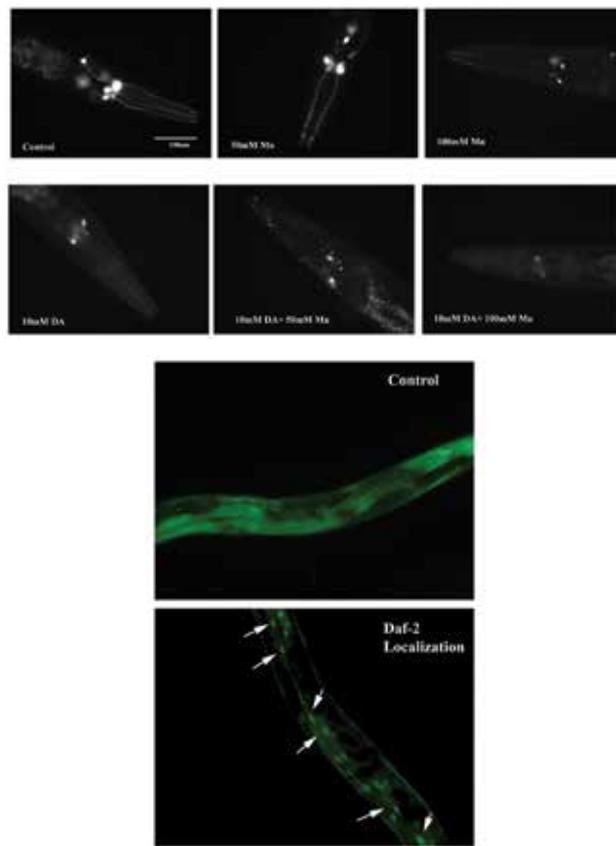


Figure 7. Calcium activation during learning process



DIVISION OF SLEEP RESEARCH

The Division of Sleep Research explores the unresolved questions related to sleep and its functions. The Division aims to understand the neural mechanisms involved in sleep regulation and conducts translational research in 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. Active principles of the medicinal plants were tested for regulation of sleep as part of translational research. Research findings were published in international journals and presented at various international meetings and forums. The Division provides extensive training to students in techniques used to study sleep and cognition in free moving animals.

Research Programmes

The Division of Sleep Research is a laboratory of National and International standard and is aimed at identifying the role of sleep during pregnancy in shaping cognition in offspring which is a very pertinent and novel area of research. The cognitive study conducted in the Division provided evidence for the first time on the maternal sleep-wake profile during entire pregnancy and nursing period with circadian patterns of NREM sleep and delta power. In addition, evaluation of neonatal sleep of pups born to mothers with total sleep deprivation or REM sleep deprivation provided important clues for the role of sleep during pregnancy. The sleep-wake patterns in neonates born to the sleep challenged dams indicated the presence of immature networks in the offspring. These novel findings indicated the need

for longer maternal care to babies if the mother is sleep-challenged during pregnancy. It was previously demonstrated that sleep deprivation during the third term of pregnancy had serious consequences on the cognitive development of offspring. Sleep deprivation during pregnancy produced hyperactivity, emotional deficits and increased risk-taking behaviour during peri-adolescence period.

The Division was engaged in finding solutions for prevention and management of hyperactivity and impulsive disorders in children. After providing evidence on adverse effects of sleep loss on the neuro-cognitive development in children, efforts were made to look for a safe herbal substitute for management of insomnia during pregnancy.

The Division popularized sleep science and research by organizing various events like World Sleep Day and popular talk sessions.

DIVISION OF THROMBOSIS RESEARCH

The Division was involved in different activities contributing successfully towards product development, translational research and testing services. A new project on 3D-Bioprinting of skin construct for in vitro testing application was initiated under the umbrella of Technical Research Centre (TRC). The Division collaborated with the Department of Biomedical Devices Engineering and developed a point-of-care instrument for measurement of prothrombin time (PT/INR) to monitor and modulate anti-thrombotic drug therapy in cardiovascular disease patients. The Biopharmaceutical Development Programme of the Division progressed well during the year. Towards stem cell research, regenerative medicine, cell/drug delivery and tissue engineering, the Division collaborated with other Institutions such as KIMS Hospital, Trivandrum, RGCB, Trivandrum and IIT-Guwahati (IIT-G) leading to joint patents and publications.



Product Development

1. Blood component production

For the isolation of albumin and immunoglobulin from cryo-poor plasma, the Class10000 facility setup was evaluated and test license was received from CDSCO. The purification process of albumin and intravenous immunoglobulin (IVIG) was standardized with service support from GE Fast Track Division, GE Health Sciences, Bangalore. Three staff members from the Division received training at the Fast Track Facility for isolation of albumin and globulin by ion exchange chromatography technique. The final products met with Indian Pharmacopoeia specifications. SOPs were prepared for demonstrating the purification process starting from 1L plasma. Industrial involvement for scale-up and commercialization were awaited.

2. Prothrombin Time/International Normalized Ratio device

Novel Prothrombin Time/International Normalized Ratio (PT/INR) monitoring technology, including the strip for point-of-care application was developed (Figure 8). The technology was validated against currently available machines with similar potential, using many patient samples. For further development and commercialization an agreement was executed with an entrepreneur.

3. 3D-Bioprinted skin tissue construct

The project was initiated under the umbrella of TRC. Different approaches were tried to select a suitable bioink formulation. ADA-Gel-PRP-based system showed promising results. Physicochemical characterization of the formulation was completed and was found to support cell viability. Degradation studies demonstrated the formulation to be stable

for two weeks. It also showed good printability. Functional studies to assess the bioink formulation and establish the skin construct were underway (Figure 9).

4. Skin substitute

Two different, but related, skin substitute development was carried out with support from TRC. Both were fibrin-hyaluronic acid based, but, one was combined with biodegradable synthetic polymer (PLGCFIBHA) and the other with amniotic membrane (AMFIBHA). Both products completed toxicological tests such as skin irritation and skin sensitization as per ISO10993. Another substitute developed in collaboration with IIT-G, used silk fibroin as the base material to produce the combination scaffold (SFFIBHA). All three products completed preclinical evaluation in porcine diabetic wound model and rabbit burn wound model. Histological analysis of the wound sites on the 28th day of the experiment showed that all three products promoted good wound healing and tissue regeneration with epithelialization, angiogenesis and development of skin appendages as compared to untreated control wound and Neuskin (commercial

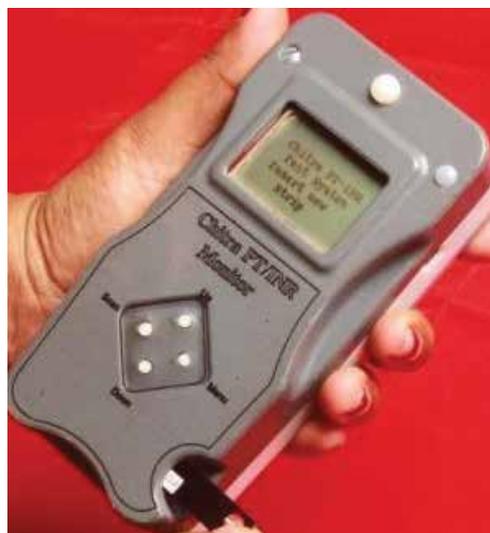


Figure 8. PT/INR device



substitute) control. All three were lyophilized, off-the-shelf products that were intended for one-time, sutureless application on acute or debrided wounds. Out of the three products, PLGCFIBHA showed best results in terms of angiogenesis and skin appendage development. All three technologies were ready for further development and commercialization by interested industry. All three were validated by preliminary experiments after plasma sterilization. More tests will be carried out for product validation (shelf-life and sterility) after package design. The documents were submitted to the DCGI for obtaining test license to produce 300 samples of PLGCFIBHA to conduct validation of shelf-life stability in the final plasma sterilized form. Discussions were underway with a prospective entrepreneur for technology transfer following the completion of the proof-of-concept and preclinical evaluation.

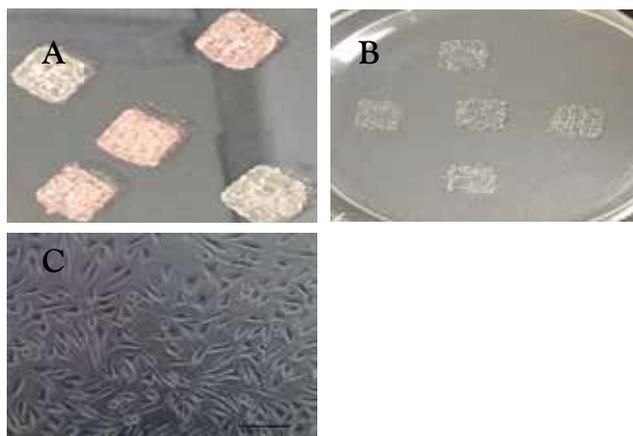


Figure 9. 3D-Bioprinted skin tissue construct. 3 layer 3D-printed Gel (Top Left), single layer 3D-printed gel (Top Right) and cells on gel (Bottom Left).

5. Anti-cancer drug formulation

The curcumin-conjugated human serum albumin (CMHSA) completed in vitro tests and qualified for intravenous infusion. Pharmacokinetic (absorption, distribution, metabolism, elimination-ADME) study was completed in

mouse model. Elimination of the drug seemed suitable to avoid adverse effects of this cytotoxic drug formulation. Single dose toxicity, maximum tolerant dose, pharmacokinetics in rat model and anti-cancer effectiveness in xenogenic lung cancer model were initiated. Discussions with an entrepreneur for technology transfer continued.

6. Anti-snake venom

In this DST-Industry sponsored project, pharmacokinetics (ADME) of anti-snake venom IgY (ASIgY) was studied in mouse model using imaging. The pharmacodynamics in venom-injected model proved accumulation of anti-venom at the site of venom injection in mouse model using imaging technology. The pharmacokinetics in rat model is ongoing to estimate the actual concentration of ASiGy in circulation using ELISA assay. Study on ED50 of the IgY was partly completed. Systemic toxicity and maximum tolerant dose testing were initiated. On-site expert committee monitoring of the project by DST was completed and found the progress satisfactory.

Research Programmes

Students in the Division worked on various problems for developing adipose-derived mesenchymal stem cell (ADMSC)-based regenerative therapy. For collection of lipo-aspirated adipose tissue, approvals were obtained from IEC-KIMS Hospital, Trivandrum, IEC-SCTIMST and IC-SCR-SCTIMST and standardized the aseptic tissue collection protocol, cell isolation, expansion and characterization. The results suggested feasibility of lipoaspirate-derived stem cell therapies. The cells multiplied >8 generations without phenotype drift and demonstrated multipotency. hADMSCs isolated from the CVTS-SCTIMST was successfully differentiated into cardiomyocyte progenitors, cardiac fibroblasts and endothelial progenitor cells for regeneration of



myocardial infarct (MI). Using the protocol and rat ADMSC-derived cardiac progenitors, rat MI model testing was carried out with promising results. Also, hADMSCs were differentiated into neurons and oligodendrocyte progenitors were tested in spinal cord injury model in rats with promising results. The hADMSCs were differentiated into smooth muscle cells (SMCs) and endothelial cells and were seeded in the lumen/albumen of poly-caprolactone-fibrin scaffold for construction of small diameter vascular graft (SDVG). After dynamic culture for 7 days using bioreactor, tissue constructs maintained cells with SMC and EC phenotypes. The fibrin-based combination products- PLGCFIBHA, AMFIBHA and SFFIBHA- were validated as potential in vitro dermal tissue engineering scaffold using ADMSC-derived fibroblasts. Dermal constructs were tested and ECM deposition was confirmed. Also, ADMSC-derived chondrocytes and human umbilical vein endothelial cells were activated using TNF- α to produce inflammatory markers and effect of CMHSA to act as anti-inflammatory molecule was demonstrated. Knee joint inflammatory model was developed in rabbits using controlled injections with TNF- α . Subsequently, CMHSA with and without rabbit ADMSC-derived chondrocytes was administered in the joint to reverse the inflammatory effects. Non-viral electroporation technology was standardized to overexpress vascular endothelial growth factor and hypoxia-inducible factor to promote wound angiogenesis in collaboration with RGCB, Trivandrum. The secretome released from engineered ADMSC was proven to promote in vitro dermal tissue construction using ADMSC-derived fibroblasts. Thus, the applications of hADMSC for various regenerative applications were validated in animal experiments.

Testing and Evaluation

Various COFRAC-accredited tests were offered to evaluate materials/components used for blood-contacting devices undertaken by various

investigators as part of TRC Programmes. Several samples submitted by internal and external patients were tested for platelet function as 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. Three new tests for HIV, HCV and HBV were validated and used as quality control for the in-house developed blood products. ISO 109934 2017 was implemented and three new tests were proposed for COFRAC accreditation. The Laboratory is participating in the Proficiency Testing Programme conducted by RCPA for the year 2019.

DIVISION OF TISSUE CULTURE

The Division of Tissue Culture offers in vitro cytotoxicity testing of biomaterials and devices performed on cultured mammalian cells under the quality platform to internal and external customers. The three basic in vitro cytotoxicity tests are: Direct Contact, Elusion Test and Agar Overlay as per the ISO 10993-5 standard. These three tests are accredited by COFRAC. The Division also offers cytocompatibility tests (non-accredited) such as MTT assay, cell adhesion, cell proliferation, osteogenic potential and DNA repair assay. The Division is involved in research and technology development in the area of cell and regenerative technologies. The Division also participates in various technology development and academic programmes of the institute. Research areas include cell technologies, biofabrication, cell-material interaction, stem cells, scaffolds for tissue engineering, 3D-Bioprinting and in vitro tissue models.

New Initiatives

Addition of a new facility

The Three Dimensional (3D) Bioprinting and Biofabrication Facility was established as the part of Institute's Core Programme. The establishment



comprises an advanced 3D-bioprinter with tissue and organ printing capabilities attached to a dedicated mammalian Cell Culture Facility. The scope of the Facility is to hasten the biofabrication technologies in the area of regenerative medicine, 3D in vitro cell culture models and research in developing therapeutic strategies. Currently, a multidisciplinary team works on developing tissue-specific bioinks, devising 3D-bioprinting modalities and methodologies in post-printing processing.

Product Development

1. Bioink for 3D Bioprinting of liver constructs for hepatotoxicity analysis

A novel photo-protective bioink was formulated for bioprinting of soft tissue constructs. The bioink was evaluated with primary hepatocytes, the most sensitive and functionally active cell. The bioink was developed from gelatin by functionalizing it with methacrylamide for photo-crosslinking. Human liver construct was biofabricated using hepatocytes. The biofabricated human liver constructs will be used as in vitro prediction models in drug screening.

2. Bioreactor for culturing liver constructs

A novel design of a microfluidic device fabricated using 3D prototyping was developed for in vitro cell culture. The device mimics fluid flow in the liver to maintain hepatocytes or other mammalian cells in a suitable 3D extracellular matrix. The device can be used for early stages of drug development, patient-specific drug screening and disease modelling.

3. Development of a novel device and a method of cell seeding for the establishment of an in vitro co-culture system

The project aimed to develop a novel device and a method of cell seeding for the establishment of

an in vitro co-cultured tissue construct that can potentially be used to understand fundamental cell biology as a drug testing model and as an artificial tissue for therapeutic applications. The objectives of the project were: fabrication of a polymeric scaffold with bio-inspired structure, design and development of a device for carrying a porous scaffold and establishment and evaluation of an in vitro co-culture system with model cell types. During the year, the first two objectives were completed.

Research Programmes

1. Biofabrication of liver constructs by 3D bioprinting

3D Bioprinting has emerged as a potential technology that can address the limitations of in vitro screening of drugs and use of large number of animals for testing. Gelatin-based bioink known as gelatin methacrylamide (GelMA) was developed for biofabrication of human liver constructs to be used as in vitro prediction model in drug screening. The liver construct bioprinted using hepatocytes was photo-crosslinked and evaluated for liver-specific functions. In order to protect the cell viability and tissue functionality during photo-crosslinking, the GelMA was further modified with a photo-protective formulation. The in vitro construct showed liver-specific functions and also responded to various drugs compared to control (Figure 10). Another bioink that was co-developed was alginate dialdehyde-gelatin hydrogel that also expressed bioprinting capabilities and functionally active hepatocytes in the construct. The Division was also involved in the programme on developing bioprinted skin construct.



Figure 10. 3D bioprinting of liver construct using RegenHU 3D Discovery bioprinter using bioink characterized for hepatocyte printing (10A) and 3D bioprinted liver construct (10B)

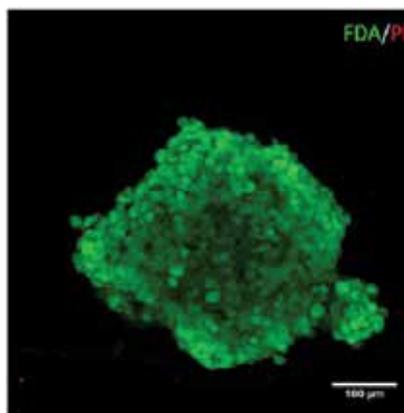


Figure 11. Liver microspheroid developed from human hepatoma cells using custom-designed cell culture chamber showing viability (Green color represents live cells and red signal signifies dead cells)

2. Photo-protective bioink for 3D bioprinted liver construct

The bioink crosslinks on exposure to UV light in the presence of a photoinitiator. The free radicals formed help in the crosslinking process and might remain even after crosslinking. To safeguard the cells from free radicals, a radical scavenging bioink was developed. The bioink was formulated and different batches of GelMA synthesized and analyzed for their degree of functionalization. As the bioink should crosslink without affecting the viability of cells, various base polymer concentrations were tried and cross-linking time was evaluated. The in vitro construct showed liver-specific functions. Once bioprinted with liver cells, the tissue construct will be transplanted in animal models.

3. Organoid bioprinting of functional liver construct engineering

A gelatin-based bioink was formulated for bioprinting of liver parenchymal microtissues. The microtissues were developed using a custom-designed cell culture chamber that allowed mass production of microspheroids (Figure 11). The microtissues were viable and showed hepatocyte-specific functions with tissue-like cellular reorganization. The microtissues were bioprinted for obtaining organized liver construct.

4. Defining the regulatory role of heat shock protein 70 in myoblast differentiation

One of the critical class of proteins involved in protecting the cardiomyocytes against damaging threats are molecular chaperones, which regulate the balance of protein synthesis and degradation, assist with refolding misfolded proteins and protect against cell death when induced in stressful/pathological conditions. The understanding of these major Heat Shock Proteins (HSPs) in cardiomyocyte maintenance is poorly understood. The stress-induced cardiomyocyte production of HSPs is appreciated in the context of sarcomere assembly, autophagy, the ubiquitin-proteasome system (UPS) and the normal turnover of proteins in the heart. The research focused on deciphering the role of the major heat shock protein, HSP70 in cardiomyocytes which plays a critical role in maintaining cardiac integrity during stress. The HSP70-targeted chemical inhibition-based approach revealed that a lysosomal-mediated protection mechanism was deployed by HSP70 in cardiomyocytes.



5. Periodontal ligament regeneration

Regeneration of periodontal defects requires formation of complex tissue with cementum, periodontal ligament and alveolar bone. For this, periodontium scaffolds that mimic extracellular matrix were designed and developed to promote rapid cell migration, adhesion and differentiation of native progenitor cells. Collaborating with the Division of Bioceramics and Indian Institute of Technology, Delhi, a novel, self-assembling, peptide-appended, dendritic polydiacetylene was used to functionalize electrospun polycaprolactone mat as an osteogenic matrix. The human periodontal ligament cells cultured on functionalized mat were viable and expressed early markers of osteogenic differentiation.

6. Bioengineered construct with cardiac mesenchymal cells for myocardial repair

A bioengineered cardiac construct with cardiac mesenchymal cells was proposed for myocardial repair. A collagen-based scaffold was developed by isolating collagen from bovine Achilles tendons. The collagen was then functionalized for photo-crosslinking. The slow adhering cardiac mesenchymal cells were isolated from mice and were characterized for mesenchymal lineage by analysing surface markers such as CD29, CD73, CD105 and CD90. This modified collagen can serve as the base hydrogel for formulating bioink for various biomedical applications including 3D bioprinting.

7. Biofabrication of stratified epithelial constructs

Growing cells in three dimensions (3D) requires in vitro construct that also mimic in vivo tissue. Epithelial tissue expresses characteristic cell-cell

contact and strong interaction with extracellular matrix. The in vitro epithelial culture model partially retains the tissue architecture by expression of specific markers, but lacks the unique arrangement of cells. A new biofabrication device was designed with a unique inflow of medium that allowed layering of epithelial cells. The substrate used for the cell culture also supported stratification of epithelium. The device was used to construct skin epithelium using keratinocytes that showed multilayered architecture.

8. Collaboration within and outside the Institute

The Division collaborated with the Division of Thrombosis Research in 3D bioprinting of skin constructs. The Division was involved in the development of bioink, its characterization and bioprinting of tissue construct.

An MoU was signed between SCTIMST and National Center for Cell Sciences, Pune, to build a partnership to design a 3D construct using iPSC-differentiated hepatocytes

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 performed as per ISO10993-5 and are accredited by COFRAC. 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. A total of 68 test requests for cytotoxicity evaluation were received at the Division from internal and external customers during the year. The following study plans were prepared as per the customer requirements for cytocompatibility evaluation of biomaterials:



Sl. No.	Title	Customer
1	In vitro biological evaluation of titanium- based materials	Venture Center Entrepreneurship Development Center, Pune c/o Dr Chinmay Khare
2	In vitro cell adhesion study	Abhijith N V, NSS College of Engineering Palakkad
3	Cytocompatibility evaluation of collagen biomaterials	Dr Senthil Kumar Muthuswamy, Division of Tissue Culture

DIVISION OF TISSUE ENGINEERING AND REGENERATION TECHNOLOGIES

The major thrust area of research in the Division is designing suitable biological substitutes/tissue-engineered constructs through the principles of tissue engineering. The research in the Division have been directed towards (a) developing novel, biodegradable and biomimetic “designer” scaffolds, (b) understanding the regeneration process using adult cells and directed stem cell differentiation, and (c) delineating the molecular pathways that regulate growth factors and other molecules or drugs to promote regeneration. Another area of interest is the use of bioprinting technology to generate cell-incorporated tissue constructs for varying applications. Scaffolds made by conventional techniques, electro spinning, 3D bioprinting, as well as regulator combinations generated by the Division find additional medical applications as products for drug delivery, wound healing and haemostats.

The Division also contributes to other institutional programmes, national and international, with indigenously developed innovative scaffolds and

biomaterials in an ongoing Indo-Danish Programme.

Wound dressing and injectable gels for cartilage repair are the promising products of this Division under the TRC Programme of the Institute which are likely be transferred to industry for commercialisation this year. Ophthalmic sponge, a product developed earlier, was relicensed to industry this year. Other products in the pipeline for addressing the skeletal segment are (a) bioprinted scaffolds for regeneration of osteochondral defects and (b) trachea. The technologies for soft tissue include a biohybrid pancreas and small diameter vascular graft. Research for these technologies is being pursued by PhD students.

Product Development

1. Modified emergency bandage with pressure pad and a hemostat for pre- hospital emergencies

In recent years, emergency bandages have come out as a lifesaving first aid option in addition to the pressure bandage. Emergency bandages are bandages or dressing that are used in pre-hospital emergency situations such as civilian situations, disaster, conflict area and other military applications where the main function is to control bleeding while preventing inflammation and necrosis. This project is aimed at designing a hemostatic dressing that will be externally applied and has a silicon pressure pad above the hemostat to further improve pressure hold that will be beneficial in the final design of the emergency bandage in future studies. The dressing is proposed to be a sponge prepared from natural biopolymers by blending and lyophilizing. Its hemostatic properties will be evaluated in vitro. Staff was recruited and work initiated during the year.

2. Evaluation of fibrous mesh sheets as scaffolds for increasing the area of neovascularisation in Moyamoya disease



Moyamoya disease (MMD) is characterized by progressive stenotic occlusion of the distal internal carotid arteries, proximal anterior and middle cerebral arteries. The treatment for MMD is surgical which involves providing alternate routes of blood supply to the ischemic brain. Direct and indirect procedures have been described. Direct procedure involves microvascular anastomosis between superficial temporal artery and middle cerebral artery through a craniotomy. Indirect procedures aim to appose alternate tissues as muscle, dura, pericranium on to the brain surface so that neovascularisation occurs from these tissues into the brain. Currently, combined direct and indirect procedures are performed. The present study envisages the use of fibrous mesh sheet scaffolds as tissue extenders for neovascularisation to occur beyond the margins of the craniotomy in rabbit models. The mesh sheets will be sutured to the edges of the dura and muscle and will be allowed to lie as flaps on the brain surface by inserting it between the dura and the brain. The project was initiated during the year with recruitment of project staff and procurement of consumables.

3. 3D bioprinting of skin

Dr Lynda Thomas of the Division is a co-investigator in the 3D bioprinting of skin project. During the year, work was initiated on 3D printed PCL based membranes. Preparation and standardization of printability of gelatin xanthan gum dialdehyde and chemical and physical characterization of the gel were carried out.

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

Injuries to the cartilage are common. The injuries could be of traumatic type as in sports injuries in the young or degeneration of the cartilage in the

older population through trauma or diseases like osteoarthritis resulting in considerable pain and a range of treatment modalities such as arthroscopic surgeries or even total joint replacement. Another area of interest is the correction of the defects of the growth plate of the very young which results in unequal limb length and considerable pain to the patient.

The product developed at SCTIMST under the TRC project was an injectable hydrogel which is a two-component system aimed at potential application in the repair of cartilage injury and growth plate defects. The technology also included the applicator through which the two-component system was mixed and easily injected to the site in the form of a biodegradable and biocompatible gel. The gel could also be used as a delivery agent to encapsulate cartilage cells for surgical correction of both types of injuries.

Different formulations of this product were standardized, tested for their biological properties and safety and preclinical studies were initiated in animal models. The product was recently transferred to Phraction Scientifics Pvt. Ltd. during the 3rd Technology Conclave of the Institute held on 24 March 2019 (Figure 12). The industry, which is a startup, had incubated at SCTIMST-TiMed



Figure 12. Transfer of injectable hydrogel to Phraction Scientifics Pvt. Ltd. during the 3rd Technology Conclave



and work was underway for completion of the formalities of permissions from the Drug Controller of India for further clinical usage.

5. Lint-free absorbent wound dressing for surgical and exudating wounds

This project aims to develop a medical dressing with controlled pores that is biocompatible, lint-free, flexible/pliable and has high liquid holding capacity. The dressing is a blend of PVA with polysaccharide which is lyophilized using a standard recipe to create a dressing with enhanced moisture vapour transmission rate that can be easily removed after application. The proof-of-concept phase was completed and technology was transferred to Phraction Scientifics Pvt. Ltd. (Figure 13). The pre-clinical phase of the study



Figure 13. The transfer of technology for lint-free absorbent wound dressing to Phraction Scientifics Pvt. Ltd.

comparing the present dressing with a commercial dressing on an incisional wound in a rabbit ear model and stability studies were underway.



Figure 14. Relicensing of ophthalmic sponge to M/s. Konnikara Ltd and training of personnel

6. Relicensing of ophthalmic sponge

An earlier product, the ophthalmic sponge was relicensed to M/s. Konnikara Ltd., Bengaluru, (Figure 14) and training for their personnel was conducted.



Figure 15. The students and staff of the Division of Tissue Engineering and Regeneration Technologies

Other products in the pipeline for addressal of the skeletal segment were bioprinted scaffolds for regeneration of osteochondral defects and trachea. Technologies for the soft tissue included a biohybrid pancreas and a small diameter vascular graft. Research for these technologies were pursued as PhD Programmes (Figure 15).

Research Programmes

The research programmes were focussed on scaffolds for tissue engineering, drug/siRNA/miRNA delivery vehicles, 3D printing and tissue regeneration in vivo. The PhD students in the Division continued to work in areas of osteochondral construct, trachea, vascular graft and biohybrid pancreas using tissue-engineering concepts.

1. New Initiatives

1. A new TDF project entitled modified “Emergency bandage” with pressure pad and a hemostat for pre-hospital emergencies was sanctioned with Dr Lynda V Thomas of the Division as PI, and Dr Prabha D Nair and Ms Sandhya as co-PIs.



2. A new TDF project entitled “Evaluation of fibrous mesh sheets as scaffolds for increasing the area of neovascularisation in Moyamoya disease.” was sanctioned to Dr Jayanand Sudhir, Department of Neurosurgery as PI and Drs Prabha D Nair and Lynda V Thomas of the Division as co-PIs.

3. Dr Lynda V Thomas of the Division was a co-investigator in TRC Project 8137- 3D bioprinting of skin.

2. Indo-Danish Programme – MUSTER

Nanoparticles and other scaffolds which can be used to deliver specific drugs, biochemicals, miRNA or exosomes specific for bone or cartilage lineages from stem cells were pursued as part of an Indo-Danish Programme funded by DBT, India. The information on the novel biocompatible and functionalized scaffolds developed at SCTIMST were shared with collaborating national and international partners through regular joint video conferences and collaborative research on further assisting the regeneration of tissues continued. As part of the Programme, Dr Sivadas was at IIT Kanpur from 11-27 July 2018 to conduct some collaborative studies on sustained delivery of LDN193189 by polymer micelles for efficient chondrogenesis. Some of the materials developed under the programme were

1. CuInS₂/ZnS nanomaterials for cell imaging (Figure 16)
2. Synthesis of polymer for drug encapsulation and release
3. Lipidated Glutamic acid derivatives for chondrogenic differentiation of stem cells.
4. PLGA coated Puululan-Gelatin scaffold loaded with H8 for osteogenesis

CuInS₂/ZnS nanomaterials for cell imaging.

- Can be used for cellular imaging in place of organic dyes
- Use of cadmium-free sources in synthesis
- High stability against light and Gram-scale synthesis is feasible.

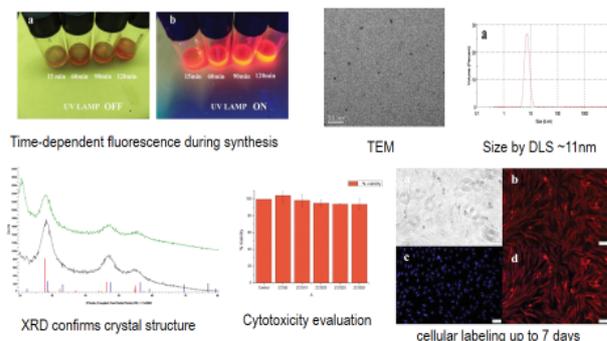


Figure 16. Nanomaterials for cell imaging

3. Synthesis of polymer for drug encapsulation and release

Pluronic F127 polymer is an FDA approved copolymer widely used in biomedical applications in various formulations. F127 was modified to get amphiphilic polymer chains for making amphiphilic polymeric spherical structures of sizes ranging from nanometer to microns. The esterification reaction was processed with DMAP as catalyst and DCC as reagent in closed atmosphere for polymer modifications. Dialyze was freeze-dried and resuspended in water to form spherical polymeric structures. A biological small molecule K1 that is specific for enhancing chondrogenesis, was used for encapsulation studies with modified F127 polymer which formed spherical structures when phase transferred from organic to aqueous. Spherical structures of the microspheres were confirmed with SEM. Drug release studies were performed using UV absorption studies. Cytotoxicity as per preliminary analysis was positive.

4. Enhancement of osteogenic differentiation potential of rabbit ADMSCs using microRNAs

Osteogenic induction potential of miR-218-5p and miR-26a-5p is known. The rabbit ADMSCs



- These molecules can self-assemble to form various extra-cellular matrix like structures.
- Two of these compounds (E12 and BE3(12)₄) were found to significantly enhance the chondrogenic differentiation as compared to chondrogenic medium alone category ($p < 0.001$).

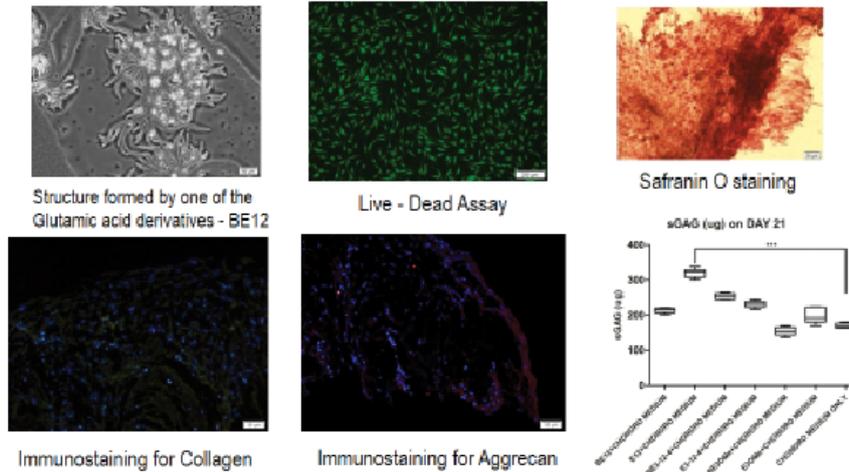


Figure 17. Chondrogenesis enhancing potential of lipidated glutamic acid derivatives

transfected with miR-26a and miR-218-5p showed better osteogenic differentiation, as compared to rabbit ADMSCs cultured in osteogenic medium alone. MicroRNA-26a-5p showed better results than microRNA-218-5p. Construction of microRNA-incorporated scaffolds continued. Analysis was carried out on 14th and 21st days for alkaline phosphatase levels (using PNPP substrate), total calcium (using OCPC method) and Alizarin red staining.

A series of lipidated glutamic acid from IIT Delhi were explored for their ability for chondrogenic differentiation of stem cells. The highlights are as given below in Figure 17. A joint manuscript was submitted.

5. Pullulan aldehyde crosslinked gelatin cryogel scaffold for chondrocyte-mediated cartilage extracellular matrix deposition

Restoration of the articular cartilage is a major challenge in orthopaedics due to its limited self-repair and regeneration prospects. An attempt was made to develop a biodegradable cryogel scaffold that afforded a physiologically

significant microenvironment and resembled the native cartilage extracellular matrix (ECM) for chondrocyte-mediated cartilage repair. The scaffold was 5. Pullulan aldehyde crosslinked gelatin cryogel scaffold for chondrocyte-mediated cartilage extracellular matrix deposition

Restoration of the articular cartilage is a major challenge in orthopaedics due to its limited self-repair and regeneration prospects. An attempt was made to develop a biodegradable cryogel scaffold that afforded a physiologically significant microenvironment and resembled the native cartilage extracellular matrix (ECM) for chondrocyte-mediated cartilage repair. The scaffold was synthesized using oxidized pullulan crosslinked with gelatin by Schiff's base reaction followed by cryogelation. Oxidation of pullulan was evidenced by the presence of aldehyde group that was confirmed using FTIR and UV-visible spectroscopy. These cryogel scaffolds with pore sizes ranging from $10\mu\text{m}$ to $80\mu\text{m}$ could withstand a compressive stress of 0.18MPa . The cytocompatibility of the scaffold was assessed by Live-Dead assay whereas cell-scaffold



interactions and the cell infiltration within the scaffold were assessed by Environmental Scanning Electron Microscopy (ESEM) and confocal fluorescence microscopy. Goat chondrocytes showed uniform distribution, good cell-scaffold attachment and rounded morphology on the PDAG cryogel. Substantial amount of ECM deposition by goat chondrocytes on to the PDAG cryogel was evident by day 21. Assessment of sulphated glycosaminoglycan (sGAG) content after 21 days revealed that PDAG scaffolds significantly enhanced the sGAG synthesis by goat chondrocytes in vitro, as compared to monolayer cultures ($p < 0.01$). Further, results of RT-qPCR-based gene expression studies demonstrated that the PDAG cryogel scaffold could significantly enhance the expression of chondrogenic marker genes viz. type II collagen, aggrecan and SOX9 when compared to 2D culture ($p < 0.05$). These results were further substantiated by immunofluorescence, Safranin O, Alcian blue

and toluidine blue staining. Overall, our results demonstrated that PDAG scaffold prepared by cryogelation technique would be a favorable niche for cartilage tissue engineering applications.

Two scaffolds were functionalized with a molecule H8 supplied by SDU Denmark that was capable of inducing osteogenesis. The study highlights are as given below in Figure 18.

6. A tissue-engineered skin substitute with localized hair follicle stem cells for hair follicles and sebaceous gland regeneration in a stress induced wound healing model

The PI of the Project, Dr Babitha had previously worked on the creation of 3D pits on the surface of electrospun membranes using microneedles for hair follicle stem cell culture for skin tissue-engineering. During the year, she initiated work on using 3D extrusion bioprinting to

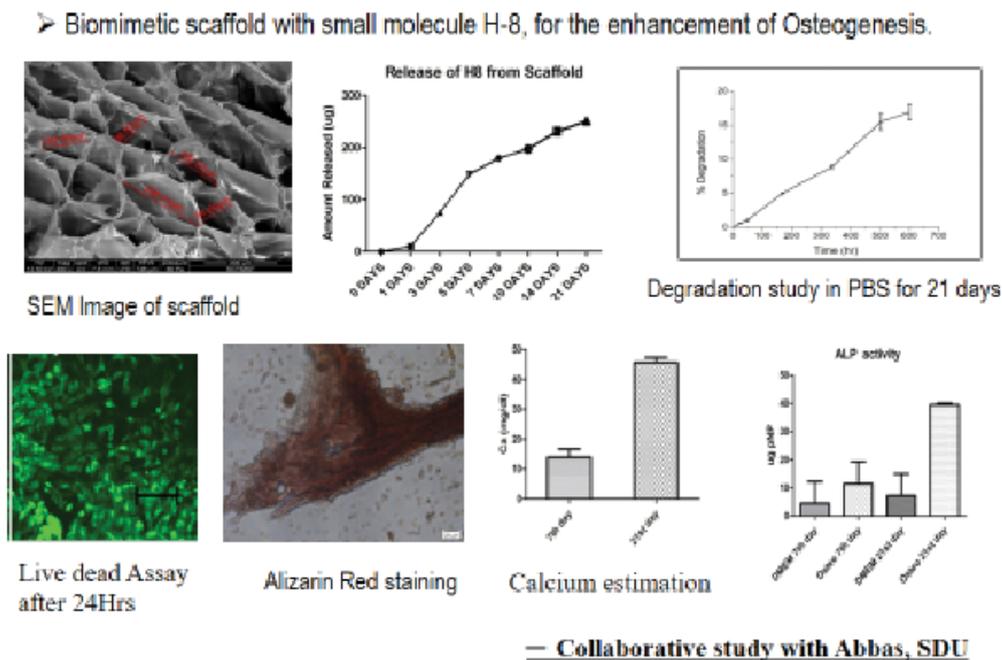


Figure 18. PLGA coated pullulan-gelatin scaffold loaded with H-8 for osteogenesis



recreate the same model as skin constructs. The standardization of generation of HFSC spheroids by hanging drop method and the effect of seeding density on spheroid size was evaluated.

7. Enhancing insulin production of islet-like clusters derived from mesenchymal stem cells by transfecting microRNAs

The work done during the year included differentiation of mesenchymal stem cells into islet-like clusters (ILCs) on tissue culture poly styrene (TCPS) and on DEXGEL scaffold and comparison of the size distribution of ILCs on scaffold and TCPS. The number of ILCs and size distribution of ILCs was significantly different on scaffold and TCPS. The size of the islet on TCPS was more than $250\mu\text{m}$ and the number of ILCs

was very less. The number of ILCs increased when stem cells were differentiated on scaffold and the size of the islets was in the range of $50\mu\text{m}$ - $300\mu\text{m}$ as in the native pancreas.

Different batches of scaffolds were prepared by varying the cross-linking parameters like temperature and duration of cross-linking. Pore size distribution of the scaffold was analyzed from SEM images. The scaffold was highly porous and pores were interconnected which favored islet cell growth. Pore size of the scaffold was determined using Image J software. Pores were in the range of 100 - $300\mu\text{m}$ in size (Figure 19). The scaffolds were conjugated with an ECM protein, laminin for better cell attachment and cell survival. Tissue-engineered pancreatic construct was prepared by seeding isolated rat islet onto the modified DEXGEL scaffold. The construct was cultured in DMEMHG and glucose-stimulated insulin secretion (GSIS) was measured at different time periods and compared with unmodified scaffolds (Figure 20).

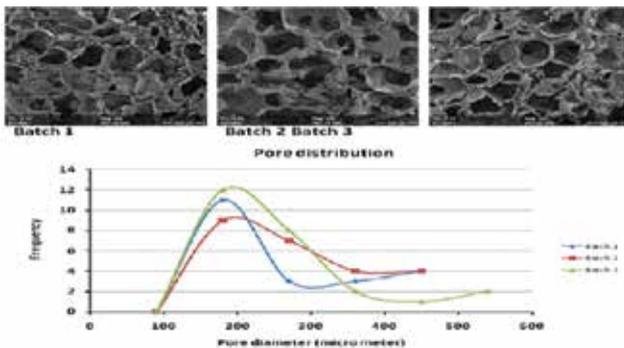


Figure 19. Pore distribution of DEXGEL scaffold

8. Tracheal tissue engineering

Tracheal constructs were fabricated by 3D bioprinting (Figure 21). The printing parameters for 3D printing of tracheal constructs were standardized. Standardization of 3D printing with nozzles of 2 different sizes was done. The conventional 27 gauge nozzle was compared with

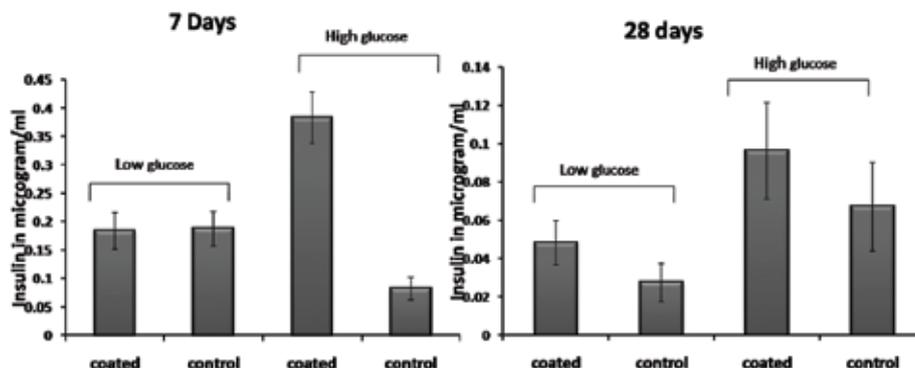


Figure 20. Glucose-stimulated insulin secretion in tissue-engineered pancreatic construct



a 30 gauge nozzle. Models having smaller details formed defective print while using 27 gauge nozzles. This precision in print was also reflected in the mechanical strength of the printed structure.



Figure 21. 3D biprinted tracheal construct

In another study, different ratios of co-polymer of caprolactone and lactide were synthesized and submitted for physicochemical studies.

9. Fabrication and evaluation of osteochondral constructs by 3D bioprinting

The management of osteochondral defects/lesions

and associated osteoarthritis (OA) affecting human diarthrodial joints represents one of the most significant challenges facing the global health care community today. Engineering these complex tissues consisting of upper hyaline cartilage and underlying subchondral bone with disparate biomechanical properties is indispensable in the current clinical scenario. However, achieving regeneration of complex tissues is extremely difficult. Osteochondral tissue-engineering (OCTE) encompassing biomaterial scaffolds, stem cells and signalling molecules favouring regeneration of bone and cartilage is a possible option that can address the drawbacks of current treatment methodologies like microfracture and mosaicoplasty. 3D printed scaffolds are beneficial in mimicking the microarchitecture of osteochondral tissues and offer great precision and control over zonal organization of layered hyaline cartilage when used along with mesenchymal stem cells. Hence, it is gradually replacing the traditional scaffold used in cartilage and bone regeneration. In the present study, we devised an effective strategy of 3D printing for fabricating bioactive factor-loaded biphasic and integrated scaffolds. An FDA approved

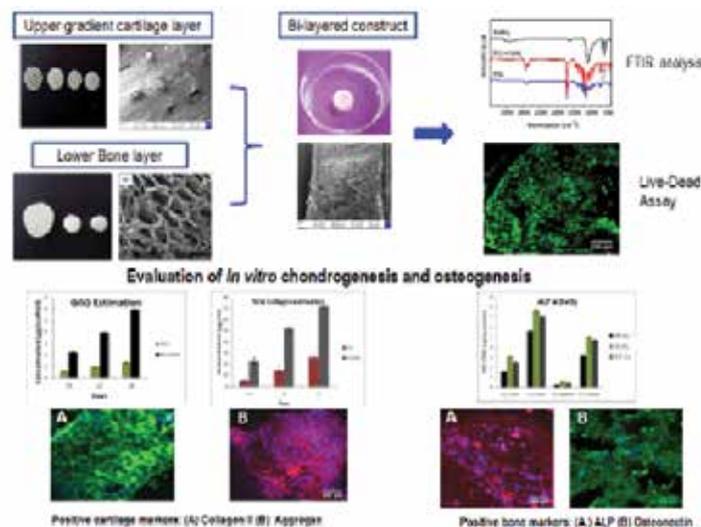


Figure 22. Bilayered osteochondral constructs for enhancing tissue regeneration



biocompatible material, polycaprolactone (PCL) was used along with another synthetic polyester for the upper cartilage layer and a well-known osteoinductive factor-loaded PCL as bone layer. The *in vitro* osteochondrogenic potential of these constructs was analyzed qualitatively and quantitatively. The quantitative and qualitative analysis of the osteochondrogenic potential of adipose- derived mesenchymal stem cells seeded

on 3D printed biphasic scaffolds cultured in specific differentiation medium at different time periods showed they simulated the native osteochondral unit (Figure 22). Thus, the results of the present study suggested the potential use of these biomimetic and biphasic scaffold design in dual lineage differentiation of a single stem cell population for enhanced osteochondral regeneration.

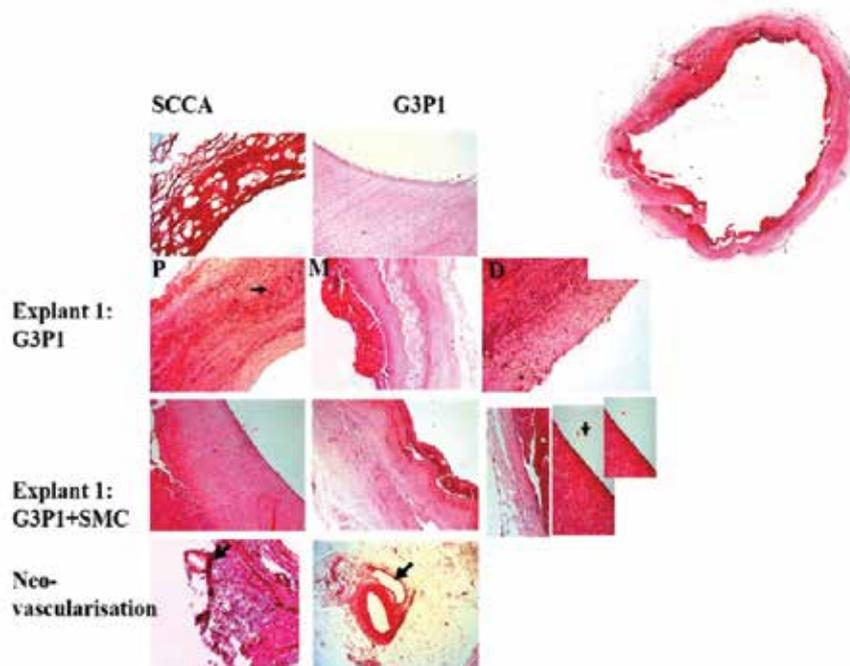


Figure 23. Histology of explant showing endothelialisation and neovascularization

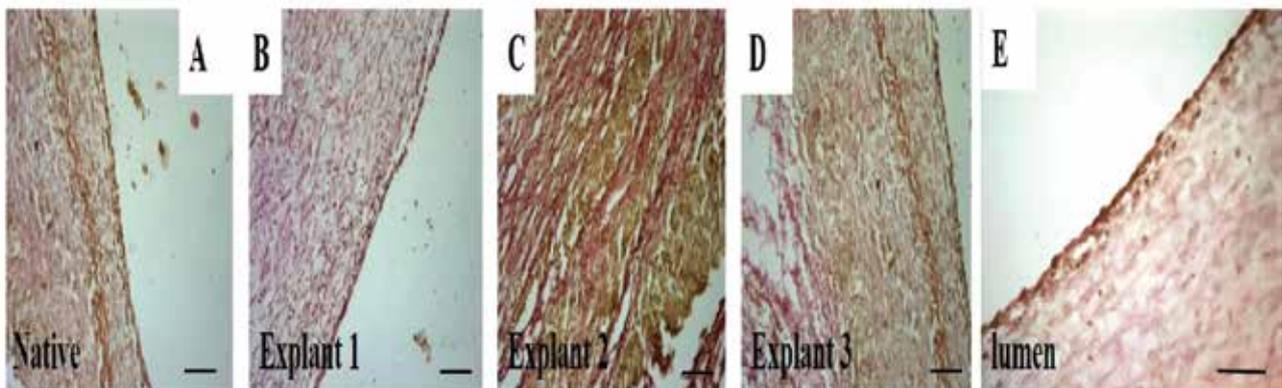


Figure 24. Extracellular matrix deposition- elastin staining



10. Tissue-engineered small diameter vascular graft

Blood vessel associated diseases is the leading cause of death worldwide and there is an increased demand for tissue-engineered small diameter vascular grafts (<6 mm). Small diameter vascular graft fabricated by dual source co-electrospinning of gelatin vinyl acetate and poly-ε-caprolactone, seeded with autologous adipose-derived smooth muscle cells was implanted in an ovine animal model replacing the common carotid artery. After an observation period of 3 months, the retrieved explant was subjected to detailed evaluation and other specific staining procedures in order to evaluate the regeneration potential of the graft in vivo. The emphasis was to analyze the endothelialization, neovascularization and extracellular remodeling of the graft. It was observed that the cell-seeded graft showed enhanced regeneration potential in comparison to that of material-alone scaffold. The neointima formation, neovascularization (Figure 23) and collagen-elastin deposition (Figure 24) were found to be more pronounced in the cellularized graft implant. This further indicated the relevance of cell and scaffold-based regeneration of tissue-engineered small diameter graft, forming the basis of patient-specific tissue-engineered products. The pilot study also provided a comprehensive awareness regarding further improvement of the graft.

Testing and Evaluation

The Division provided the Contact Angle Analysis Facility on request on a free complimentary basis to members of other laboratories on campus and external laboratories such as NIIST, IISER, IIST of Trivandrum, NPOI and CUSAT, Cochin, and NIT, Calicut. Other free testing services provided included inverted and upright fluorescence microscopes, lyophilizer, and viscometer which were offered to members of many laboratories on campus.

DIVISION OF TOXICOLOGY

The Division is a premier laboratory in the country in the field of biomaterial toxicology and is accredited by COFRAC, France as per ISO 17025. The Division has a full-fledged facility for preclinical safety and toxicity evaluation of various materials and medical devices as per international standards such as ISO, USP and ASTM. The toxicological studies are an integral and indispensable part of development of medical device technology. The main aim of the Division is the toxicity/biocompatibility evaluation of materials, medical devices, tissue-engineered products intended for the fabrication of medical products and investigation of potential safety/biological hazards of nanomaterials used for health care applications.

Product Development

1. The proof-of-concept for the development of medicated haemostatic sponge to control bleeding was underway
2. 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 continued. This ELISA-based method for pyrogenicity assessment is suited for a wide spectrum of applications to measure the undetected non-endotoxin pyrogens such as pyrogens of chemical or biological nature.

Research Programmes

1. New Initiatives

1. Development of 'Human-on-a-Chip' device technology supported by the Department of Science and Technology, Government of India, was initiated
2. Toxicity evaluation of materials for TRC projects was initiated



2. Other

1. Interfacing of nanographene (PrGO) with mouse bone marrow mesenchymal stem cells and its allied molecular toxicity using in vitro and in vivo methods funded by ICMR, New Delhi was completed.
2. Investigation of toxicity of Zinc Selenium/Zinc Sulfide (ZnSe/ZnS) quantum dots at molecular level funded by DST - Inspire
3. Investigation of Interleukin-1 from pooled human blood stimulated with toxicants and associated molecular toxicity funded by CSIR, New Delhi
4. Bio-nano interactions of polymer-coated titanium dioxide nanotubes funded by CSIR, New Delhi
5. Biological interactions of 2D Zn-Al layered double hydroxides (LDHs) in in vitro and in vivo systems funded by SCTIMST
6. Molecular toxicity, biodistribution and foetoplacental transmission of Tungsten disulphide (WS₂) quantum dots using rat model funded by UGC-CSIR, New Delhi

Testing and Evaluation

The details of toxicity studies carried out during the year are indicated in the Table below:

Samples	Number
Samples received for testing/studies	239
Reports released	63
Accredited test reports	41
Non-accredited test reports	22

Staff

Faculty

Dr A Maya Nandkumar, Scientist G and Head of the Department

Dr Lissy K Krishnan, Scientist G (Senior Grade)

Dr Prabha D Nair, Scientist G (Senior Grade)

Dr T V Anilkumar, Scientist G

Dr Anoopkumar Thekkuveetil, Scientist G

Dr Mohanan P V, Scientist G

Dr A Sabareeswaran, Scientist F

Dr Kamalesh K Gulia, Scientist F

Dr Anugya Bhatt, Scientist E

Dr Anil Kumar P R, Scientist E

Dr V S Harikrishnan, Scientist D

Dr Lynda V Thomas, Scientist D

Dr Renjith P Nair, Scientist C

Dr Naresh Kasoju, Scientist C

Dr Remya N S, Scientist C

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Ms Sulekha Baby, Scientific Officer

Ms Usha Vasudev, Scientific Officer

Mr Pradeep Kumar S S, Senior Scientific Assistant

Dr Geetha C S, Junior Scientific Officer

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Mr Ranjith S, Technical Assistant

Ms Deepa K Raj, Technical Assistant

Mr Vinod D, Technical Assistant

Ms Nimi N, Technical Assistant

Ms Vandana Unnikrishnan, Technical Assistant

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Mr Pradeep Kumar B, Animal Handler

Mr Manoj M, Animal Handler

Mr Sunil Kumar M, Animal Handler

Mr Harikumar G, Animal Handler

Ms Amrutha Kumari, Unit Assistant



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 consists of the following Divisions:

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

DIVISION OF BIOCERAMICS

The Division is engaged in developing bioceramics-based tissue repair materials for orthopaedics and dentistry. The know-how of two products reached technology transfer stage, with M/s Prevest Denpro, Jammu, as the Industrial partner. The research team optimised calcium-strontium-silicate-based hydraulic cement for endodontic repair. The major studies done were: (i) the evaluation of the regeneration ability of self-setting bioactive calcium composition for periodontal bony defects and (ii) development of graded bioactive membranes from modified chitosan for periodontal regeneration.

Product Development

1. Calcium-strontium-silicate-based hydraulic cement for endodontic repair

Silicate-based cements are highly popular for conservative pulp vitality treatments, perforation repair and root end filling because of their self-setting property, sealing ability, dimensional stability and non-resorbability. The present silicate cements are based on Portland cement composition and contain heavy metals for radio-

opacity. A new bioactive calcium-strontium-silicate cement composition was developed which avoids toxic heavy elements and is compatible with periradicular tissues. The essential ingredients like dicalcium silicate, tricalcium silicate and strontium orthosilicate were prepared by sol-gel method and mixed in optimized quantities. The presence of calcium provides bioactivity to generate dentin tissues in vivo and the strontium content ensures radio-opacity. The alkaline setting imparts anti-bacterial properties to the cement.

The setting time, dimensional stability and radiopacity were determined as per ISO 6876. Mechanical properties of the set cement (compressive strength, flexural strength and micro-hardness) were studied, and cytocompatibility and anti-bacterial property were evaluated. The cement composition satisfied all the essential requirements of ideal endodontic cement (Figure 25).

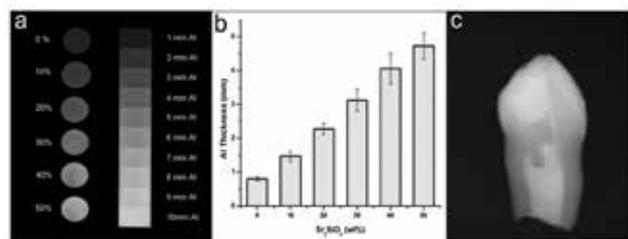


Figure 25. (a) X-Ray contrast of set cement pellets containing different weight percentages of strontium orthosilicate, shown along with aluminium step wedge, (b) Quantitative results of the radio-opacity measurements shown as bar chart of equivalent Al thickness versus Sr₂SiO₄ weight percentages, and (c) Radiograph of an in-house cement containing 30 wt% Sr₂SiO₄ placed in root canal



2. Evaluation of the regeneration ability of a self-setting bioactive calcium composition for periodontal bony defects

Augmentation, grafting and filling of bone defects are often required in periodontal surgery like infected alveolar ridge and after dental extraction. Osteoconductive ceramic graft materials in fine granule form are used currently for grafting. Bioactive cement based on calcium sulfate-phosphate composition was designed, which was highly bioactive and less expensive compared to bioceramic grafts.

'PerioCem' was formulated out of calcium sulfate and phosphate ions, bioactive additives, setting accelerators, gelling agents and biocompatible radio-opacifiers. The biological evaluation was carried out using primary Human Periodontal Ligament cells (HPDL cells). The osteogenic potential was assessed by osteogenic marker expression and gene expression profile. HPDL cells were seeded onto 1cm² cement discs and cultured for 24 h, for assessing the viability and morphology of the cells by immunofluorescence staining and SEM. The cells were cultured on the cement discs for 7, 14 and 21 days and immunocytochemistry - immunofluorescence (ICC/IF) evaluation was carried out with specific osteogenic markers, alkaline phosphatase, osteonectin, dentin matrix protein and collagen

type I. The relative expression of osteogenic genes, RUNX2, ALP, COLIA, and Osterix was evaluated by qPCR (Figure 26).

The HPDL cells exhibited positive responses in viability and morphology evaluations. The cells differentiated to an osteogenic lineage in the presence of the cements with positive gene and protein marker expression. These data suggested that PerioCem can be used for the treatment of periodontal bony defects, alveolar ridge augmentation and as resorbable filler for socket filling following dental extraction

3. Graded bioactive membranes from modified chitosan for periodontal regeneration

Guided Tissue Regeneration (GTR) in periodontal treatment aims at the regaining of bony tissue lost due to periodontitis. A membrane is used to ward off the epithelial cells hindering the healing (i.e., barrier) and the wound is left protected for natural repair. The objective was development of a new generation GTR membrane that can actively participate in natural regeneration process as well as act as a conventional barrier membrane. The basic material was a modified form of chitosan made into a porous structure by incorporating graded quantities of nano calcium phosphate.

Chitosan was modified by glycidyltrimethyl ammonium chloride to obtain 'quaternised chitosan' (QC). This was a biodegradable form and the graded porous structure was obtained through controlled freeze drying. Nano calcium phosphate (CaP) was incorporated in solution state by in situ precipitation, which imparted bioactivity. Degradation test was performed by dipping in PBS and observing in SEM. In vitro bioactivity of the membranes was assessed by immersing in stimulated body fluid for 48 hrs and observing the apatite (bone mineral) layer formation in SEM as

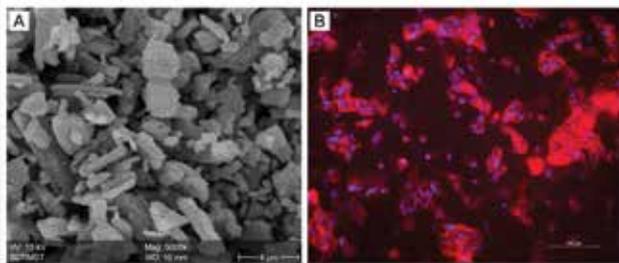


Figure 26. (A) The micromorphology of 'PerioCem' as seen in SEM (B) Actin cytoskeleton staining of HPDL cells for 48 hours, showing osteogenic potential



well as phase analysis by XRD (Figure 27). The tensile properties and suture pull-out strength was assessed using universal testing machine. The cell viability of the bioactive membrane was tested through direct contact cell culture and MTT assay with L929 cell lines.

The porous bioactive QC membrane with graded nano-CaP was found compatible to cells and showed good bioactivity and degradability in vitro. The mechanical properties were found suitable for surgical use. It can act as a barrier membrane as well as enhance the regeneration of the periodontal bone.

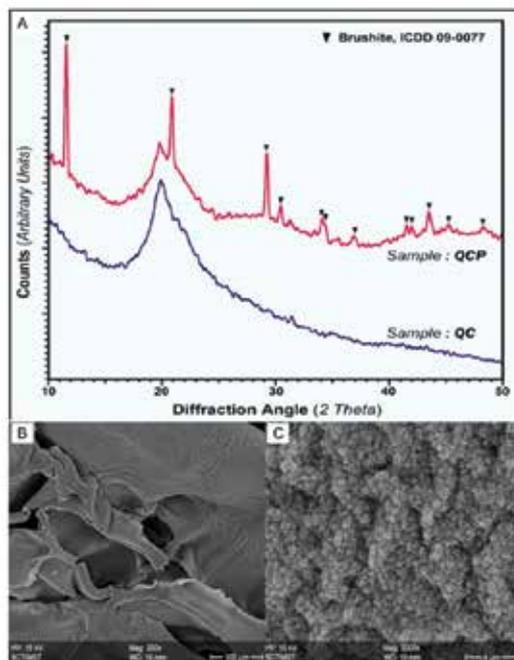


Figure 27. The results on the QC-nanoCaP graded membrane: A) The precipitated phase identified in XRD, B) the result of the in vitro bioactivity test wherein apatitic layer gets deposited from SBF, C) a magnified image of a region in B showing the thick layer formation.

4. In vivo efficacy testing of hydrothermally generated bone grafts in animals

The objective of this work was to develop a faster resorbing ceramic filler material to be used as a socket filler to prevent the alveolar bone loss

following dental extraction. Scaffolds prepared from two different precursor sources namely, calcite and tricalcium phosphate were effectively transformed to hydroxyapatite via hydrothermal exchange reactions. Hydrothermal method of scaffold preparation avoids high temperature, sintering and the associated problems of grain growth, shrinkage and reduction in porosity. Also, the in vivo degradation rate of the sintered mass will be low. The developed non-sintered scaffolds had adequate handleability and mechanical properties. It passed the in vitro screening tests for biocompatibility. The in vivo efficacy was tested in rabbit models for dental extraction socket filling.

The result of a 3 month study revealed the faster resorption potential of the developed material in comparison to the sintered hydroxyapatite granules. Test materials were named: CHA (calcium carbonate-derived hydroxyapatite) and THA (tricalcium phosphate-derived hydroxyapatite) and control used was 1mm sized sintered hydroxyapatite (HA) granules. There was no reduction in height of alveolar ridge or collapse of buccal socket during the study period of 12 weeks in the test and control materials.

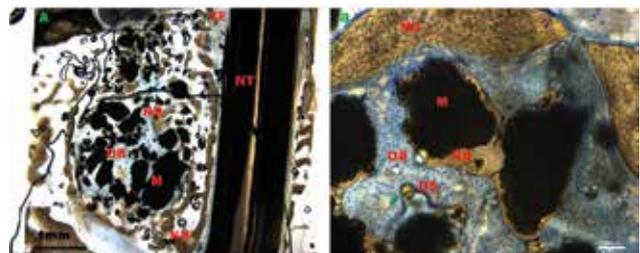


Figure 28. CHA material: (A) shows the implanted region at 4× magnification. Material remaining, new bone formation and osteoblasts are seen at the site along with the neighboring tooth.

(B) shows the implant and new bone formation around the material, ossification centers are visible here 10× magnification. The sections in PMMA were stained with Stevenal's blue (osteoblast-like cells - blue) and van Gieson's picrofuchsin (osteoid matrix - yellow) staining. (Abbreviations and symbols used: M denotes material remaining, ossification centres are denoted as OS, OB like cells are shown in blue, New bone formation is seen around the material denoted as NB)



The rate of new bone formation and the degradation of the material were found to be higher for CHA in comparison to THA. Both the test materials demonstrated better performance than control sintered HA granule in terms of bone formation and material degradation (Figure 28).

Testing and Evaluation

The Bioceramics Division offers tests and analyses 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 are available to both internal and external customers

Outreach Programme

Dr Manoj Komath presented a talk on Sir C V Raman in the Department of Physics, Kerala University, Karyavattom, Trivandrum, on the event of National Science Day on 28 February 2019.

MoUs

An MoU was signed with the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, for collaborative work in areas of common interest

DIVISION OF BIOSURFACE TECHNOLOGY

The major activity in the Division 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.

Non-viral gene delivery vectors were developed for gene delivery applications. These polymeric non-

viral vectors were found to be non-toxic or less toxic. Various vectors such as thiomeric gold nanoparticles and polysaccharide hybrid vectors were developed towards gene delivery applications. With these vectors intracellular dual delivery of anticancer drug and p53 gene could be done simultaneously. In vitro results demonstrated good transfection efficiency.

Product Development

1. Wound dressing

Infection is a major concern in wound management. Although many advanced wound care materials are available, they are not always effective in treating chronic and infected wounds. Chitosan-based antioxidant sponge dressings are meant for treating chronic non-healing wounds (Figure 29). This product has the ability to



Figure 29. Chitosan-based wound dressing

scavenge excess reactive oxygen species in the non-healing wound bed. This is also designed to deliver anti-microbial drugs to the wound site directly. The dressing is able to absorb the wound exudate, facilitate moist environment and promote water vapour transmission. 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 these sponges were evaluated using antimicrobial drugs and the antimicrobial effect was evaluated and established against *E.coli* and *S.aureus*. The sponges were found to be biocompatible on carrying various tests as per the relevant standards. Presently, the efficacy evaluation in rabbit model is ongoing.

2. Oral insulin delivery system

Polymeric oral insulin carrier was developed and the gap areas were addressed. Initially, insulin-loaded nanogels were developed and tested for their efficacy in diabetic rats and were found promising. Currently, these nanogels are being converted into free-flowing powder which can be filled in gelatin capsules. The in vitro efficacy evaluation of this formulation is ongoing

Research Programmes

1. Wound dressing

Alginate-based wound care products have found wide acceptance in wound care market due their unique properties like moisture-assisted wound healing. The alginate fibre-based dressings currently available in the market have excellent absorbing capacity, but their poor mechanical strength and deposition of alginate fibres in the wound bed initiating inflammatory reaction are major problems. Moreover, controlled drug delivery is not possible with such dressings. So, hydrogels-based systems will be more suitable for such applications, but sterilization of hydrogels is the major issue. In this scenario, alginate xerogels will be an excellent choice, enabling sterilization and controlled drug delivery. The Division developed an alginate-grafted poly (methacrylic acid)-xerogels for wound healing application. The xerogels were further crosslinked with bisacrylamide and strontium ions to improve mechanical strength. The xerogels

were chemically characterized by FTIR and NMR analysis and showed higher thermal stability. The material had excellent swelling ability similar to commercial dressings and possessed a water vapour transmission rate of $1879 \pm 75 \text{ g/m}^2/24 \text{ hour}$. The xerogels had a pore size distribution ranging from $80\text{-}160 \mu\text{m}$, favourable for biomolecule delivery. The percentage weight loss of alginate xerogels at pH 7.4 showed $< 20\%$, while commercial products had $>80\%$ alginate deposition. The cytotoxicity evaluation carried out on fibroblast cell lines showed that the xerogel-treated cells had $>80\%$ cell viability when assessed by direct contact assay.

2. Non-viral gene delivery for anticancer therapy

Thiomic vectors were developed for gene delivery applications. These polymeric non-viral vectors were found to be non-toxic or less toxic. With these vectors intracellular dual delivery of anticancer drug and p53 gene could be done simultaneously. In vitro results demonstrated good transfection efficiency and the retention of anticancer drug doxorubicin owing to the efflux pump inhibitory capability of the thiomers. The dual delivery had an enhanced effect on cell death compared to that of individual therapeutic molecules intracellularly. In vivo efficacy evaluation was carried out in mice bearing solid tumor which was induced by injecting Daltons lymphoma cells. The thiomers, PPDBA developed here was used for in vivo efficacy studies. The nano-complex, PPDBA/p53/DOX was prepared by intercalating the drug, DOX with p53 plasmid and complexed with PPDBA polymer. In comparison with untreated animals, a reduction of nearly 20% from the initial tumor size was observed in the groups treated with PPDBA/p53 or PPDBA/p53/DOX nano-complexes. The results were encouraging.



DIVISION OF BIOPHOTONICS AND IMAGING

The Division comprised of one faculty, three project staff and six PhD students. During the year, a project on the development of “Blood brain barrier permeable nanocarriers for diagnosis and therapy of neurodegenerative diseases” was initiated under DBT. Two staff, a JRF and Research Associate is working in this Project. A TDF Project on the “Development of ultrasensitive sensor platform for the detection of circulating tumor cells” was also initiated. A prototype of the Optical Peripheral Nerve Stimulator was developed as part of the TRC Program and was tested on Wistar rats. A good stimulation as represented by the EMG signal and the twitching of the leg of the animal using a 1W diode laser working at 940 nm was evident when stimulating the peripheral nerve of rat. Majority of the work in the Division are related to projects of PhD students. The Division is working mainly on the development of materials and devices for biophotonics applications in the field of sensing, imaging, diagnosis and therapy. Development of a nanocarrier-mediated gene delivery to stem cells for cardiac therapy is underway. Studies on: basic biological interaction of nanomaterials in vitro and in vivo, development of multifunctional nanomaterials based on anisotropic systems for simultaneous sensing of different analytes, and development of metallic nanostructures of atomic size for tumor imaging and gene regulation-based cancer therapy are ongoing. As a part of PhD work, an all-in-one Nanoplatfrom built on Gold-Graphene hybrids for multifunctional cancer theranostics was developed and the proof-of-concept was completed. Near Infra-Red emitting chitosan-based fluorescent nanoparticle capable of imaging and gene delivery were also prepared for stem cell tracking. A major multi-institutional project in collaboration with CSIR-NIIST, Trivandrum, funded by DBT titled “Development of Gold Nanorod Based Targeted Nanoprobe For Cancer Theranostics:

Diagnosis By Surface Enhanced Raman Scattering (SERS) and Fluorescence Imaging and Therapy By PDT and PTT” is underway.

Product Development

1. Medical Device

A TRC Project on Optical peripheral nerve stimulation was initiated last year and the feasibility study was completed successfully. A prototype of the Optical Peripheral Nerve Stimulator (Figure 30) 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 using a 1W diode laser working at 940 nm was evident when stimulating the peripheral nerve of rat. Histopathological tests were conducted on the stimulated nerve. There was no sign of any damage. Also, the pain score study of the animal during the stimulation was carried out. The results show that the animal does not suffer from any pain during the stimulation. Transcutaneous stimulation was conducted without exposing the nerve, but the results were not promising. The future plan is to conduct the experiment using a different light source, laser diode.



Figure 30. Optical peripheral nerve stimulator



2. Biomaterials

Many biomaterials were synthesised for imaging, sensing and therapeutic applications. This includes, nanoscale vanadium pentoxide nanoparticles for cancer therapy, gold nanocluster for diagnosis and therapy of neurodegenerative disorders, polysaccharide-based nanomaterials for stem cell tracking, gold cluster for imaging and sensing and a graphene-based system as an all-in-one nanoplatform for multiple imaging and therapy.

Research Programmes

1. Nanoscale vanadium pentoxide nanoparticles were synthesized, well-characterized and

evaluated for their biological interaction on MDA-MB-231 breast cancer cell line. A notable observation was that nanosphere treatment resulted in increased autophagy by upregulating a protein called LC3b. Also, the GFP-LC3 expressing cells demonstrated strong green fluorescent puncta formation in nanoparticle treated MDA-MB-231 cells indicating autophagy induction. The autophagy initiation was associated with a decrease in mitochondrial membrane potential and mitochondrial activity. Lysosomal integrity studies confirmed that the membrane stability was well-maintained despite induction of autophagy (Figure 31).

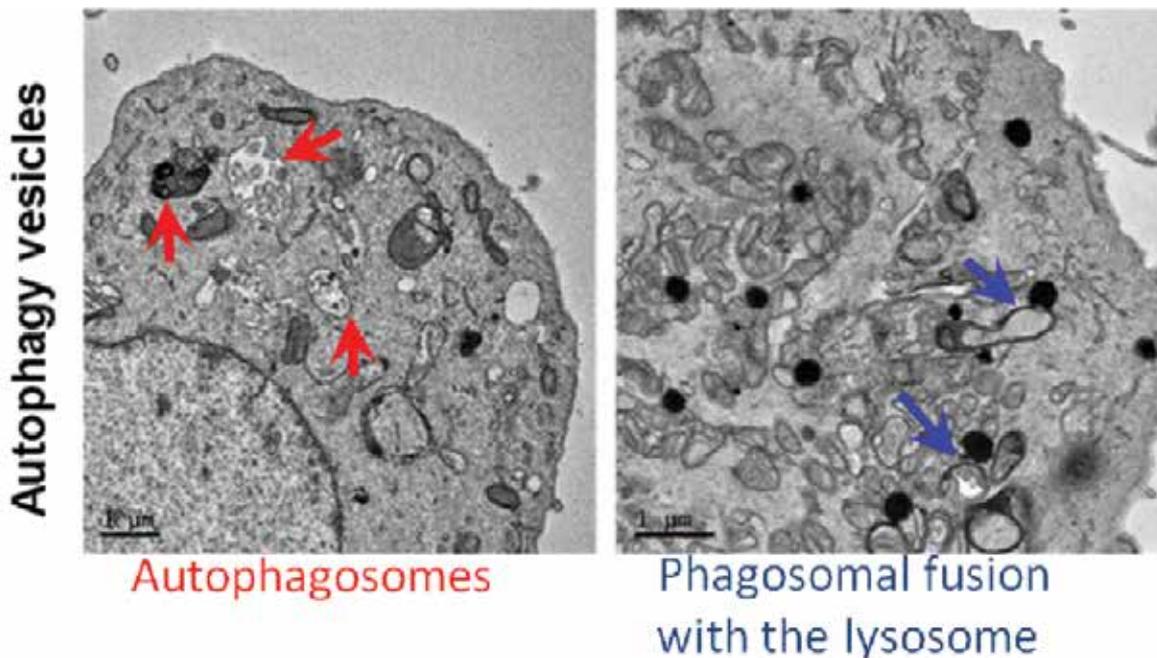


Figure 31. Increased autophagy in breast cancer cell line treated with vanadium pentoxide nanoparticles

2. In another study, we developed a multimodal imaging and therapeutic system by incorporating a chemotherapeutic drug, mitoxantrone (MTX) onto PEG-coated gold nanorods (GNR). Strong absorption in the near-infrared (NIR) and visible

regions qualifies GNR as an efficient photothermal (PTT) agent upon irradiation with either a NIR or visible laser. Additionally, the enhanced electric field of GNR makes it a suitable substrate for Surface Enhanced Raman Scattering (SERS).



Modification of GNR with amino PEG offers biocompatibility without affecting its optical property. In order to achieve tumor specificity, GNR-PEG was conjugated with a tumor specific marker that can target cancer cells, leaving the normal cells unaffected. The incorporation of fluorescent chemotherapeutic drug, mitoxantrone onto GNR-PEG facilitated chemotherapy as well as fluorescence imaging (Figure 32). The therapeutic efficacy of the developed GNR-based system was tracked using fluorescence imaging and Raman imaging.

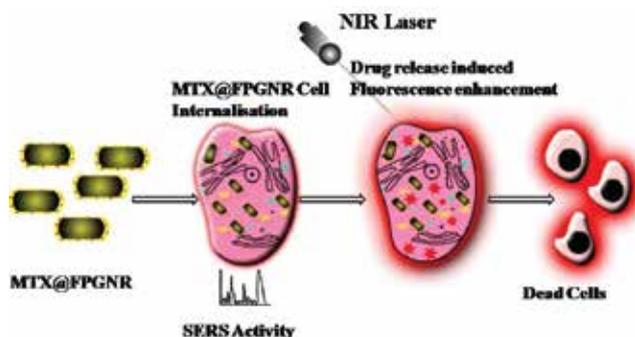


Figure 32. Multimodal imaging and therapeutic system incorporating chemotherapeutic drug mitoxantrone (MTX) onto PEG-coated gold nanorods

3. The major multi-institutional project funded by DBT in collaboration with CSIR-NIIST, Trivandrum is in progress. Here, the spatio-temporal synchronization of Photothermal Therapy (PTT) and chemotherapy was adopted as an insightful approach to enhance the therapeutic efficacy. Localized photothermal-chemotherapy was initiated by goldnanorod (GNR) conjugated to (i) Raman signature molecule (RSM) i.e. squaraine dye (SQ) attached target-specific peptide substrate susceptible to matrix metalloproteinases (MMP2 & MMP9), over-expressed in extracellular matrix of cancer cells; (ii) secondly, 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 (Figure 33).

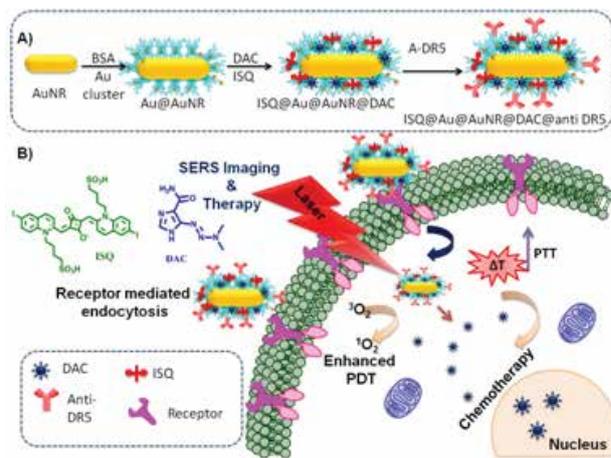


Figure 33. Spatio-temporal synchronization of photothermal therapy and chemotherapy

Outreach Programme

A student outreach programme was conducted at Science Facilitation Centre, Mar Ivanios College Trivandrum on May, 2018 on topic “Lasers and its Applications in Medicine” by Dr Jayasree R S.

DIVISION OF DENTAL PRODUCTS

A simple and elegant approach for the development of multifunctional oligomers for fast in situ step growth photopolymerization for medical application was the main outcome during the year. Shell nacre containing bio-resins with polymerizable dimethacrylate groups were synthesized and characterized for hard tissue replacement applications. Two patent applications were filed. The new composite showed good physico-mechanical properties (DTS, FS) and low polymerisation shrinkage values. Remineralisation studies, water sorption solubility, radiopacity measurement (using standard aluminium wedge), in vitro cytotoxicity, cell adhesion and cell proliferation studies and in vivo biocompatibility evaluation were completed. The optimised formulations were found to be radiopaque, bioactive, biocompatible and non-



cytotoxic. The Division formulated a novel bioresin for hard tissue applications. Dr Deepure represented the Institute in a three-day exhibition conducted as part of the Silver Jubilee celebration of Kairali Vidya Bhavan, Nedumangad.

Product Development

The development of bioactive, radiopaque, low shrinkage dental composite based on inorganic-organic hybrid resin with polymerizable dimethacrylate groups continued. The mechanical properties of the composite were optimized and the radiopacity of the material was evaluated. The preliminary characterization of the material was completed. The material exhibited bioactivity and low shrinkage with good depth of cure.

Research Programmes

In vitro osteogenesis and biocompatibility evaluation of bioactive biocomposite was initiated. In vivo osteogenesis study of shell nacre-containing biocomposite was initiated and B Form for femoral defect in Sprague Dawley rats was approved.

Testing and Evaluation

The Division extended the testing facilities including Thermal Cycling, High Performance Liquid Chromatography, microCT, FTIR, FT Raman and UV-visible spectrophotometer, Universal testing machine and particle size analysis to external and internal customers.

Staff

Faculty

Dr Manoj Komath, Scientist G and Head of the Department (Acting)

Dr Rekha M R, Scientist F

Dr Jayasree R S, Scientist F

Dr Lizymol P P, Scientist F and Section-in-Charge

Dr Shiny Velayudhan, Scientist D

Dr Manju S, Scientist D

Dr Franciz Fernandez, Scientist C

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Mr Nishad K V, Scientific Assistant (Instruments) - A

Mr Sajin Raj R G, Technical Assistant (Instruments) - A

Ms Remya K R, Technical Assistant (Instruments) - A

Dr Parvathy J, Technical Assistant



DEPARTMENT OF MEDICAL DEVICE ENGINEERING

The Department focuses on the research and development of medical devices, covering the entire life cycle from conceptualization to technology transfer including, empirical design, computer-aided modelling, in silico evaluation, fabrication, prototyping and functional evaluation. The Department has six Divisions, four of which established their own domains of medical devices development; while the other two strongly support the device development activities in terms of precision fabrication of prototype devices and developing animal models for pre-clinical evaluation.

1. Division of Artificial Internal Organs
2. Division of Extracorporeal Devices
3. Division of in-vivo Models and Testing
4. Division of Medical Instrumentation
5. Division of Polymeric Medical Devices
6. Division of Precision Fabrication

Apart from the above functions, the Department extends support services to other internal divisions and external customers, like Rapid Prototyping Facility, ethylene oxide sterilization, package validation, material characterization and computer-aided design and analysis.

During the year, Vein Viewer technology from the Department was commercially launched in India and internationally by the Technology partner, M/s. Agappe Diagnostics Ltd.. The LVAD and PT/INR monitor technologies developed in the Department were transferred to industry and Hydrocephalus Shunt technology was relicensed during the Technology Conclave 2019.

DIVISION OF ARTIFICIAL INTERNAL ORGANS

The Division is executing 7 TRC projects aimed at development of high-risk medical devices which are nearing the completion of the proof-of-concept

stage. The Hydrocephalus Shunt technology was relicensed to M/s Phraction Scientifics, Pathanamthitta.

Following new projects were initiated during the year:

1. Programmable Hydrocephalus Shunt (PHS)
2. TiN coated Coronary stent
3. proBNP diagnostic kit

Product Development

1. Bioprosthetic Heart Valve

Prosthetic device for replacement of diseased heart valves for both aortic and mitral position using tissues of animal origin was under development. Prototypes were developed for two designs - an internally mounted and externally mounted leaflets design.

2. Annuloplasty Ring

Prototype of rigid annuloplasty ring was fabricated and in vitro testing is underway (Figure 34). Flexible annuloplasty ring design was completed and fabrication is in progress.



Figure 34. Modal analysis of annuloplasty ring



3. Leukocyte Filter

Candidate designs were developed for Leukocyte Filter and CFD characterisation was completed.

4. Programmable Hydrocephalus Shunt

Design and analysis of a device for treatment of hydrocephalus progressed.

5. Aortic Stent Graft and Delivery System

This is a prosthetic endovascular device for treatment of thoracic aortic aneurysms. The design for the tip release mechanism of the delivery system and the design of a braided cuff for preventing endo leaks were developed.

6. Atrial Septal Defect Occluder

This is a prosthetic endovascular device for treatment of atrial septal defect (ASD). A design for the ASD delivery system incorporating a device release mechanism was developed. FEM simulations were done to analyse the stress and deformation as shown below (Figure 35).



Figure 35. Deformation of atrial septal defect occluder delivery system prongs and von Mises stress of atrial septal defect occluder delivery system prongs

7. Flow Diverter Stent

This is a prosthetic endovascular device for treatment of intracranial cerebral aneurysms. The design for the device and the design for the delivery system were completed. CFD simulations were done to analyse the flow patterns as shown below (Figure 36).

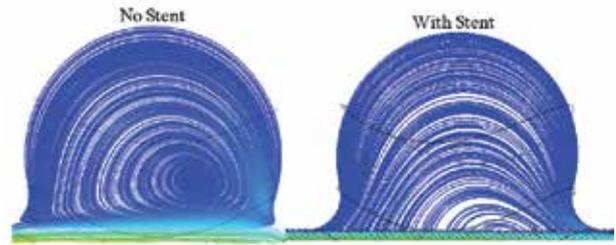


Figure 36. CFD simulation of flow dynamics at intracranial aneurysm location before and after the introduction of the flow diverter stent

Testing and Evaluation

The design for in vitro arteriovenous malformation experimental set up for a new liquid embolic agent was completed and an experimental setup was developed for its evaluation outside the body. The new liquid embolic agent was tested to observe precipitation qualitatively.

DIVISION OF EXTRACORPOREAL DEVICES

The Division focuses 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, implantable infusion pump, membrane oxygenators, cerebral microdialysis device, transcutaneous energy transfer system, infrared energy-based technologies for blood warmers, infant warmers and vein viewers.

The Division also supports various TRC Projects of the Institute. A new TRC Project for development of implantable micro infusion pump with wireless recharge was initiated. Faculty in the Division is also involved in supporting medical device regulatory system. Nagesh D S, Vinodkumar V and Amrutha C took part in the Materiovigilance Programme of India (co-ordinated by India Pharmacopeia Commission, Ghaziabad) as expert members. The Division also supports other Divisions in the institute for obtaining



regulatory approval for medical device manufacturing. The International Launch of the Vein Viewer product from the Division was done by the Technology partner, Agappe Diagnostics Pvt. Ltd. at “Medica 2018” Expo held at Dusseldorf, Germany on 15 November 2018 (Figure 37). The Technology transfer of paracorporeal Left Ventricular Assist Device (pLVAD) was done to M/s Meril Lifesciences Pvt. Ltd. during Technology Conclave 2019. The technology of PT/INR measurement device co-developed with the Division of Thrombosis Research Unit was transferred to M/s Agappe Diagnostics during the Technology Conclave 2019. The services of Ethylene oxide sterilization and Rapid prototyping were extended to other Departments and Divisions of the institute.



Figure 37. International launch of the Vein Viewer from the Division by the Technology partner Agappe Diagnostics Pvt. Ltd. at “Medica 2018” Expo, Dusseldorf, Germany on 15 November 2018

Product Development

1. Paracorporeal Left Ventricular Assist Device

Ventricular Assist Devices (VADs) are circulatory support devices that help to maintain a nominal cardiac output for various physiological functions of the human body in end stage cardiac failure patients. The Chitra pLVAD is a magnetically levitated third generation LVAD which is

composed of a centrifugal blood pump with a miniature brushless DC motor, a controller and a cable connecting controller to the pump. The Chitra pLVAD including the LVAD pump, microcontroller-based controller, battery pack and charging unit were designed and prototypes fabricated (Figure 38). In vitro evaluation of the prototypes with blood analogous fluids is ongoing at present.

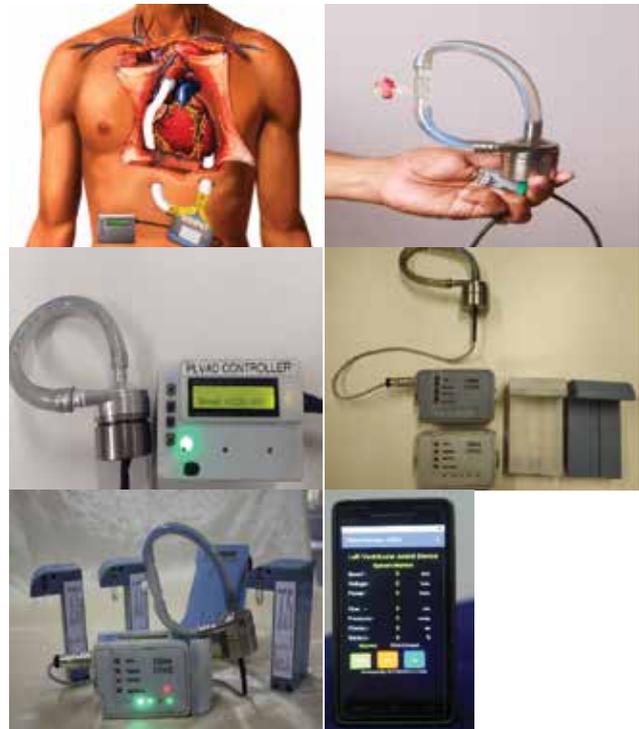


Figure 38. Chitra paracorporeal Left Ventricular Assist Device with controller, battery pack and charging unit

2. Centrifugal blood pump with drive and flowmeter

In this project, a centrifugal blood pump with its associated drive was developed for maintaining systemic circulation during cardiopulmonary bypass surgery. As shown in Figure 39, the system consists of a disposable centrifugal pump and a miniature controller with detachable drive unit. The drive and the pump can be kept close to the patient to reduce the priming volume of the fluid

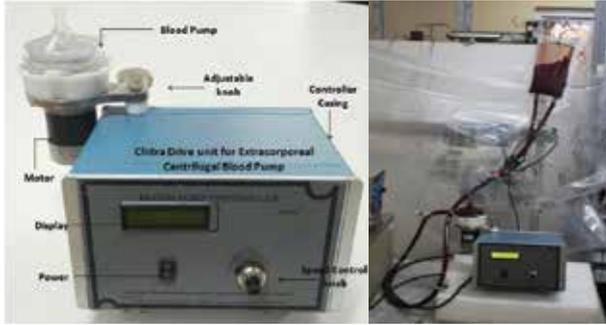


Figure 39. Extracorporeal blood pump, controller and drive unit

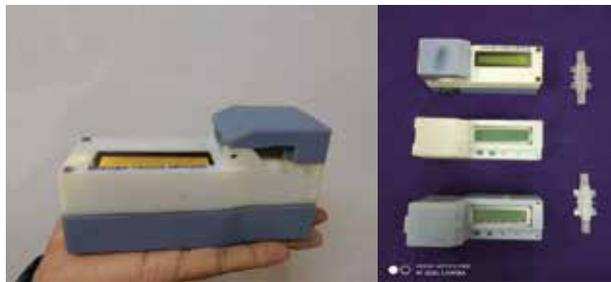


Figure 40. Chitra blood flow meter and flow tube

required during the surgery. A portable blood flow meter measures the velocity of the blood flowing through the tubing and displays the fluid flow rate in litres/minute (Figure 40).

3. Implantable micro infusion pump

In this project, an implantable device for precisely delivering drugs to various regions of the body was developed. The device has a storage unit, a driving unit with associated electronics to deliver



Figure 41. Implantable micro infusion pump

drugs like insulin, chemotherapeutic agents and and pain management drugs (Figure 41). Preliminary design of the device was completed and optimization and refinement were underway.

4. Vein Viewer

A device for viewing the veins of patients, especially paediatric patients using infrared



Figure 42. Vein Viewer prototypes and industrial model

technology and image processing. The technology was transferred to M/s Agappe Diagnostics Pvt. Ltd. for commercialization (Figure 42). The commercial launch of the device was on 24 March 2019.

5. Infrared infant warming wrapper and bassinet

A system for efficient and non-contact warming of a premature baby to physiological conditions, thereby preventing excessive heat loss from the body. The infant warming wrapper device consists of a portable baby wrapper fitted with infrared warming pad which can be powered continuously by low power batteries. The bassinet consists of a portable baby bassinet fitted with a removable infrared warming pad which can be powered continuously by low power batteries or using home mains power supply (Figure 43). Multiple prototypes of the device were fabricated and completed bench top safety and performance tests as per relevant standards.



Research Programmes

1. Development of membrane oxygenator using active gas transfer enhancement techniques

This is project aimed at studying techniques for enhancing gas transfer efficiency of membrane



Figure 43. Infant warming wrapper (Top) and infant warming bassinet (Bottom)

6. Infrared blood and IV fluid warming system

A device for warming blood and IV fluids to physiological conditions from refrigerated conditions using infrared radiations emitted from small, low-cost IR LED cluster. The device consists of a blood bag warming unit and an IV tube warming unit which ensures flow rate independent warming suitable for massive as well as slow transfusion. The IV tube warmer also provides inline temperature drop compensation



Figure 44. Infrared blood and IV fluid warming system with inline temperature loss compensation

for reduction in temperature of the blood due to influence of ambient environment (Figure 44). Multiple prototypes of the device were fabricated and completed bench top safety and performance tests as per relevant standards.

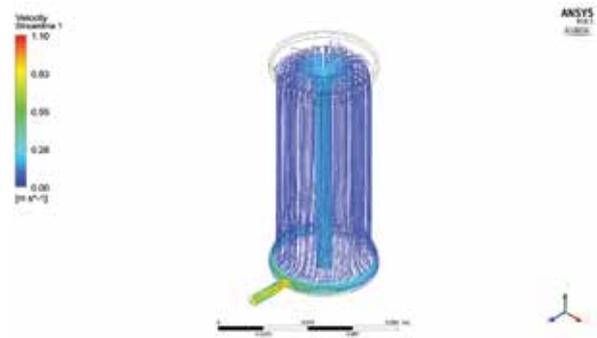


Figure 45. Computational fluid dynamics analysis of oxygenator - flow velocity streamlines

oxygenators (artificial gas exchange devices used for supporting lungs). Computational fluid dynamics-based estimation of gas transfer in oxygenators in a micro scale approach was ongoing (Figure 45).

2. Development of cerebral microdialysis device

The project was aimed at development of a device for microdialysis for aiding early estimation of biomarkers in cases like traumatic brain injuries. Prototypes of micro dialysis probe based on a preliminary design were fabricated and evaluation is ongoing.

DIVISION OF IN VIVO MODELS AND TESTING

The primary responsibility of the Division is to conduct medical device translational studies using physiologically normal animals or disease-induced 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 for assessing its functional safety and performance. To achieve this objective, the Division is equipped with qualified and trained staff, infrastructure such as operation theatre, clinical laboratory, acute care rooms, animal preparation/explantation rooms and CPCSEA registered large animal house which provides healthy, traceable large experimental animals such as pigs and sheep.

Six large animal studies were completed during the year. Two device evaluations for industry such as covered stent and lung volume reduction coil were undertaken in a pig model.

Other animal studies such as testing of anti-arrhythmic activity of a novel molecule in rabbit model in collaboration with Professor Haridas, IIT Delhi, rat myocardial infarction model by left coronary artery ligation for evaluation of in vitro cardiomyocyte differentiated adipose-derived mesenchymal stem cells and juvenile rat subcutaneous study to evaluate calcification and tissue response of differently processed bovine pericardium were completed.

The new initiatives during the year were:

1. Pig model for lung volume reduction coil evaluation was developed
2. Pig diabetic model for wound care product evaluation was standardized
3. Rat model of myocardial infarction was standardized
4. A TDF Project titled: 'Multilayer warp knitted polyester for valve strengthening after valve repair' was sanctioned

Product Development

1. Development of bioprosthetic heart valve

The project is ongoing and as part of it a source for biomedical quality animal tissue was identified at Meat Products of India, Koothattukulam, a Public Sector Unit under Government of Kerala. Valve

prototypes were made and underwent preliminary testing.

2. Non-cytotoxic glutaraldehyde processed porcine pericardium as dural substitute

A non-cytotoxic, glutaraldehyde-processed porcine pericardium suitable as dural substitute was developed. Animal testing in rabbit dural defect model showed encouraging results. Other tests as per ISO 10993 were conducted as part of preclinical safety data collection

Research Programmes

Research for improving the performance and safety of processed bovine pericardium meant for valve leaflet application was conducted. Accordingly, a new process was identified which preserved collagen structure, was non-cytotoxic and less calcifying as demonstrated in juvenile rat subcutaneous implantation model.

Testing and Evaluation

Six large animal studies were completed during the year. Two device evaluations for industry: covered stent and lung volume reduction coil were undertaken in pig model. Processed bovine pericardium used for pig aortic implantation was evaluated for 6 months for calcification, inflammatory and healing response. An in-house developed wound care product was evaluated in pig diabetic model. Another in-house developed device, blood pump was tested in sheep model for 3 and 6-hours pump support during standard cardiopulmonary bypass. The evaluation of Sirolimus-eluting bioresorbable polymer mesh covered coronary stent system in adult Swine coronary artery was completed.

Lung Volume Reduction Coil (LVRC) was evaluated in pigs. Five LVRC coils were successfully implanted in lungs using bronchoscopy and fluoroscopy techniques. One coil could be retrieved using bronchoscopy at the end of one month as per the protocol. Lung with coil was subjected to histopathological evaluation.



The wound healing study for “Preclinical evaluation of biodegradable PLGC-fibrin hemostatic graft for skin regeneration” was successfully completed in 2 Pigs with induced type 1 diabetes. The healing of surgically created wounds was evaluated for a period of 30 days

DIVISION OF MEDICAL INSTRUMENTATION

The Division is equipped with facilities required for research and development in medical instrumentation and its activities include technology development for medical transducers and bio-electrodes, development of bio-electrical impedance measurement techniques and novel diagnostic tools required for artifact-free monitoring of breathing and early detection of various disorders. Currently, the core research focuses on the development of highly sophisticated active implants like deep brain stimulators, cardiac defibrillators and various kinds of sensors and electrodes such as subdural and depth electrodes. A MoU was signed with Shree Pacetronix Ltd., for the co-development of Implantable Cardiac Defibrillator on 8 August 2018.

Product Development

1. Deep brain stimulator system for movement disorders

Deep brain stimulation involves implanting electrodes within certain areas of brain to induce electrical impulses to regulate abnormal impulses. The amount of 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. Deep brain stimulation is used to treat several neurological conditions, such as Essential tremor, Parkinson’s disease and dystonia. Deep brain stimulation is also being studied as a treatment for epilepsy, cluster headaches, Tourette syndrome, chronic pain and major depression.

The device consists of following subsystems:

- Neurostimulator module
- Leads and electrodes
- Extension cables
- Programmer module

Device prototype fabrication was under process in

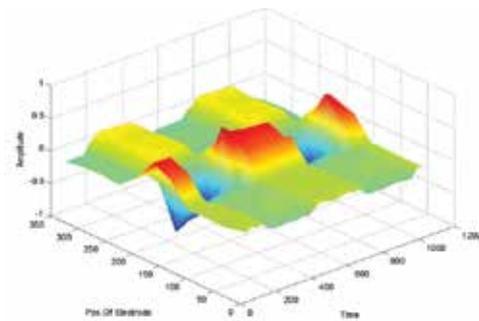
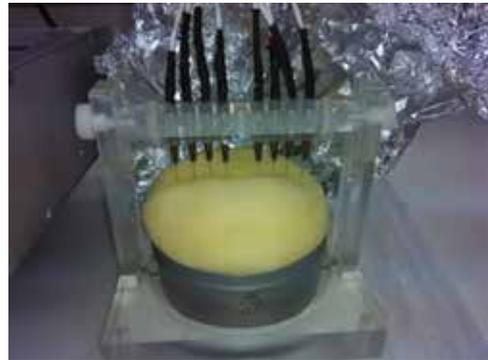


Figure 46. Phantom model (Top) and results of charge distribution and conductivity studies (Bottom)

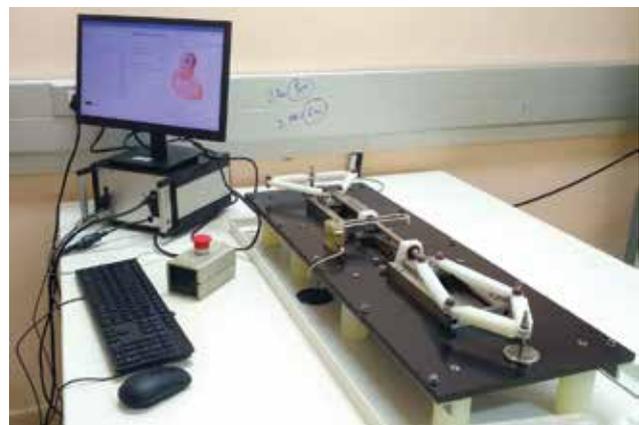


Figure 47. Lead body flexion testing



Figure 48. Conductor flex testing

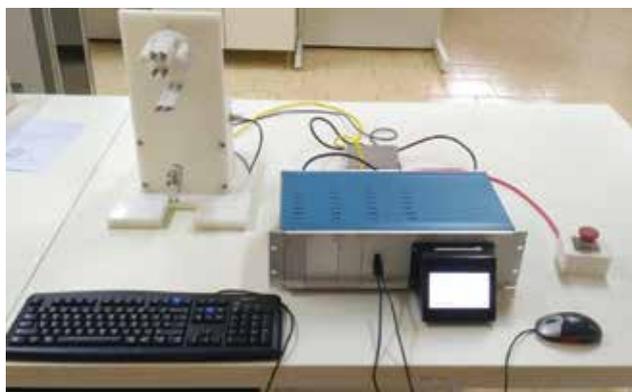


Figure 49. Terminal connection endurance test

collaboration with Bhabha Atomic Research Centre (BARC). Different test systems were developed and various bench top studies were conducted to evaluate the performance. A phantom model was set up for studying voltage distribution over brain impedance (Figures 46-49).

2. Automated implantable cardioverter defibrillator

Implantable Cardioverter Defibrillator (ICD) is a battery powered pulse generator implanted under the skin, just below the collar bone. ICD monitors the heart electrical activity using electrodes placed in specific areas of the heart and responds to irregular life threatening heart rhythms with either anti-tachycardia pacing consisting of low energy impulses to promote a normal heart beat, or shock therapy with high energy impulses to prevent sudden cardiac arrest.

DIVISION OF POLYMERIC MEDICAL DEVICES

The Division focuses on the development of polymeric medical devices. Device development projects and exploratory research activities through PhD Programmes are ongoing. A radiopaque liquid embolic agent intended for the treatment of arteriovenous malformation was formulated and the material was tested for its physicochemical properties. Preliminary biocompatibility tests showed satisfactory performance. Two Indian patent applications were filed for this project. A couple of printable bioink formulations were developed as part of the project on 3D bioprinting and two Indian patent applications were filed. A programme on development of leukodepletion filter using electro spun membranes continued. A project on development and evaluation of dural substitute made by electrospinning of polycarbonate urethane was initiated.

The following projects were initiated during the year:

1. “Design and fabrication of a head phantom for the dosimetric evaluation of radiotherapy treatment plans” in collaboration with Regional Cancer Centre, Trivandrum, Kerala. The project was funded by Kerala State Council for Science, Technology and Environment, with Dr Roy Joseph as Co-Principal Investigator from SCTIMST.
2. “Parylene coating for implantable medical devices and device delivery systems” under the Technical Research Centre Scheme of Department of Science and Technology, Government of India. The project was awarded to Dr P Ramesh as the Principal Investigator.
3. “Radiopaque polymeric microspheres for embolization therapy” under the Technical Research Centre Scheme of Department of Science and Technology, Government of India.



The project was awarded to Dr Roy Joseph as the Principal Investigator.

Product Development

1. Development of liquid embolic agent

Aim of this project was to develop injectable radiopaque liquid embolic composition free of metal particles for the treatment of arteriovenous malformations in brain. A few radiopaque polymer formulations of appropriate viscosity suitable for injection were developed and showed excellent precipitation behaviour in saline (Figure 50). Preliminary in vitro biocompatibility tests



Figure 50. Precipitation behaviour of radiopaque liquid embolic agent in saline

showed the material was non-toxic and non-hemolytic. An in vitro test system was designed and fabricated for assessing the precipitation behaviour of the liquid embolic agent in the brain. This was used for testing anticipated clinical performance of liquid embolic agent in the brain with good results. Currently, the material is undergoing toxicological profile evaluation.

2. Development of radiopaque polymeric microspheres for embolization therapy

In this programme, iodinated monomers were synthesized and converted into polymers. The process for converting them into microspheres was successfully completed. Physicochemical characterization of selected compositions and

their process optimization are ongoing.

3. Design and fabrication of a head phantom for the dosimetric evaluation of radiotherapy treatment plans

A commercial head phantom was analysed to find out its physicochemical properties and based on the inputs received a few formulations were developed using commercially available polymers. These formulations were tested for their suitability for the intended application.

4. Development of Leukodepletion filter and its evaluation

Electrospun polymeric membranes were prepared from different grades of polymers. The electrospinning parameters were optimised in order to get different membrane characteristics. The physicochemical properties of the membranes and the filter performance were evaluated.

Testing and Evaluation

Services such as mechanical testing, dynamic mechanical analysis and viscosity measurements available in the Division were extended to internal and external customers.

DIVISION OF PRECISION FABRICATION

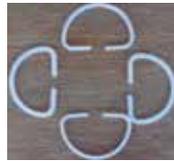
This Division provided service support to other laboratories of the Institute in fabricating moulds, dies, jigs, fixtures and machining of prototype components related to various projects utilizing the CNC machines and conventional machines. Major support was provided for the ongoing TRC Projects like centrifugal blood pump, paracorporeal left ventricular assist device, annuloplasty ring and aortic stent for endovascular treatment of thoracic aortic aneurysm, bioprosthetic heart valve, intracranial electrodes,



Terminal connection Flex test system assembly for Project P8125



SS Contact strip mould for Project P8132



UHMWPE and SS annuloplasty ring for Project 8128



SS Pivots, Delrin Bottom bearing and Delrin top bearing for Project P8122



Different titanium components for Project P8123



Acrylic components for Project P8122

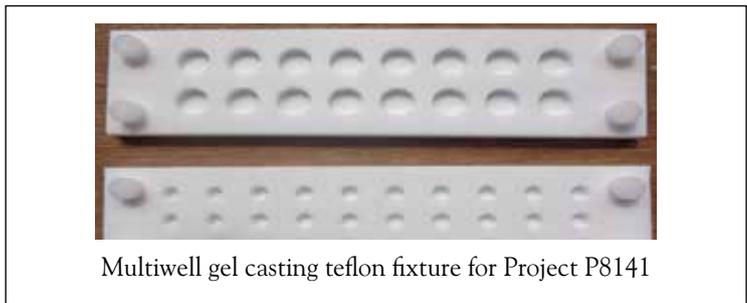
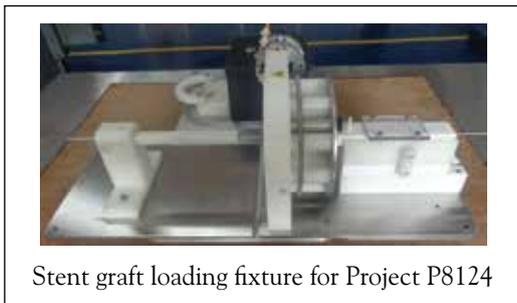


Figure 51. Prototypes for various projects



flow diverter stent and atrial septal defect occluder. Hundreds of components from 95 major work orders related to fabrication, machining of test setups and prototypes for various projects were executed and delivered during the year (Figure 51).

Staff

Faculty

Dr Roy Joseph, Scientist G and Head of the Department

Mr Muraleedharan C V, Scientist G (Senior Grade)

Mr D S Nagesh, Scientist G (Senior Grade)

Mr Ramesh Babu V, Engineer G

Dr P R Umashankar, Scientist G

Dr Ramesh P, Scientist G

Mr Vinodkumar V, Engineer F

Mr Sujesh Sreedharan, Engineer F

Dr Sachin J Shenoy, Scientist F

Mr Ranjith G, Engineer E

Mr Sarath S Nair, Engineer D

Dr Manoj G, Scientist D

Dr Sivakumar K G V, Engineer D

Mr Sarath G, Scientist D

Mr Jithin Krishnan, Engineer C

Mr Anoop Gopinathan, Engineer C

Mr Subhash N N, Engineer C

Dr Gijo Raj, Scientist C

Mr Arvind Kumar Prajapati, Engineer C

Mr Saurabh S Nair, Engineer C

Dr Chhavi Gupta, Engineer C

Ms Amrutha C, Scientist C

Ms Neethu S, Engineer B

Technical Staff

Mr Rajeev A, Senior Scientific Assistant

Mr Prem Mohan M, Technical Assistant - A (Lab)

Mr Subhash Kumar MS, Technical Assistant - A (Instruments)

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

Mr Biju Benjamin, Technical Assistant - A (Instruments)

Ms Jasmin Joseph, Scientific Assistant - A (Instruments)

Dr M Chandra Shekhar Nayak, Technical Assistant - A (Instruments)

Mr Reji Kumar S, Technical Assistant - A (Machine Operation)

Mr Prathyush M, Technical Assistant - A (Machine Operation)

Mr Jiji Kumar R S, Junior Technical Assistant - A (Machine operation)

Mr Vijesh S S, Junior Technical Assistant - A (Machine operation)

Mr Sinulal M V, Junior Technical Assistant - A (Machine operation)

Ms Smitha P, Technical Assistant - A (Anesthesia)

Mr Biju V, Laboratory Animal Caretaker - A

Mr Manoj Kumar K, Laboratory Animal Caretaker - A



DEPARTMENT OF TECHNOLOGY AND QUALITY MANAGEMENT

The Department co-ordinates and manages the transfer of technologies to industries, facilitation of technology commercialization, intellectual property of various technologies, quality system activities, accreditation (COFRAC, France, for testing and NABL, India, for calibrations) activities, network/communication systems, and engineering services in the campus.

The Department also includes a Central Analytical Facility for characterisation of medical devices and materials and an NABL-accredited Calibration Facility.

CALIBRATION CELL

NABL desktop audit was completed by March 2019 in mechanical, thermal and electro-technical calibrations. One project entitled “System validation of ethylene oxide sterilizer” for TTK Health Care Pvt. Ltd. was completed.

Product Development

Preparation and standardization of reference biomaterials for biological evaluations

The increasing demand for safe medical devices has led to the inevitable need for preclinical evaluation of the biomaterials and medical devices prior to the regulatory approval. Traceability to international standards is a requirement of accreditation bodies for global acceptance of test reports and evaluation results of product or process in medical device development. But traceability by accredited calibrations using reference standards cannot be achieved for qualitative characteristics, especially in biological evaluations based on ISO 10993 standards. In such cases, use of reference material (RM) has become an essential tool. Indigenous development of ready-to-use RMs can assure the availability of RM in a cost-effective manner

in the country. Preparation and standardization of three classes (polymer, metal and ceramics) of RMs (Figure 52) to be used as control materials for biological evaluations based on ISO 10993 (muscle implantation studies, bone implantation studies, and cytotoxicity) at affordable cost progressed.

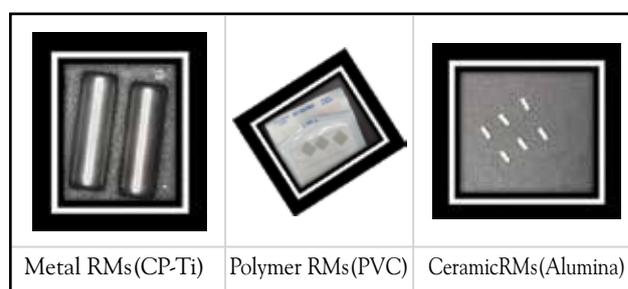


Figure 52. Reference materials for metal, polymer and ceramic classes

Testing and Evaluation

The Calibration Cell carries out mechanical, thermal and electro-technical calibrations which are accredited by NABL, India. Mechanical calibration includes calibration of volumetric glassware, micropipettes, electronic balances, mass sets and rotational speed. Calibration of Relative Humidity (RH) monitors, thermometers and temperature chambers like incubators are included in thermal calibrations. Summary of calibrations and measurements performed during the year:

1. Internal Calibrations: 185
2. External Calibrations: 110
3. Hospital Wing Calibrations: 30

CENTRAL ANALYTICAL FACILITY

Central Analytical Facility (CAF) is the analytical service facility open to both internal and external



customers operating under the Department of Technology and Quality Management. CAF provides material characterization using equipment like FT-IR spectrophotometer, UV-Vis spectrophotometer, thermo-gravimetric analyser, differential scanning calorimeter, high permeation liquid chromatography, gas chromatography, confocal Raman microscope, textural analysis, fluorescent microscope and UTM. In addition, the facility is actively involved in various projects of Institute by providing analytical support. CAF also hosts M. Phil/ M. Tech students during their lab modules or internships. CAF organized a new initiative named KYAF for the benefit of student and research community to improve their understanding of various instrumentation techniques and interpretation of data.

Testing and Evaluation

During the year, the Division tested 741 samples submitted by internal and external customers for analyses like FTIR, TGA, DTA, DSC, HPLC, GPC, Raman, textural analysis, viscosity analysis, GC, UV-Vis spectrophotometer and luminescent image analysis. Headspace Gas Chromatography was activated and protocols for estimation of ethylene oxide and propylene oxide were developed.

ENGINEERING SERVICES

The Division is engaged in providing technical support for general maintenance of equipment and environment at various facilities, management of utility supply like power, water and maintenance of waste incinerator and sewage systems of the BMT Wing campus. Electrical service section maintains the 11-kV supply system and the diesel generator for power backup in the campus.

Activities

The major activities conducted were:

1. IT Up-gradation Programme

Upgradation of Information Technology infrastructure was initiated by Network Services Section for meeting the augmented need of research and development activities.

2. The major electrical work and installations completed included shifting and installation of 500KVA Dg set with AMF panel to new substation and re-erection work, 500KVA DG set Radiator LT core replacement and 250KVA UPS shifting and replacement of old SMF with new tubular batteries.

QUALITY CELL

The activities of Quality Cell include the implementation, maintenance and improvement of quality management systems to assure that the facilities, equipment, personnel, methods, practices, records and its control are in conformance to the requirements of International Standard ISO 17025.

Activities

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

1. The Revision of Quality Manual and all system procedures based on the revised standard ISO/IEC 17025:2017 was completed and the documents are valid from 15 November 2018.
2. COFRAC surveillance assessment was scheduled in July 2019. Application for the surveillance assessment, documents required by COFRAC (Lab form 03, 05, 48, 49, Gen Form 15 etc) along with work procedures and test report format for extension of scope in the Division of Thrombosis were forwarded to COFRAC.
3. NABL desktop surveillance assessment for thermal, mechanical and electro technical calibrations were completed successfully in March 2019 and confirmation was received in April 2019.
4. The Management Review Committee meeting was held on 5 February 2019 and two Technical



Management Committee meetings were held on 29 June 2018 and 16 January 2019.

5. Two internal audits were carried out during 7-17 May 2018 and 15-27 November 2018.
6. The following documents were revised / issued:
 - (i) 121 system procedures and work procedures were revised/ issued
 - (ii) 107 Lab notebooks were issued
 - (iii) 88 Registers and logbooks were prepared and issued to various laboratories/Sections
 - (iv) 32 corrective actions were generated by different laboratories

Events Organized

The Quality Cell organized various training programmes:

1. Internal Auditor Training in the revised standard ISO/IEC 17025:2017 was for 42 personnel of the Institute was conducted on 23-25 May 2018 and 28-30 May 2018 at Hotel Central Residency, Thiruvananthapuram.
2. ISO 10993 training for 83 personnel was conducted in two batches on 1 October 2018 and 1 November 2018 at BMT Wing.
3. Awareness Training on ISO/IEC 17025:2017 for 22 support staff of the Institute from Administration, Stores and Purchase, Security and Engineering Services was conducted on 2 February 2019 Hotel Central Residency, Thiruvananthapuram.

TECHNOLOGY BUSINESS DIVISION

The Division comprises: Customer Service Cell and Intellectual Property Rights Cell.

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

1. Institute-Industry interactions related to

technology transfer and research project collaborations

2. Intellectual Property Rights like patent, design and trademark registration of the Institute
3. Testing services and specific protocol-based study requests from the industry and academia for medical devices and biomaterials
4. Training, problem solving and consultancy activities of the Institute through the Industry Institute Partnership Cell
5. Internal research project funding of the Institute comprising of the Technology Development Fund Scheme, internal review of the project application and interim status review of projects
6. Reports/questions for submission to external agencies such as DST, DSIR, ICMR, Lok Sabha/ Rajya Sabha etc. on the activities of Institute
7. Outreach Programmes including giving exposure to students from different Institutions across India at the Institute and outside on development of medical devices
8. Discussions with clinicians on projects under development

Activities

Industry Innovators Meet and Technology Conclave

The Industry Innovators Meet and Technology Conclave were held on 24 March 2019 (Figure 53). The Industry Innovators Meet had brainstorming sessions on the following topics: orthotics and rehabilitation, in vitro diagnostics, regeneration technologies, 3D bioprinting and smart materials. It was a convergence of clinicians, representatives from the medical device industry and scientists from BMT Wing. The brainstorming focused on developing future products required by the patient population. A summing up session on the brainstorming was also presented to the participants.



Mr Prakash Bachani, Head, Medical Equipment and Hospital Planning Department, Bureau of Indian Standards (BIS), delivered a talk on “Presentation of BIS activities: Standardization of medical devices”.

The Technology Conclave was presided by the Hon’ble president of the Institute, Dr V K Saraswat. Dr C Balagopal, Founder and former Managing Director, Terumo Penpol Ltd., gave the felicitation address. Dr Asha Kishore, Director, SCTIMST and Dr Harikrishna Varma, Head BMT Wing were present.

Two commercial launches were made during the event:

1. Vein Viewer System, developed by SCTIMST and manufactured by M/s. Agappe Diagnostics Ltd., Kochi
2. DRIPO infusion monitor, developed by Evelabs Technologies, incubated at TIMed, SCTIMST

The Technology Transfer of various technologies

were announced at the event, and industry as well as Principal Investigators for the same were felicitated (Figure 53).

An exhibition of the products developed at the Institute was arranged at BMT Wing, which was open to the industry and clinicians (Figure 54).

New technologies transferred:

1. Paracorporeal Left Ventricular Assist Device to M/s Meril Lifesciences Pvt. Ltd. (Agreement signing underway)
2. PT/INR Monitoring Device and TB Screening Device to M/s Agappe Diagnostics Ltd. (Agreement signed)
3. Injectable hydrogel for cartilage repair to M/s Phraction Scientifics Ltd. (Agreement signed)
4. Lint-free absorbent wound dressing to M/s Phraction Scientifics Ltd. (Agreement signing underway)





Figure 53. Technology Conclave on 24 March 2019



Figure 54. Exhibition of the products developed at the Institute during the Technology Conclave on 24 March 2019



5. SCTAC2010: Human serum albumin-conjugated anti-cancer drug formulation to M/s Eightoaksbio Pvt. Ltd. (Agreement signing underway)

Relicensing of Technologies:

1. Hydrocephalus shunt to M/s Phraction Scientifics Ltd. (Agreement signing underway)
2. Calciumsulfate cement and calciumphosphosilicate cement to M/s Prevest Denpro Ltd. (Agreement signing underway)
3. Polyvinyl alcohol sponge to M/s Konikkara Industries (Agreement signed)

Co-development:

Implantable cardioverter defibrillator with M/s. Shree Pacetronics (Agreement signed)

Memorandum of Understanding

1. MoU was signed with Meat Products of India (MPI) to facilitate exchange of scientific and technological information and animal tissues leading to application of mammalian-derived organs/tissue for biomedical device development. (Figure 55). The agreement was signed by Dr Asha Kishore, Director, SCTIMST, and Dr A S Bijulal, Managing Director, MPI, on 15 May 2018 at Government Secretariat Complex, Thiruvananthapuram in the presence of Shri Adv K Raju, Minister for Wildlife Protection, Animal Husbandry, Dairy Development and Zoos, Government of Kerala, Adv T R Ramesh Kumar, Chairman, MPI, Dr H K Varma, Head, BMT Wing and other senior officials from MPI and SCTIMST.
2. MoU was signed with M/s Shree Pacetronix, Madhya Pradesh, for the development of implantable defibrillator on 23 October 2018. Mr Akash Sethi, Director, Shree Pacetronix signed the MoU on behalf of the company and Dr Asha Kishore, Director, SCTIMST signed on behalf of

the Institute. The project will be executed at the Division of Medical Instrumentation, BMT Wing.

3. MoU was signed with Indian Council of Medical Research on 24 January 2019. This was a general MoU which describes the general modalities and the broad terms and conditions for those projects



Figure 55. Signing of MoU with Meat Products of India

on which SCTIMST and ICMR work together for further development and validation.

4. MoU was signed with National Centre for Cell Science for collaborative research for development of 3D liver construct using iPSCs differentiated into hepatocytes.
5. MoU was signed with International Advanced Research Centre for Powder Metallurgy and New Materials, for collaborative research in areas of mutual interest.

Expression of Interest

To enhance technology transfer, an Expression of Interest (EOI) was invited from the medical device industry and start-ups for the different products. Advertisement was given in Times of India and Economic Times (All India edition). The advertisement appeared on 6 June 2018 and last date for EOI was 31 July 2018. The details were provided in the link <https://www.sctimst.ac.in/technology-transfer>. The interests received were discussed in the Technology Transfer Committee meeting.



Technology Transfer Committee

The standing internal Technology Transfer Committee meetings were held on 7 April, 7 July, 10 August in 2018 and 24 January 2019, 19 February and 21 March in 2019.

Technology Development Committee

Technology Development Committee met on 28 September 2018.

Industry visits

The Division co-ordinated with the following industry for the purpose of exploration of technology transfer and also for project or R&D collaborations:

1. M/s Shree Pacetronix
2. M/s Prevest Denpro
3. M/s BL Lifesciences
4. M/s Anabond Stedmann
5. M/s Agappe Diagnostics
6. M/s Onyx Medical
7. M/s Tata Consultancy services
8. M/s Phraction Scientifics
9. M/s Sahajanand Medical Technologies
10. M/s Meril Lifesciences
11. M/s Polymedicure
12. M/s Fanem India
13. M/s Sumiran enterprises
14. M/s Eightoaks Bio Pvt. Ltd.
15. M/s Konikkara Industries
16. M/s Oriental Aquamarine Biotech India Pvt. Ltd.
17. M/s 7 Lamps Pvt. Ltd.
18. M/s Aurolab

Intellectual Property Rights

The details of intellectual property made by the institute during the year are as follows:

1. Patents granted: Nil
2. Foreign Patent applications filed: 3
3. Indian Patent applications filed: 18
4. Design registrations filed: 3

Placement Cell

A campus selection aptitude test was conducted for M Tech Clinical Engineering students for the companies, EXL Analytics and UBS Business Solutions Pvt. Ltd.. A campus selection recruitment interview was conducted and 8 students from M Tech Clinical Engineering and M Phil were placed in HCL.

Exhibitions

1. The Institute was represented by Drs Anugya Bhatt, Naresh Kasoju, Pavan Kumar Srivas and Chhavi Gupta at the 106th Indian Science Congress Association, Kolkata held by the Ministry of Science and Technology, Department of Science and Technology and Vigyan Prasar, an autonomous body of DST, from 3-7 January 2019. The SCTIMST Thiruvananthapuram stall was set within the Department of Science and Technology, Government of India Pavilion in Hall-D of the Expo area. A total of 17 items, including 2 products from TRC-funded projects, were presented at the stall. Brochures with details of institute profile, TRC funded programmes, TIMED and CSR were distributed at the stall. A set of 4 background banners were installed representing various activities and products of SCTIMST. An audio-visual presentation of institute profile was also displayed at the venue.
2. The Institute was represented in the exhibitions conducted by Bharatiya Vidya Bhavan, Trivandrum, Kairali Vidya Bhavan, Nedumangadu and IISF 2018 EXPO, Lucknow.



Student visits

The Division co-ordinated visits of students from different academic institutions as below and provided an overview on medical device development and other activities of the Institute:

1. Vellayani Agricultural College
2. Medical College, Trivandrum
3. IEEE Travancore Hub
4. MPH students from Achutha Menon Centre for Health Science Studies.
5. Alpha College of Engineering, Chennai
6. TKM College of Engineering
7. Karunya Institute of Technology and Sciences
8. Kerala Agricultural university
9. MA College, Kothamangalam
10. SCMS Institute of Bioscience and Biotechnology Research and Development

Customer Service Cell

Customer Service Cell co-ordinated the internal and external testing services and study projects for the evaluation of medical devices and biomaterials. The summary of the testing services is as follows:

Staff

Faculty

- Mr S Balram, Engineer G, Head of Department
- 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 E
- Mr Renjith S, Scientist B

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

Description	External			Internal		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Number of work orders	578	463	391	313	143	300
Number of test materials	1355	935	735	941	435	945
Income (Rs)	37,32,527	44,86,133	29,31,350	19,95,175	11,23,300	35,07,325



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 Selastin A J, Junior Technical Assistant - A
 Mr Manu M H, Junior Technical Assistant - A
 Mr Sajid A, Technical Assistant - A
 Mr Binu C P, Junior Engineer A
 Mr Sabu K S, Junior Engineer A
 Ms Deepa G K, Junior Engineer
 Mr Sajilmon B, Junior Technical Assistant - A

Events Organized

1. A training programme on Experimental Toxicology Pathology was organized by the Division of



Figure 56. Training programme on Experimental Toxicology Pathology organized by the Division of Experimental Pathology and Industry Institute Partnership Cell on 9-11 August 2018

Experimental Pathology and Industry Institute Partnership Cell (IIPC) during 9-11 August 2018. Dr Chirukandath Gopinath, Dr Vasanthi Mowat, Dr Serge Rousselle were the external faculty and Dr T V Anilkumar and Dr A Sabareeswaran were internal faculty. 16 participants attended the course (Figure 56).



Figure 57. Training programme on “Packaging and sterilization of medical device” on 17-19 September 2018

2. A training programme on “Packaging and sterilization of medical device” with faculty Mr R Kolappan, Assistant Director, Indian Institute of Packaging (IIP), Mr Mathiyazhagan M, Assistant GM, HCL technologies, and Mr Prem Raj, IIP was conducted by IIPC during 17-19 September 2018 in which Principal Investigators of various projects in SCTIMST and technology partner M/s Agapge participated (Figure 57).
3. A Workshop on “Biological safety and efficacy evaluation of medical devices” was conducted from 24-26 September 2018 at Hotel Central Residency, Thiruvananthapuram (Figure 58). There were participants from the medical device industry consisting of DNV GL Business Assurance India Pvt. Ltd., Sahajanand Medical Technologies Pvt. Ltd., Meril Lifesciences Ltd., Axio Biosolutions Pvt. Ltd., Stericon Pharma Ltd., Advanced Medtech Solutions Pvt. Ltd.. The Workshop consisted of lecture sessions, exercises, case studies, quiz and a visit to the Biomedical Technology Wing.
4. A Workshop on “Confocal Raman Microscopy and its applications in Materials Science, Medical



Figure 58. Workshop on “Biological safety and efficacy evaluation of medical devices on 24-26 September 2018



Figure 59. Training programme on “Confocal Raman Microscopy and its applications in Materials Science, Medical Science and Biomedical Technology” was conducted by IIPC on 4- 6 October 2018



Science and Biomedical Technology” was conducted by IIPC on 4-6 October 2018 (Figure 59). The Workshop comprised lecture sessions, demonstrations and lab visits. There were three external faculty – Mr Hitesh Mangain from Witec GmbH, Dr Kaustabh Kumar Maiti, Senior Scientist, CSIR-NIIST, Thiruvananthapuram, Dr Benny K George, Group Director, VSSC, Thiruvananthapuram and Dr R S Jayasree was the internal faculty. The demonstrations were handled by Mr Hitesh from Witec. There were 29 participants from different academic institutions.

5. A special training for SC/ST candidates on “Analytical instruments for research” was conducted by IIPC on 24-25 January 2019 at Biomedical Technology Wing (Figure 60). The programme was offered free of registration fee and had an overwhelming response. There were 45 participants from all over Kerala. The Workshop included lectures, demonstrations, lab visits, group activity and quiz.
6. Two focus group discussions were conducted with clinicians on 7 December 2018 and 13 February 2019 at Satelmond palace to discuss the



Figure 60. Special training for SC/ST candidates on “Analytical instruments for research” was conducted by IIPC on 24-25 January 2019



Figure 61. Focus group discussions with clinicians to discuss products developed at the Institute



following: (i) Five wound dressing products and (ii) orthopedic products (Drug-eluting beads, injectable hydrogel, intervertebral spacer, bio-ceramic extrusions) developed at BMT Wing (Figure 61). The discussion was designed to gather information on the clinical acceptance and on the market positioning of the products. Clinicians from different hospitals in Trivandrum participated.



Figure 62. Workshop on Image Analysis in Biomedical Research

7. The Division of Experimental Pathology organized a lecture, as part of ERUDITE Programme, entitled “The hair follicle - an unsung hero of wound healing” by Dr Desmond J Tobin, Professor of Cell Biology and Director of the Centre for Skin Sciences, University of Bradford, UK, on 27 June 2018 at BMT Wing.

10. Central Analytical Facility organized a new initiative named KYAF for the benefit of student and research community. The major objective of the programme was to improve the understanding of students on various instrumentation techniques and interpretation of data. 13 technical sessions were organized as part of KYAF in 2018-19 (Figure 63).

8. The Division of Laboratory Animal Science organized the 22nd training programme in Laboratory Animal Handling, Ethics and Techniques from 10-15 December 2018 at BMT Wing. 16 candidates from all over India attended the programme.



Figure 63. Technical sessions - KYAF

9. The Division of Tissue Culture and Division of Thrombosis Research organized a One-Day Workshop on Image Analysis in Biomedical Research on 12 September 2018 (Figure 62).

11. Central Analytical Facility hosted a seminar on Field Flow Fractionation (FFF) by Ms Galaxy International on 31 January 2019. The programme was attended by 18 students and staff from the institute.



Figure 64. Talk on Differential Scanning Calorimetry

12. Dr Radhakumary conducted a talk on Differential Scanning Calorimetry which was attended by 16 MSc Chemistry students and a faculty of Department of Chemistry, Mar Ivanios College, Thiruvananthapuram, on 26 February 2019 (Figure 64).

Awards and Honours

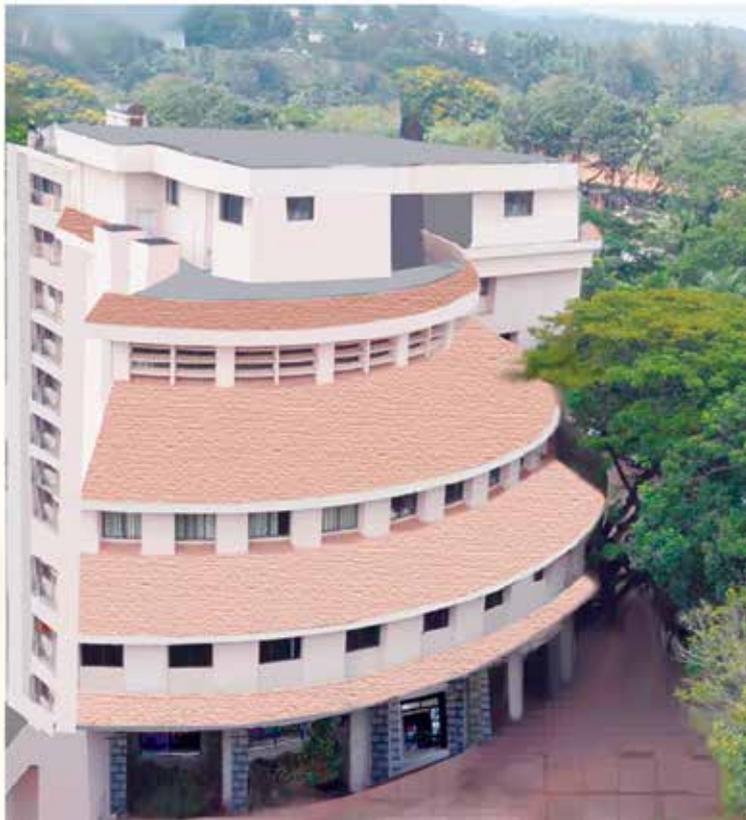
1. Ms Reshmi Raj won the best oral presentation award at the 8th Annual Conference of Indian Academy of Biomedical Sciences from 25-27 February 2019 at CSIR NIIST, Thiruvananthapuram.
2. Dr Harikrishnan V S received a Travel Grant from SCAND-LAS Board to present a paper at Scand-LAS Meeting, Norway.
3. Dr Harikrishnan V S received a scholarship to attend PhD Course on “Animal Biology and Behaviour” from 14-18 May 2018 at the Graduate School of Health and Medical Sciences, University of Copenhagen, Denmark.
4. Dr Harikrishnan V S received a scholarship to attend PhD Course on “Optimize your communication and train your personal impact” from 7-8 May 2018 at the Graduate School of Health and Medical Sciences, University of Copenhagen, Denmark.
5. Dr Harikrishnan V S received the LASA, United Kingdom Scholarship to attend the “Winter School on Systematic Reviews” organised by the European Society of Laboratory Animal Veterinarians and Trinity College Dublin from 14-18 January 2019 at Dublin, Ireland.
6. Dr Syama S, ICMR-Senior Research Fellow, received the JSPS Postdoctoral Fellowship for the year 2018-2020, at National Institute of Advanced Industrial Science and Technology, Japan. The fellowship is supported by Japan Society for the Promotion of Science, Government of Japan.
7. Dr P V Mohanan was elected Secretary General of Society of Toxicology, India, affiliated to the International Union of Toxicology, USA, from 2018-2020.
8. Ms Athira S S, PhD Scholar, won the best poster award for the poster entitled “Consequences of graphene oxide nanoparticles in HEK 293 cells” at the International Conference on the Role of Toxicology in Public Health and 38th Annual Conference of Society of Toxicology, India (STOX 2018) from 13-14 December 2018 at Sri Balaji Vidyapeeth, Puducherry.
9. Dr Naresh Kasoju was selected Member of the prestigious National Academy of Science, India.
10. Ms Shilpa Ajit received the best oral presentation award for the work entitled “A gel casting device to establish consistent three dimensional sandwich cultures for in vitro cytotoxicity analysis” in SciCon Series on Research Interventions and Advancements in Life Science RIAL-2018 from 1-3 August 2018 at Pune.
11. Mrs Aswathy M R received the best poster presentation award for the work entitled “Alginate dialdehyde - gelatin hydrogel as bioink for 3D Bioprinting” at the International Symposium On Advanced Functional Materials 2018 on 12 October 2018 at Mar Ivanios College, Trivandrum.
12. Dr Kamalesh K Gulia received Best Presentation Award for the talk “Lack of awareness on peri-



pregnancy health and jeopardising maternal-child outcomes” in the Technical Session on “Women in Health, Economy and Power” 2nd International conference of Future of Women 2019 with theme “Voices of Women: Transition from Inspiration to Action” on 15 Feb 2019 at Colombo.

13. Dr Kamalesh K Gulia received approval to organize International Neuroscience School for the International Brain Research Organization-Asia Pacific Regional Committee (IBRO-APRC) from IBRO.
14. Ms Amrita Natarajan received the best poster award of RSC Biomaterials Journal for the work entitled “Osteochondro mimetic gradient 3D printed based constructs for enhancing tissue regeneration” at the International Conference BioMet 2018 on 26-28 July 2018 at VIT,Vellore.
15. Dr Jayasree R S was elected Fellow of the Academy of Sciences, Chennai
16. Dr Jayasree R S was nominated member of the Nano Science Advisory Group of DST Nanomission for a period of three years.
17. Dr Jayasree R S was inducted into the Technical Review and Advisory Committees (TRACs) for the project entitled, “Nanoelectronics Network for Research & Applications (NNetRA)” to be implemented by Indian Institute of Science, Bangalore, Indian Institute of Technology, Bombay, Indian Institute of Technology, Madras, Indian Institute of Technology, Delhi and Indian Institute of Technology, Kharagpur
18. Mr Nishad K V from Bioceramics Division, BMT Wing secured the best poster award (Ceramics category) for the work titled “Calcium-strontium-silicate composite cement for endodontic repair – design and in vitro studies” at the International Conference on BioMaterials, BioEngineering and BioTheranostics (BIOMET -2018) held at Vellore Institute of Technology during 26-28 July 2018.
19. Ms Priya won the best oral presentation award at National Seminar on Recent Biochemical approaches in Therapeutics (RBAT-V) 2019 held from 23-25 January 2019 at Department of Biochemistry, University of Kerala, Kariavattom.
20. Bridget Jeyatha W received ICMR SRF award for the project entitled “Shell nacre integrated bioactive composites for bone defect treatment”.
21. Ms Resmi R, PhD Scholar, Division of Polymeric Medical Devices, BMT Wing, won the best paper award (Category – Health Sciences) for her work entitled, “Alginate dialdehyde gelatin hydrogels - A boon to athletes and labourers” at the 31st Kerala Science Congress on 2-3 February 2019 at Kollam.

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES





ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

The Achutha Menon Centre for Health Science Studies (AMCHSS) is the Public Health Wing of the Institute. Since its inception in 1996, AMCHSS has been in the forefront of public health training and academic research in priority areas. It is one of the first Public Health Schools in India.

Activities

Teaching

Public health teaching is the main activity of AMCHSS. During the academic year 2018-19, 25 students had enrolled for the two-year Master of Public Health (MPH) Programme and 12 students graduated. A National Conference, AMCCON, was organised as part of the academic activity on 1-3 March 2019. The main theme of AMCCON was 'Health System Management'. The keynote sessions on Aardram Mission of Kerala Government, Health Financing and Quality Management were well appreciated by the participants. Additionally, AMCHSS organised several other short courses in Public Health or related disciplines: (a) Systematic Reviews and Meta-analysis, (b) Grant Writing Skills, (c) Quantitative Measurements and Methods, and (d) Project Management. Apart from the regular courses and workshops conducted at AMCHSS, the faculty members were also involved in organising workshop and courses in other institutes. The Faculty represented the Institute in the selection for MPH/PhD courses 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). The faculty members are also involved in teaching some of the modules at the affiliated institutes, and guiding PhD students from these institutes.

Research

The key research initiatives of AMCHSS during the year were focused on the priority areas of non-communicable diseases, health equity, tribal health,

primary care, and health technology assessment.

New Research Initiatives

1. **The long-term effects of a peer-led lifestyle intervention program on diabetes progression and cardiovascular risk: the Kerala Diabetes Prevention Program (PI: Jeemon P)**

The Kerala Diabetes Prevention Program (KDPP) in India is one of the first peer-led lifestyle intervention model developed to prevent/delay the onset of Type 2 diabetes mellitus in the rural population of Kerala. The KDPP was a cluster randomized controlled trial undertaken in 60 communities in Kerala (NHMRC ID 1005324). At the two-year follow-up, KDPP intervention demonstrated significant reduction of diabetes incidence only among those with impaired glucose tolerance. However, the program achieved a significant reduction in key cardiovascular disease (CVD) risks factors and the mean predicted CVD event risk at 24 months. The current proposal envisages measuring the effectiveness of the KDPP interventions after 7 years of recruitment in the same study participants. The study is funded by the National Health and Medical Research Council, Australia. The total budget of the project is Rs 5.2 Crores over a period of three years.

2. **Delineating the role of DNA methylation in insulin resistance driven breast cancer development and progression (PI: Srikant A)**

Globally, breast cancer is the most common cause of cancer-specific mortality in women, accounting for nearly half a million deaths each year. A recent umbrella review reported association between pre-diagnostic type 2 diabetes (T2D) and



increased risk of developing selected cancer types including breast cancer. The T2D is characterised in the early stages by insulin resistance (IR) and consequent hyperinsulinemia which starts several years before overt diagnosis.

Epigenetic mechanisms including DNA methylation play a crucial role in regulating gene expression without modification of the DNA sequence. Previous studies have reported associations between DNA methylation, breast cancer development and recurrence, as well as between insulin resistance (IR) and altered global and site-specific DNA methylation. However, it is unclear how IR influences DNA methylation to modulate breast cancer risk. Furthermore, the mechanisms and pathways of IR-driven DNA methylation changes in breast cancer development and progression remain unexplored.

This project explores the hypothesis that IR promotes breast cancer development and progression by DNA methylation-based reprogramming of genes. The proposed research programme has the following specific aims: Aim1: Conduct genome-wide DNA methylation profiling of IR and insulin-sensitive (IS) cell lines to identify loci associated with breast cancer development and progression. Aim 2: Conduct genome-wide DNA methylation profiling of breast cancer tissue samples from IR and IS patients to identify progression associated loci. Aim3: Targeted validation of DNA methylation sites associated with IR-driven breast cancer progression in surrogate tissues (whole blood and plasma) from breast cancer patients. Aim 4: Explore the functional relevance of DNA methylation differences associated with IR-driven breast cancer progression.

The study is funded by Department of Biotechnology, Government of India. The total budget out-lay of the project is Rs 40 Lakhs for five years.

3. National Environmental Health Profile-NEHP (PI: Manju Nair)

NEHP is a twenty city multicentric study that aims to assess the effects of air pollution on health outcomes and to generate a model to predict the burden of health outcomes attributable to air pollution in India. The study involves an ecological longitudinal time series component, a cross sectional study and statistical modeling. This is a three-year project (2018-2021) funded by the Ministry of Environment, Forests and Climate Change, Government of India. The total budget outlay of the project is Rs 52.7 Lakhs.

4. Availability, distribution and utilization of health care facilities in Kerala (PI: Manju Nair)

The objectives of the project are: to document the existing distribution and coverage of health care facilities in Kerala, study the patterns of health services utilization in the state and factors that influence the differential use of public and private services. The Kerala State Planning Board, Government of Kerala (2018-19), is funding the project. The total budget is Rs 9.0 Lakhs.

5. Efficient portable stand-alone vaccine refrigerator for rural application (PI: Biju Soman)

Vaccines used for routine immunization should be stored between 20°C and 80°C to retain their potency. Often, vaccines are taken to remote locations in order to reach out to the marginalised sections like the tribal population. It is difficult to maintain the specific temperature range in the conventional vaccine carriers (that use four ice blocks to keep the temperature low). Therefore, we plan to develop electronic vaccine carriers that could be used in such challenging situations in collaboration with the Centre for Development of Advanced Computing, Thiruvananthapuram (C-DAC (T)), the Indian Institute of Science



(IISc), Bangalore, and the University of South Carolina (USC), Columbia, South Carolina, USA. The units will have standalone electric battery to power itself, would be a lightweight and will have electronic alert mechanisms. Option to charge the battery using solar panel would also be explored. Such a stand-alone mechanism is also essential during a power outage and in emergency conditions. Apart from developing two prototypes of 3 litre and 1.5 litre capacities, we plan to evaluate its appropriateness of use in a challenging tribal area in Noolpuzha Panchayat in Wayanad under this collaborative research project for the next two years. CDAC (T) is the lead agency and it is a Rs 1.52 Crore project funded by the Department of Science and Technology, Government of India through its MI Off-grid Access to Electricity Scheme. The budget allocation for SCTIMST under this scheme is Rs 4.95 Lakhs.

6. Community Impact of Measles Rubella Vaccine Campaign in India (IMRVI) project (PI: Biju Soman)

The Government of India has plans to launch measles elimination and rubella control campaign in the coming years. As part of the baseline work, surveys are planned in nine states in India to estimate the seroprevalence of Measles-Rubella in three age strata (children nine months to 4 years and 5 to 14 years of age, and women 15 to 49 years of age). Indian Council of Medical Research (ICMR) is heading the study with technical support from the Johns Hopkins Bloomberg School of Public Health. In seven states, the Model Rural Health Units (MRHU) under ICMR have been entrusted with the survey except in Hyderabad (National Institute of Nutrition-NIN) and Kerala (SCTIMST). In Kerala, Thiruvananthapuram district is selected for the survey, and the budget allocation for SCTIMST under this project is Rs 27.5 Lakhs.

Ongoing Research Activities

1. The PROLIFIC Study (PI: Jeemon P): This is a family-based intervention trial in individuals with family history of premature coronary heart disease. It is funded by the Wellcome Trust/DBT India Alliance. The total budget outlay of the project is 3.67 crores. The project will end in June 2020.
2. India-Works (PI: Jeemon P): This is a worksite-based diabetes prevention project in 12 large worksite settings in India. It is funded by the National Heart, Lung and Blood Institute, United States of America. The project will end in September 2020.
3. KDPP-KSM project (PI: Jeemon P): It is a scale-up project of peer lead Diabetes Prevention Project implemented in Kerala with the help of Kudumbasree Mission (a women's self-help group in Kerala). As part of programme we have trained 15,000 peer leaders in diabetes prevention and over 3.75 Lakh participants from three districts in Kerala. The project is funded by World Diabetes Federation. The project will be completed in May 2019.
4. Mobile Tele-Medicine Project (PI: Biju Soman): 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. The project is funded by the Department of Science and Technology, Government of India. The total budget outlay is Rs 5.67 crores. The project will end in November 2021.
5. Regional Technical Research Centre for Health Technology Assessment (PI: Raman Kutty): Health Technology Assessment (HTA) is policy research that aims to inform priority setting and resource allocation. A resource centre for Health Technology Assessment was established at AMCHSS with support from the Department of Health Research, Government of India



Completed projects

Prevention of Non-Communicable Diseases in Kerala (PI: Raman Kutty): Extensive primary prevention activities in all districts of Kerala were conducted as part of the project. 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.

Events Organized

1. Dr Srinivasan K and Dr Ravi Prasad Varma P organised a Project Management Workshop for Psychiatrists on 17 June 2018.
2. Dr Jeemon P organised a Workshop on "Critical Appraisal of Literature, Systematic Review and Meta-analysis" on 25-17 July 2018. The Workshop was attended by 33 participants.
3. Dr Srinivasan K organised a Workshop on "Qualitative Methods in Educational Research" on 10 August 2018 at Annammal College of Education for Women, Thoothukudi, affiliated to Tamilnadu Teachers Education University, Chennai.
4. Dr Jeemon P with the help of MPH students, 2018 batch extended medical aid and psycho-social assistance to flood victims of Kerala on 27 August 2018.
5. Dr Biju Soman organised a Workshop on "GIS in Public Health using R software" on 3-5 October 2018 at School of Public Health, K S Hegde Medical Academy, Mangalore.
6. Dr Biju Soman organised a Workshop on "Workshop on Zotero, the Bibliographic Software" on 10 October 2018 at the Institutional Ethics Committee, Government Medical College, Trivandrum.
7. Dr Biju Soman organised a Workshop on "Geographic Information System (GIS) in

Public Health for Healthcare Professionals and Researchers using QGIS and R software" on 21-22 November 2018 at University Kuala Lumpur, Royal College of Medicine, Perak.

8. Dr Ravi Prasad Varma and Dr Jissa V T organised a Workshop on "Measurements and Methods - an Introduction for novice researchers" on 28 Feb-1 March 2019.
9. Dr Srinivasan, Dr Ravi Prasad Varma and Dr Jeemon P organized the National conference, AMCCON on "Health System Management" on 1-3 March 2019.
10. Dr Jeemon P organised a Workshop on "How to write winning grant applications" on 8-9 March 2019. The Workshop was attended by 31 faculty members of SCTIMST.

Awards and Honours

1. Dr Jeemon P was selected as Associate Editor of BMC Public Health
2. Dr Jeemon P was selected as Honorary Senior Research Fellow, University of Birmingham, UK
3. Dr Jeemon P received 'Certificate for outstanding contribution' in recognition of the contributions made to the quality of the journal from the Editors of "Preventive Medicine".
4. Dr Jeemon P was nominated member of the Local Research Advisory Committee of the Multi-Disciplinary Research Unit in Trivandrum Medical College, Trivandrum, Kerala.
5. Dr Jeemon P received scholarship support to attend executive MSc in Health Economics Outcomes and Management in Cardiovascular Sciences 2018-19 Cohort from London School of economics (The Wellcome Trust-DBT India Alliance as part of the intermediate CPH fellowship).
6. Dr Srikant A was awarded Ramalingaswamy Re-entry fellowship



Faculty

Dr Sankara Sarma P, Professor and Head

Dr Raman Kutty V, Emeritus Professor

Dr Mala Ramanathan, Professor

Dr Biju Soman, Professor

Dr Srinivasan K, Professor

Dr Rakhal Gaitonde, Professor

Dr Ravi Prasad Varma P, Associate Professor

Dr Jeemon P, Assistant Professor

Dr Srikant A, Assistant Professor

Dr Jissa V T, Scientist C

Dr Manju Nair R, Scientist C



DIVISION OF ACADEMIC AFFAIRS



DIVISION OF ACADEMIC AFFAIRS

The Institute continues to be a much sought-after destination for super specialty courses leading to DM or MCh Degrees in Cardiac and Neurosciences. This is also one of the few institutions that offer Post-Doctoral Fellowship Programmes 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 Cardiovascular Imaging and Vascular Interventional Radiology
5. DM Cardiothoracic and Vascular Anaesthesia
6. DM Neuroanaesthesia
7. MCh Cardiovascular and Thoracic Surgery
8. MCh Vascular Surgery
9. MCh Neurosurgery (after M.S)
10. MCh Neurosurgery - 5-year course (after MBBS and 1 year Senior house surgery/ Residency in General Surgery)
11. Post-Doctoral Certificate Course in Cardiothoracic and Vascular Anaesthesia
12. Post-Doctoral Certificate Course in Neuroanaesthesia

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 and 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 Programme 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
- Master of Public Health (MPH)

C. IITMK, Trivandrum

- PhD (Medical Imaging Technology)

D. IIPH, New Delhi

- Master of Public Health
- PhD

The annual selection process for admission to various programmes was carried out in the months of November and December. A supplementary selection process was carried out to select Senior Residents for Cardiology Department in July 2018 along with PhD (Fellowship holders) and MPhil (Biomedical Technology) selection.

The newly-admitted students were welcomed at a function held on 5 January 2019 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.

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 01.04.2018 to 31.03.2019

54 senior residents were enrolled for DM/MCh/PDF and Post-Doctoral Certificate Courses. 14 students were enrolled for PhD, 8 for MPhil Programme and 1 for MD Transfusion Medicine. 36 students were enrolled for various Diploma/PG Diploma Programmes. The candidates admitted to various programmes had 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 448.

Admission Process

Admissions to various programmes was regulated by policy and procedures approved by the Academic Committee of the Institute from time to time. The Admission announcement was published in leading newspapers and on the Institute website during 1st week of September. The assessment and interviews for admission to Postdoctoral, Doctoral, Postgraduate and Diploma Programmes were held in the Institute during the months of November/December. Admissions to PhD (Fellowship holders) and MPhil (Biomedical Technology) were 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 34th batch of graduates for the year 2017 was held on 5 May 2018. Shri

Natarajan Chandrasekaran, Chairman, TATA Sons and Group, was the Chief Guest and delivered the convocation address. Dr M R Rajagopal, Chairman, Pallium India, was the Guest of Honour. Shri K M Chandrasekhar, President of the Institute and former Cabinet Secretary, Government of India, presided over the function and conferred the Degrees. 134 graduates received their degrees during the Convocation.

Degrees / Certificates Awarded

Name of Programme	Total	Remarks
MD	1	
DM	25	
MCh	9	
PDF	10	
PDCC	6	
PhD	10	
MPhil	10	
MPH	2	CMC, Vellore
MPH	16	NIE, Chennai
MPH	15	SCTIMST, Trivandrum
MS Bioengineering	1	
DPH	1	
Diploma in Cardiovascular & Thoracic Nursing	8	
Diploma in Neuro Nursing	10	
Diploma in Operation Theatre Technology	2	
Diploma in Advanced Medical Imaging Technology	2	
PG Diploma in Cardiac Laboratory Technology	1	
PG Diploma in Clinical Perfusion	1	
PG Diploma in Medical Records Science	2	
PG Diploma in Neuro Technology	2	
Total	134	



National Science Day Celebrations

National Science Day 2019 was celebrated on 28 February 2019 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 in the Institute premises.

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. Inspection on Official Language Implementation from DST was held during 14-15 February 2019.

Faculty

Prof Asha Kishore, Director and Chairperson

Dr Kalliyana Krishnan V (till 30.11.2018), Dean of Academic Affairs

Prof Sankara Sarma P (from 01.12.2018), Dean of Academic Affairs

Prof Thomas Koshy, Associate Dean (Examinations & Curriculum)

Dr Roy Joseph, Associate Dean (PhD Programme)

Prof Shrinivas V G (till 14.09.2018), Associate Dean (Faculty & Student Affairs)

Prof Prasanta Kumar Dash (from 15.09.2018), Associate Dean (Faculty & Student Affairs)

Prof Sundari Ravindran (till 14.09.2018), Associate Dean (Health Sciences)

Prof Biju Soman (from 15.09.2018), Associate Dean (Health Sciences)

Dr Shivakumar K (till 14.09.2018), Associate Dean (Research & Publication Cell)

Prof Kesavadas C (from 15.09.2018), Associate Dean (Research & Publication Cell)

Dr George A V, Registrar

Dr Santhosh Kumar B, Deputy Registrar

Staff

Mr Shibu Raj R (till 31.12.2018), Assistant Administrative Officer (Academic)

Ms Jeeva K H, (from 01.01.2019), Assistant Administrative Officer (Academic)

Mr Sarath Sam S S (from 30.04.2018), Executive Assistant

Mr Ramaprasad P (till 08.05.2018), Upper Division Clerk

Mr Subin D Savio (from 27.02.2019), Upper Division Clerk



Figure 1. National Science Day Celebration

NURSING EDUCATION

During the year, 31 students - 18 Cardiovascular and Thoracic 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 2018
	I year	II year	
Diploma in Cardiovascular and Thoracic Nursing	10	8	6
Diploma in Neuro Nursing	4	9	8

The 30th batch of Cardiovascular and Thoracic nursing students and the 26th batch of Neuro nursing students graduated in December 2018.

Clinical Observership

During the year, 103 MSc Nursing students from 30

institutions within and outside Kerala undertook Clinical Observership.

Staff

Mrs Suja Raj L, Lecturer in Nursing

LIBRARY, HOSPITAL WING

The Hospital Wing library has a collection of 15962 books and 15811 back volumes of journals. During the year, the library subscribed to 110 journals. Electronic access to the subscribed journals was available in both the campuses.

Being part of National Knowledge Resource Consortium (NKRC), the library continued to have access to full-text articles in selected journals from Elsevier, Wiley, Springer, Oxford University Press, American Chemical Society, Royal Society of Chemistry, Nature Publishing Group, Taylor & Francis, etc. and databases, of Web of Science and ASTM Standards.

The publications of our Institute from 1977 onwards were listed in the library site with an interface to search by date, department and author. The average impact factor of the journals in which the articles were published was also available.



Staff

Ms Sudha T, Librarian-cum-Information Officer - A
Ms Dimple Gopi, Librarian-cum-Documentation Officer - A
Mr Jayamohan C S, Librarian-cum-Documentation Assistant - A
Ms Seema S, Librarian-cum-Documentation Assistant - A

LIBRARY, BMT WING

The library of the Biomedical Technology Wing has 11296 books, 6019 back volumes and subscribed to 51 journals. It subscribed 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, orthopedic and neurological medical devices 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.

Seven personnel (Scientists/Engineers/Information Professionals) from BMT Wing attended a presentation on “ASTM standards and Engineering Digital Library” held at Thiruvananthapuram.

The Document Archiving Cell forms part of the library and the Librarian-cum Documentation Officer acts as Archivist.

Staff

Mr Anil Kumar C, Senior Librarian-cum-Documentation Officer - A
Mr Joy Vithayathil, Senior Librarian-cum-Documentation Assistant - B

MEDICAL ILLUSTRATION

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

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

The Audiovisual services provided include web streaming, video conferencing and live broadcast services. Computer-based audiovisual equipment is used in clinical education, national and international conferences and seminars.

Staff

Mr Lijikumar G, Scientific Officer
Mr Viji Kumar N, Projectionist



PUBLICATIONS

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EXTERNALLY-FUNDED RESEARCH PROJECTS (ONGOING)

Hospital Wing

Title of the Project	Principal Investigator	Funding agency	Total outlay (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	4 years
Effect of Yoga on motor cortex plasticity, motor learning and motor deficits in 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
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	32.38	3 years
Establishment of a biorepository of epilepsy and 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
Effect of yoga on neuropsychological functions and brain connectivity networks in mild cognitive impairment (MCI) 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
Pilot study for establishing nationwide network of registries on Management Of Acute Coronary Event (MACE Registry)	Dr Harikrishnan S	ICMR	23.84	4 years
Trivandrum Heart Failure Cohort	Dr Harikrishnan S	ICMR	9.42	5 years
National Heart Failure Registry	Dr Harikrishnan S	ICMR	25.65	3 years
A resting state fMRI & task-based fMRI	Dr Kesavadas C	GE Technology Centre	09.00	3 years
International Stroke Perfusion Imaging Registry (INSPIRE)	Dr Sylaja P N	University of Newcastle, Australia	04.60	3 years
Establishment of the India Stroke Clinical Trial Network (INSTRuCT)	Dr Sylaja P N	ICMR	25.87	3 years



Improving Stroke Care in India (IMPROVISE)	Dr Sylaja P N	NIHR, UK	£48,382.00	3 years
Ayurvedic treatment in the rehabilitation of ischemic stroke patients in India: A randomized controlled trial (RESTORE)	Dr Sylaja P N	ICMR	59.29	3 years
Improvement of secondary prevention in stroke survivors by a primary health care approach	Dr Sylaja P N	ICMR	7.27	3 years
Apolipoprotein B and A1 in ischemic stroke subtypes	Dr Sylaja P N	Emory University, USA	7.96	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	16.16	5 years
Prospective single-arm, multicenter, 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
eDelivery system for Health Care Management and Research at SCTIMST	Dr Geetha G	MEITY	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	7.28	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	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	55.21	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	3.80	2 years
Understanding phenotypes in moyamoya disease by resequencing 17q25'ter region: An imaging genomics approach	Dr Arun K	Wellcome Trust DBT India Alliance	36.45	2 years
Molecular, clinicoradiologic and pathological characterization of oligodendrogliomas with CIC and FUBP1 mutations	Dr Deepti A N	SERB	47.18	3 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



Three Dimensional printing in congenital heart disease	Dr Kapilamoorthy	SERB	38.12	3 years
Desialylation-driven uptake of lipoprotein (a) to endothelial cells and monocytes / macrophages in diabetic cardiovascular patients: Is immune complex with natural antibodies a vehicle?	Dr Geetha M	SERB	23.11	3 years
Evaluation of intermediate-term cardiac and neurodevelopmental outcomes of children undergoing corrective arterial switch operation for complete transposition of great arteries	Dr Bajju S Dharan	National Health Mission, State Office, Trivandrum	2.81	6 months
Virtual reality-based solution for effective neuroanatomy teaching	Dr Kapilamoorthy	SERB	106.52	3 years
Transcriptional and translational regulation of periostin and its interaction with DDR2 in cardiac fibrosis	Ms Sruthi Radhakrishnan	DST	19.44	3 years
General anesthesia vs sedation-cognitive decline in elderly – a randomized controlled trial in patients with chronic subdural hematoma (GAS-CDE)	Dr Smita V	DST	26.42	3 years
VAJRA Faculty Scheme	Dr Keasavadas C	SERB	11.23	3 years



Biomedical Technology Wing

Project Title	Principal Investigator	Funding Agency	Total Outlay (Rs in Lakhs)	Duration
Mechanism of epileptogenesis in young and adult brain - role of NMDA receptor subtypes in hippocampal neurons and astrocytes	Dr Pradeep Punnakkal	DBT (Ramalingaswamy Fellow)	87.3	7 years
Defining the mechanobiology that leads to heterogeneity in muscle stem cells and its implication in regeneration	Dr Praveen K S	SERB (Ramanujan Fellow)	89.00	5 years
Alleviate cognitive deficits in the offspring induced by sleep loss during pregnancy by alpha-asarone	Dr Kamalesh Gulia	DST	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 networking	Dr Renu Mohan	DBT (Ramalingaswamy Fellow)	88	5 years
Programme support on translational research on biomaterials	Dr H K Varma Dr Manoj Komath Dr A Sabareeswaran	DBT	47.05	3 years
Gold nanorod-based nanoprobe for cancer theranostics SERS and imaging 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 (Ramalingaswamy Fellow)	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	3 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 in organic-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 based on self-assembling peptide dendrimers and resorbable calcium phosphate for endodontic tissue regeneration	Dr Manoj Komath	DBT	20.75	3 years
MUSTER - musuloskeletal stem cells targeting	Dr Prabha D Nair	DBT	209.96	4 years
MUSTER - musuloskeletal stem cells targeting	Dr Harikrishna Varma	DBT	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 K Krishnan	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	2 years
Development of indigenous voice prosthesis for rehabilitation of laryngectomies	Dr Roy Joseph	KSCSTE-RCC Trivandrum	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
Bioengineered construct with cardiac mesenchymal cells for myocardial repair	Dr Senthilkumar Muthuswamy	DBT (Ramalingaswamy Fellow)	88.00	5 years
Design and fabrication of a head phantom for dosimetric evaluation of radiotherapy treatment plant	Dr Roy Joseph	KSCSTE-RCC Trivandrum	29.34	3 years
Blood-brain barrier permeable nanocarriers for diagnosis and therapy of neurodegenerative diseases	Dr R S Jayasree	DBT	94.98	3 years
Development of 'Human on-a-chip' device technology	Dr P V Mohanan	DST	311.82	3 years
Evaluation of blood/platelet storage system	Dr Lissy K Krishnan	HLL	38.04	3 years
Accelerated ageing studies on coronary stent system	Mr C V Muraleedharan	various companies	42.58	3 years
Joint Programme on M Tech and PhD		DST	119.13	3 years



Validation of ETO	Ms Leena Joseph	TTK Health Care	4.16	3 years
Toxicity study of materials	Dr P V Mohanan	Eucare Pharmaceuticals	9.53	3 years
Raising antibodies in rabbit model against specific hormones	Dr V S Harikrishnan	HLL	7.43	3 years
Proof-of-concept study for short term LV support	Dr Umasankar	TTK Health Care	1.14	3 years
Biofunctional and histological evaluation of everolimus-coated bioresorbable polymeric stent system-pilot study	Dr Umasankar	Nano Therapeutics	7.61	3 years
In vitro evaluation of cellular uptake and cytotoxicity of nanomaterials	Dr T V Kumary	IIST, Trivandrum	8.7	3 years
Histopathological evaluation of dental implants in rabbit femoral and tibial condylar implant for assessment of osteointegration	Dr A Sabareeswaran	Dr Ramesh Chowdary, Rajarajeswari Dental College	0.94	3 years
Fluoropassivated and hydrogel-sealed vascular graft	Dr Roy Joseph	TTK Health Care	45.3	3 years
Dose ranging study for DES with predicate device	Dr A Sabareeswaran	Sahajanand Vascular Technovention Pvt. Ltd.	15.7	3 years
Bioresorption test of cranial fixation for magnesium skull implant	Dr Harikrishnan V S	Surgiwear Ltd., IISER Trivandrum	5.1	1 year



Achutha Menon Centre For Health Science Studies

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)	Duration
Baseline Surveillance of major risk factors of NCD in Kerala (KIRAN)	Dr Raman Kutty	Government of Kerala	258.00	2 years
Resource Centre/HUB for conducting “Health Technology Assessment”	Dr Raman Kutty	Department of Health Research, Government of India	44.70	3 years
National Environmental Health Profile	Dr Manju R Nair	Ministry of Environment, Forest & Climate change, New Delhi	52.67	3 years
Impact of Measles, Rubella vaccination campaign on population immunity in India (IMRV Study)	Dr Biju Soman	ICMR	18.70	6 months
Mobile telemedicine project for Waynad	Dr Biju Soman	DST	564.00	3 years
Kerala Diabetics Prevention Program (KDPP II)	Dr Jeemon, Panniyammakal	World Diabetics Foundation, Denmark	US \$ 250541	3 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	152.65	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	Total Outlay (Rs in Lakhs)	Duration
Development of annuloplasty ring for mitral valve correction	Ranjith G	9.41	2 years
Evaluation of the bioavailability efficacy of human proteins as delivery vehicle of curumin in animal models	Dr Lissy K Krishnan	9.90	2 years
Development of cell encapsulated click gels as bioink for 3D bioprinting	Dr Kalliyana Krishnan	8.11	18 months
Design of membrane oxygenator with active membrane vibration for enhanced gas filter	Mr Vinod Kumar V	9.50	2 years
Development of a novel device and a method of cell seeding for the establishment of an in vitro co-culture system	Dr Naresh K	4.90	1 year
Estimation of Ethylene oxide (EtO) and other volatile organic compounds using headspace gas chromatograph	Mr Renjith S	9.80	1 year
An ultrasensitive sensor platform for the detection of circulating tumor cells	Dr Jayasree R S	9.90	3 years
Development of a dural substitute with mucoadhesive and antibacterial properties	Dr.P Ramesh	9.99	1 year
Post-surgical adhesions - role of alginate dialdehyde gelatin hydrogel as a pericardial adhesion barrier in cardiac surgery	Dr Soumya Ramanathan	5.74	1 year
Development of skull base buttress device for the closure of osteodural defects	Dr Prakash Nair	4.88	1 year
Modified emergency bandage with pressure pad and a hemostat for pre-hospital emergencies	Dr Lynda V Thomas	5.80	1 year
Design and development of cerebral microdialysis device and methodology for estimation of cerebral metabolites	Dr Ajay Prasad Hrishi	7.50	1 year
Reverse suction and suction arrester device	Mr Anoop Gopinath	4.91	1 year
Multilayered wrap knitted polyester in strengthening valve annulus after valve repair	Dr Varghese T Panicker	6.76	2 years



Technical Research Centre	Mr Muraleedharan C V	9325.00	5 years
Development of centrifugal blood pump	Mr Vinod Kumar V	55.88	18 months
Development of paracorporeal left ventricular assist device	Mr Nagesh D S	209.26	3 years
Development of aortic stent graft	Mr Sujesh S	98.44	2 years
Development of Deep Brain Stimulator System	Mr Muraleedharan C V	162.14	3 years
Implantable cardioverter defibrillator system	Mr Muraleedharan C V	187.41	3 years
Development of leukodepletion filter and its evaluation	Dr P Ramesh	19.83	2 years
Annuloplasty ring for mitral valve correction	Mr Ranjith G	59.78	18 months
Development of bioprosthetic heart valve	Dr P R Umashankar	142.01	3 years
Bioactive intervertebral spacers for lumbar fusion	Dr Manoj Komath	29.83	2 years
Bioactive material platform for drug delivery in bone	Dr Harikrishna Varma	55.05	2 years
Development of intracranial electrodes for use in electrocorticography	Mr Jithin Krishnan	25.37	18 months
Optical peripheral nerve stimulator	Dr R S Jayasree	28.54	12 months
Hydrocephalus shunt and pressure valve design	Mr Anoop Gopinathan	80.30	30 months
Standardization of albumin and FVIII production and purification of IVIG from 'small pool' human plasma	Dr Lissy K Krishnan	35.14	1 year
Development of novel wound healing matrix	Dr Lissy K Krishnan	15.00	1 year
3D printing of skin tissue constructs in vitro testing and applications	Dr Anugya Bhatt	140.20	24 months
Development of platform technology for an implantable infusion pump with wireless recharging system	Mr Sarath S Nair	73.74	36 months
Repair of cartilage injury	Dr Prabha D Nair	43.51	24 months



3D printing of liver tissue	Dr Roy Joseph	340.59	24 months
Development of assay platform and sensing device for PT/INR monitoring	Dr Anugya Bhatt	2.00	5 months
Chitosan /alginate antioxidant polymeric WD	Dr Rekha M R	12.68	18 months
A wound healing matrix from porcine cholecystic EM	Dr T V Anil Kumar	28.20	36 months
Lint-free absorbent dressing	Dr Lynda V Thomas	33.01	18 months
Point-of-care diagnosis for infectious diseases	Dr Anoop Kumar T	3.75	12 months
Alginate scaffold with recombinant growth factors	Dr Anoop Kumar T	40.80	24 months
Biodegradable PLGC-fibrin graft for skin regeneration	Dr Lissy K Krishnan	11.49	12 months
Development of atrial septal defect occluder	Mr Sujesh S	35.53	24 months
Development of radiopaque liquid embolization device	Dr Roy Joseph	34.35	36 months
Characterisation of bacillus species - Methicillin Resistant S Aureus (MRSA)	Dr Maya Nandkumar	40.02	12 months
Oral insulin delivery system	Dr Rekha M R	26.44	12 months
Development of flow diverter stent for treatment of aneurysms	Mr Sujesh S	89.14	2 years
IT Infrastructure Upgradation Plan for TRC	Mr Sajith Lal M K	64.10	18 months
Toxicological evaluation for TRC projects	Dr P V Mohanan	42.84	36 months
Large animal evaluation for TRC projects	Dr P R Umashankar	37.77	36 months
Blood compatibility evaluation for TRC projects	Dr Lissy K Krishnan	14.49	36 months
Cytocompatibility evaluation for TRC projects	Dr P R Anilkumar	12.35	36 months
Histopathological evaluation for TRC projects	Dr.SabareeshwaranA	21.25	36 months
Microbiological evaluation for TRC projects	Dr Maya Nandkumar	11.20	36 months
Analytical characterization for TRC projects	Dr Roy Joseph	13.53	36 months



Design and Fabrication - Prototyping, Jigs and Fixtures for TRC projects	Dr K Ramesh Babu	33.76	36 months
Development of equipments for package validation for TRC projects	Mr Ranjith G	39.73	36 months
Reference Biomaterials for biological evaluations for TRC projects	Ms Leena Joseph	32.20	36 months
Programmable hydrocephalus shunt	Mr Anoop Gopinathan	80.30	30 months
Development and preclinical study of novel wound healing matrix composed of human fibrin, amniotic membrane and hyaluronic acid	Dr Renjith P Nair	15	12 months
Parylene coating for implantable medical devices and device delivery systems	Dr P Ramesh	83.74	24 months
Development of titanium nitride-coated coronary stent system	Mr Subhash N N	53.75	18 months
Radiopaque polymeric microspheres for embolization therapy	Dr Roy Joseph	29.52	24 months
Development of “Patent Landscape Reports (PLRS)” and patent search reports to aid high stake decision making of product development from concept to product	Mr Rajkrishna Rajan	26.60	24 months
A primer for technology transfer with technical market, financial, clinical and regulatory inputs	Ms Sandhya C G	14.48	24 months



COMPLETED PROJECTS DURING 2018-19

Hospital Wing & Achutha Menon Centre For Health Science Studies

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)
Quantification of disability in epilepsy: A move towards rehabilitation and empowerment	Dr Sanjeev V Thomas	Centre for Disability Studies, Government of Kerala	07.45
Analysing the functional connectivity networks in brain in drug resistant idiopathic generalized epilepsy using EEG-fMRI co-registration	Dr Ashalatha R	SERB	28.70
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
Equipment for Heart Failure and Transplant Clinic	Dr Harikrishnan S	Jamsetji Tata Trust	317.00
Mitochondrial remodeling for prevention of chronic pressure overload induced cardiac remodelling	Dr Renuka Nair	ICMR	21.20
Oxidative stress mediated stem cell modification promotes cardiac failure in hypertrophic remodeling	Dr Renuka Nair	BRNS	20.00
Molecular mechanisms in wound healing in the heart: Regulation of the cardiac fibroblast AT1 receptor	Dr Shivakumar K	DBT	37.80
Mitochondrial metabolism and function in type 2 diabetic heart	Dr Srinivas G	SERB	50.77



In vitro beta amyloid uptake by peripheral blood microphages: predictor for progression on mild cognitive impairment (FCI) to Alzheimer`s disease (AD)	Dr Srinivas G	ICMR	18.91
Study of carbamazepine embryotoxicity in relation to MDR1 polymorphisms	Dr Manna Jose	DST	25.81
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
Improvement of secondary prevention in stroke survivors by a primary health care approach	Dr P N Sylaja	Health Department, Government of Kerala	9.51
Control and prevention of non-communicable disease in Kerala	Dr Raman Kutty V	Department of Health and Family Welfare, Government of Kerala	495.00
Closing the gaps: Health equity research initiative in India	Dr T K Sundari Ravindran	International Development Research Centre, Canada	295.00



Biomedical Technology Wing

Project Title	Principal Investigator	Funding Agency	Total Outlay (Rs in Lakhs)
Alternate adult stem cells for ocular surface regeneration	Dr T V Kumary	SERB	47.21
Preparation of hydrogel formulations from cholecystic extracellular matrix	Dr Akhila Rajan	SERB	24
Multifunctional hydroxyapatite lanthanide core shell nanoparticles for near-infrared theranostic imaging	Dr Sunitha Prem Victor	DBT	39.69
Detailed state model of CaMKII activation and auto-phosphorylation in the presence of NR2B and its behaviour in epileptic conditions	Dr Arun Anirudhan	KSCSTE	18.36
Tissue-engineered ceramic for promoting osteo integration in osteoporotic animal models with relevance to the clinical problem in women	Dr Annie John	DST	34.94
Effects of vascular endothelial growth factor transfected human ADMSCs in promoting angiogenesis for chronic wound healing	Ms Amita Ajit	DST	25.96

NEW RESEARCH INITIATIVES FOR 2019-20

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)	Duration
Genetic Architecture of Parkinson's disease in India	Dr Asha Kishore	Michael J Fox Foundation, USA	185.78	3 years
Incidence, prevalence, risk analysis of dementia and basic research thereof	Dr Ramshekhar N Menon	DBT through NBRC	36.42	3 years
Centre for Advanced Research and Excellence in Heart Failure	Dr Harikrishnan S	ICMR	119.75	5 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
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
New Delhi

Shri J B Mohapatra (till 4 May 2018)
Joint Secretary and Financial Advisor
Department of Science & Technology
Technology Bhavan, New Mehrauli Road
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Shri B Anand (from 7 May 2018)
Additional Secretary and Financial Advisor
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Director General of Health Services
Ministry of Health & Family Welfare
Government of India
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New Delhi

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

Dr Suresh Das
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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

Vice-Chancellor (Ex-officio)
University of Kerala
Thiruvananthapuram

Dr G K Singh
(Former Director, AIIMS, Patna)
Professor & Head
Department of Orthopaedics Surgery
King George Medical University
Lucknow

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

Dr Suranjan Bhattacharji
Christian Hospital, Bissamcuttack
Rayagada District, Odisha

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
Amity Univeristy
Noida

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

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Banaras Hindu University, Varanasi

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

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All India Institute of Medical Sciences , New Delhi

Prof Asha Kishore
Director,
SCTIMST

Dr P R Harikrishna Varma
Head, Biomedical Technology Wing
SCTIMST

**INSTITUTE BODY (WITH EFFECT
FROM FEBRUARY 2019)**

Dr V K Saraswat (President)
Member-NITI Aayog
New Delhi

Member of Parliament (Rajya Sabha)

Two Members of Parliament (Lok Sabha)

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

Dr S Venkatesh
Director General of Health Services
Ministry of Health & Family Welfare
Government of India, Nirman Bhavan,
Maulana Azad Road, New Delhi

Smt Annie G Mathew
Joint Secretary (Pers.)
Department of Expenditure, Ministry of Finance
Government of India, New Delhi

Ms Ishita Roy
Joint Secretary (Higher Education)
Ministry of Human Resource Development
Government of India,
Shastri Bhawan, New Delhi

**Member representing Ministry of Health & Family
Welfare, Government of India (to be nominated)**

Dr K P Sudheer
Executive Vice-President
Kerala State Council for Science, Technology &
Environment
Sasthra Bhavan, Thiruvananthapuram

Shri Rajan N Khobragade
Principal Secretary Health & Family Welfare &
Ayush
Thiruvananthapuram

Prof V P Mahadevan Pillai
Vice-Chancellor
University of Kerala
Thiruvananthapuram



Dr Tapas K Kundu

Director
Central Drug Research Institute
Lucknow

Dr Chitra Mandal

Indian Institute of Chemical Biology
Raja S C Mullick Road
Kolkata

Shri T P Senkumar

Ex-DGP Kerala
Pradeeksha , Anand Lane
PTP Nagar, Vattiyookavu PO
Thiruvananthapuram

Prof Gagandeep Kang

Executive Director
Translational Health Science & Technology Institute
NCR Biotech Science CluCR Biotech Science
Cluster, Faridabad

Prof B Ravi

Department of Mechanical Engineering
IIT Mumbai
Mumbai

Dr B N Gangadhar, Director

NIMHANS
Bengaluru

Prof Shally Awasthi

King George's Medical University
Lucknow

Prof Goutam Ganguly

Bangur Institute of Neurosciences
Kolkata

Prof Asha Kishore (Member Secretary)

Director
SCTIMST

Dr Harikrishna Varma P R

Head, Biomedical Technology Wing
SCTIMST

GOVERNING BODY

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

Prof Ashutosh Sharma

Secretary to Government of India
Department of Science & Technology
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Shri B Anand

Adtl. Secretary and Financial Advisor
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Dr S Venkatesh

Director General of Health Services
Ministry of Health & Family Welfare
Government of India
Nirman Bhavan, Maulana Azad Road
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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
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Prof Sneha Anand

Department of Biochemical Engineering
Indian Institute of Technology Delhi
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Prof M V Padma Srivastava

Department of Neurology
All India Institute of Medical Sciences
New Delhi

Prof Asha Kishore

Director
SCTIMST



Dr P R Harikrisna Varma
Head, Biomedical Technology Wing
SCTIMST

Dr V Kalliyana Krishnan (till 31st August 2018)
Dean, Academic Affairs
SCTIMST

Prof Ajit Kumar V K (from 1 September 2018)
Head, Department of Cardiology
SCTIMST

GOVERNING BODY (WITH EFFECT FROM JULY 2019)

Dr V K Saraswat (President)
Member-NITI Aayog
New Delhi

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Secretary to Government of India
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Shri B Anand
Addl. Secretary and Financial Advisor
Department of Science & Technology
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Dr S Venkatesh
Director General of Health Services
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Dr K P Sudheer
Executive Vice-president
Kerala State Council for Science, Technology &
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Thiruvananthapuram

Shri T P Senkumar
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Pradeeksha, Anand Lane
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Prof Goutam Ganguly
Bangur Institute of Neurosciences
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Prof Asha Kishore (Member Secretary)
Director
SCTIMST

Dr Harikrishna Varma P R
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Prof Ajit Kumar V K
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University of Kerala
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Dr P R Harikrishna Varma
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Dr C P Reghunadhan Nair

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Kochi

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Government Medical College
Kozhikode

Prof Sunil Chandu

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SCTIMST

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Head, AMCHSS
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Biomedical Technology Wing
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Secretary to Government of India
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SCTIMST

**Shri Girijavallabhan V K (Ex-officio Convener, till
July 2018)**

Ex. IA & AS, Senior Deputy Director
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**Shri Mahadevan R (Ex-officio Convener, from
August 2018)**

Financial Advisor
SCTIMST

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

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Thampuram Nagar
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Thiruvananthapuram

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Latex Bhavan, Poojappura
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Molecular Biophysics Unit
Indian Institute of Science
Bangalore

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Director
SCTIMST

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Director
CSIR-Indian Institute of Toxicology Research
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Director
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

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Professor, Materials Research Centre
Associate Faculty, Centre for Biosystems Science and
Engineering
Indian Institute of Science
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Mahatma Gandhi University
Priyadarsini Hills PO
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Former Director, ARCI, Hyderabad
Professor, Department of Metallurgical and
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Indian Institute of Technology Madras
Chennai

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Department of Materials Engineering
Indian Institute of Science
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Former Director, IICB,
Senior Professor & Dean of Studies
Bose Institute,
Kolkata



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Former Director, Electronics & Instrumentation
Group, BARC
Sreeniketan, Anushaktinagar
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Professor & Head
Department of Biosciences & Bioengineering
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Mumbai

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Amrita School of Medicine
Ernakulam

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Alapuzha

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Assistant Professor
Government Law College
Kochi

Dr Aneesh V Pillai (Legal Expert)
Assistant Professor, School of Legal Studies
Cochin University of Sciences and Technology
Kochi

Mr Satheesh Chandran (Social Scientist)
Secretary, SOMA India, Always House,
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Dr P Manickam (Scientific Member)
Scientist E
National Institute of Epidemiology (NIE)
Ayapakkam, Chennai
Tamil Nadu

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Retd. Director, Technical & Operation
HLL Life Care Limited, Poojappura
Thiruvananthapuram

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Professor, Department of Cardiology
SCTIMST

Dr Harikrishna Varma P R (Scientific Member)
Head, Biomedical Technology Wing
SCTIMST

**Dr V Raman Kutty (Clinician – Alternate
Member)**
Professor, AMCHSS
SCTIMST

Dr Mala Ramanathan (Member Secretary)
Professor, AMCHSS
SCTIMST

Ms Sreepriya C S (Co-ordinator)
Executive Secretary to the Director
SCTIMST



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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

Vellayani
Trivandrum

Dr Lincy Joseph - Link Nominee

Professor & Head, Pharmaceutical Chemistry
Pushpagiri College of Pharmacy
Thiruvalla

Dr Mathew George - Scientist from outside the Institute

Principal
Pushpagiri College of Pharmacy
Thiruvalla

Dr Santhosh Sankaran- Socially Aware nominee

Consultant Veterinarian
IISER
Thiruvananthapuram

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Director, Rajiv Gandhi Centre for Biotechnology
Thycaud PO, Poojappura
Thiruvananthapuram

Prof Vikram Mathews (Vice-Chairman)

Clinical Haematology
Christian Medical College, Vellore
Tamil Nadu

Prof R V G Menon

Haritha, Poojapura
Thiruvananthapuram

Smt Sathi Nair

Retd. Chief Secretary
Samtripthi, Peroorkada
Thiruvananthapuram

Smt J Lalithambika

I A S, Former Addl. Chief Secretary
Abhilash, Jawahar Nagar
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
Thiruvananthapuram

Dr Annie John

UGC Emeritus Professor
Department of Biochemistry
University of Kerala
Thiruvananthapuram



Shri Nemom V Sanjeev

Advocate & Notary
Nemom Chamber
Vanchiyoor PO
Thiruvananthapuram

Shri Jaideep G Nair

Advocate
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Thiruvananthapuram

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Scientist D
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SCTIMST

Ms Sreepriya C S (Co-ordinator)

Executive Secretary to the Director
SCTIMST

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Biomedical Technology Wing
SCTIMST

Dr A Maya Nandkumar (Member Secretary)

Scientist F
Division of Microbial Technology
Biomedical Technology Wing
SCTIMST

Dr Kavita Raja (Biosafety Officer)

Professor & Head, Department of Microbiology
Medical Superintendent
SCTIMST

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Principal Scientist (Biotechnology) & Head
Microbial Processes and Technology

National Institute of Interdisciplinary Science and
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Scientist E-II, Proteomics Core Facility
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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
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SCTIMST

**TECHNOLOGY DEVELOPMENT
COMMITTEE**

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Director
SCTIMST

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Head, Biomedical Technology Wing
SCTIMST

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Director
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

Shri C Balagopal

Maryknoll Bungalow, Kuravaonkonam



Thiruvananthapuram

Dr Suresh Das

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

Sri A V Ramani

Group Advisor (R&D)
TTK Group of Companies
Bangalore

Prof Vrisha Madhuri

Pediatric Orthopedic Surgeon
Christian Medical College
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Prof Ashok Kumar

Department of Biological Sciences & Engineering
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Uttar Pradesh

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SCTIMST

Prof Ajit Kumar

Head, Department of Cardiology
SCTIMST

Prof Shrinivas V G

Department of Anaesthesiology
SCTIMST

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Director
SCTIMST

Dr Suresh Das

Executive Vice-president, Kerala State Council for
Science, Technology & Environment
Principal Secretary S & T

Government of Kerala
Sasthra Bhavan
Thiruvananthapuram

Shri G Vijayaraghavan

Former CEO, Technopark & Former Member, State
Planning Board
Lakshmi Priya, Chempaka Nagar
Thiruvananthapuram

Dr Harikrishna Varma P R

Head, Biomedical Technology Wing
SCTIMST

Shri K Muraleedharan Nair

Head, CMD (Retd)
VSSC/ISRO
Trivandrum

**Shri Girijavallabhan V K (Ex-officio Convener -
till July 2019)**

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

**Mr Mahadevan R, (Ex-officio Convener - from
August 2019)**

Financial Advisor
SCTIMST

**SENIOR STAFF SELECTION
COMMITTEE**

Director (Chairman - Ex-Officio)

Head, Biomedical Technology Wing

Nominee of the Secretary, DST

An expert from outside the Institute nominated by
the President

Scientist nominated by the President from among the
members of the Institute

Senior academic staff of the Institute not below the
rank of Professor/Scientist G/Engineer G



JUNIOR STAFF SELECTION COMMITTEE

The Medical Superintendent

Head, Biomedical Technology Wing

A representative of the Academic Wing of the Institute nominated by the Director

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: Nil
2. Number of complaints disposed of during the year: Nil
3. Number of cases pending for more than 90 days: Nil
4. Number of Workshops or Awareness Programmes against sexual harassment carried out: Training/ Awareness Programme was organised by ICC-SCTIMST for students and faculty in January 2019

RESERVATION AND OTHER WELFARE MEASURES FOR SCHEDULED CASTES/ SCHEDULED TRIBES /OTHER BACKWARD CLASSES AND PERSONS WITH DISABILITIES

SCTIMST has been following, in letter and spirit, the Presidential Directives and other guidelines related to reservation/concession for Scheduled Castes/ Scheduled Tribes/Other Backward Classes issued by the Government of India from time to time. An adequate monitoring mechanism has been put in place in the Institute for sustained and effective compliance with the Reservation Policy. Rosters are maintained as per the Directives and are regularly inspected by the Liaison Officer to ensure compliance. A Reservation Cell is functioning with 3 members, including the Grievance Officer. In order to address the grievances of students, a Student Grievance Cell with an SC student as Member is also functioning.

The Hon'ble Vice-chairman of the National Commission for Scheduled Castes, New Delhi, visited the Institute on 12 February 2019 to review the implementation of the Rule of Reservation, including service safeguards provided to Scheduled Caste employees.

The Institute received an amount of Rs 2.0 Crores and Rs 6.1 Crores from DST under the head: Grant-in-Aid "ST-General Component" during the years 2016-17 and 2017-18, respectively. Out of the above, Rs 5.64 Crores will be utilized for implementation of the Mobile Telemedicine Project for Wayanad, "to provide specialist services in the Wayanad district of the State of Kerala".



A Comprehensive Health Care Project is being run by the Institute funded by the Scheduled Tribes Development Department, Government of Kerala, for the benefit of Scheduled Tribe patients since 2008, with a funding (as on date) of Rs 85 Lakhs to the Institute for reimbursement of treatment costs to ST patients within Kerala, who are treated at SCTIMST. Approximately, 300 patients have benefited from the medical treatment facilities provided by the Institute till date, worth Rs 63 Lakhs over their 1230 visits as IP/OP patients.

A Workshop on “An Insight into Analytical Instruments for Research”, exclusively for SC/ST candidates, was conducted in the BMT Wing. The Workshop comprised Lecture Sessions, visits to Analytical Instrument Facility, Demonstrations and Discussions.

SCTIMST has implemented the “The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995.



STATEMENT OF ACCOUNTS 2018-19





SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31st March 2019

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	2018-19	2017-18
		[Rs.]	[Rs.]
CAPITAL FUND	1	3576749148	3314855834
RESERVES & SURPLUS	2	235362851	229938803
EARMARKED ENDOWMENT FUNDS	3	865922085	714266971
SECURED LOANS & BORROWINGS, UNSECURED LOANS & BORROWINGS, DEFERRED CREDIT LIABILITIES	4,5,6	0	0
CURRENT LIABILITIES & PROVISIONS	7	689303572	528746612
TOTAL		5367337656	4787808220
ASSETS			
FIXED ASSETS	8	1262838554	1177428425
INVESTMENTS FROM EARMARKED ENDOWMENT FUNDS	9	816074767	763015110
INVESTMENTS-OTHERS	10	235362852	229938803
CURRENT ASSETS , LOANS, ADVANCES ETC	11	3053061484	2617425882
MISCELLANEOUS EXPENDITURE (TO THE EXTENT NOT WRITTEN OFF)			
TOTAL		5367337656	4787808220
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES & NOTES ON ACCOUNT	25		

Sd/-
Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR 2018-19

	Schedule	2018-19	2017-18
		[Rs.]	[Rs.]
Income from Sales / Services	12	1198696987	1139824582
Grants Received from Govt of India(Salary & General)	13	1344142000	1056136000
Fees/Subscription	14	15771586	13166275
Income from Investments }	15	6676134	22264599
Withdrawal from ERF }		0	0
Income from Royalty, Publication etc	16	2905743	4119692
Interest earned	17	58962388	70134122
Other Income	18	214787289	227904916
Total		2841942127	2533550186
EXPENDITURE			
Establishment Expenses	20	2063317897	1545420481
Other Administrative Expenses	21	947107375	884550859
Bank Charges	23	1115084	120872
Depreciation - Current Year		136480238	175839614
		0	0
Total		3148020593	2605931826
Balance being Excess Expenditure over Income		306078467	72381640
Add: Transfer to Special Reserve Account		6618727	9708189
BALANCE BEING DEFICIT CARRIED TO CAPITAL FUND		312697193	82089829

Sd/-
Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM
SCHEDULES**

SCHEDULE 1 - CORPUS/CAPITAL FUND		2018-19	2017-18
PARTICULARS		[Rs.]	[Rs.]
SCHEDULE 1 - CORPUS/CAPITAL FUND			
Balance as at the beginning of the year		6079965277	4898765559
Less Depreciation up to the end of the previous year		2765109442	2589269828
Net balance at the beginning of the year		3314855835	2309495731
Add: Plan Grants received from Government of India for creation of Capital Assets		723349000	1094755000
Add: Grants received under CSR scheme		2862700	7545001
Less: Unutilized Grant-in-Aid ST-General		107332000	0
Deduct: Balance of net expenditure transferred from the Income and Expenditure Account		312697194	82089830
Less: Value of Assets Written off during the year		44289192	14850069
Deduct Transfer to BMT/Add Transfer from CHO		0	0
SCHEDULE 2-RESERVES AND SURPLUS:			
1. Capital Reserve:			
As per last Account		--	--
Addition during the year		--	--
Less: Deduction during the year		--	--
3. Special Reserves:			
As per last Account		229938803	221557820
Addition during the year (Current year transfer- Increase in provision)		5424048	8380983
Less: Deductions during the year		0	0
4. General Reserve:			
As per last Account		--	--
Addition during the year		--	--
Less: Deductions during the year		--	--
TOTAL		235362851	229938803

Sd/-
Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS		2018-19	2017-18
	a) Opening balance of the funds	714266971	797201599
	b) Additions to the funds:		
	i. Donations/grants	1043315047	1049467372
	ii. Income from Investments made on account of funds		
	iii. Other additions (Specify nature)	0	0
	TOTAL (a+b)	1757582018	1846668971
	c) Utilisation / Expenditure towards objective of funds		
	i. Capital Expenditure		
	- Fixed Assets	94030783	83525778
	- Others	1585255	336688935
	Total (Detailed Schedule Attached)	95616038	420214713
	ii. Revenue Expenditure		
	- Salaries, Wages and allowances etc.	75200964	66399848
	- Rent & Consumables etc.,	54433608	53475845
	- Other Administrative expenses	666409322	592311594
	Total	796043894	712187287
	TOTAL (c)		
	NET BALANCE AS AT THE YEAR-END (a+b+c)	865922085	714266971

Sd/-
Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS - AS ON 31.03.2019

PROJ #	NAME OF GRANTEE/PRINCIPAL INVESTIGATOR	FUND-WISE BREAK UP			TOTAL	FIXED ASSETS
		OPENING BALANCE	ADDITIONS TO FUND			
			GRANTS	OTHER RECEIPTS		
	HOSPITAL PROJECTS		ADDITIONS TO FUND			
5000	PROJ-MISCELLANEOUS	7930122	0	37742658	45672781	0
5008	GENERAL CONFERENCE,WORKSHOP	10916	0	0	10916	0
5033	MPH PROGRAMME	1480	0	0	1480	0
5040	DEVELOPING EXPERIMENTAL THERAUPEUTICALS	727442	0	0	727442	0
5055	ROCKFELLER FOUNDATION,USA	686120	0	0	686120	0
5078	PROJECT GRANT/DR MALA RAMANATHAN	5810	0	0	5810	0
5094	KERALA STATE AIDS CONTROL SOCIETY	257594	339674	0	597268	0
5100	AMC/MAC ARTHUR FOUNDATION/02-70546	46315	0	0	46315	0
5108	EVAL.SUB-TYPES DEMENTIA/DR.MATHURA	15801	0	0	15801	0
5119	STAKE HOLDER-PERCEPT/INST.REV BO	104493	0	0	104493	0
5133	WHO FELLOWSHIP TRAINING CBICD	215059	0	0	215059	0
5135	A 16-WEEK,DOUBLE BLIND/ASHA KISHORE	921444	0	0	921444	0
5139	A 24 WEEK, MULTICENTER/DR. MATHURANATH	2602047	0	0	2602047	0
5140	HARVARD SCHOOL OF PUBLIC HEALTH	91794	0	0	91794	0
5142	BANKING FOR BETTER HEALTH-MEDISAVE	153911	0	0	153911	0
5146	DEVELOPMENT OF SPECTROSCOPIC PROTOCOL	11026	0	0	11026	0
5150	PROTOCOL 6002-INT 001	105039	0	0	105039	0
5153	DEV REF. MANUAL FOR PRIMARY	155802	0	0	155802	0
5155	COMM BASED DETECTION	209315	0	0	209315	0
5159	NCD RISK FACTOR SURVEILLANCE	71123	0	0	71123	0



SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

Amount Rs.

UTILIZATION						TOTAL EXPENDITURE	NET BALANCE
CAPITAL EXPENDITURE		REVENUE EXPENDITURE					
OTHERS	TOTAL	SALARIES/WAGES	RENT/CONSUMABLES	OTHER ADMN EXP	TOTAL		
		UTILIZATION					
0	0	0	0	37449597	37449597	37449597	8223184
0	0	0	0	0	0	0	10916
0	0	0	0	0	0	0	1480
0	0	0	0	93500	93500	93500	633942
0	0	0	0	0	0	0	686120
0	0	0	0	0	0	0	5810
0	0	0	0	154650	154650	154650	442618
0	0	0	0	0	0	0	46315
0	0	0	0	0	0	0	15801
0	0	0	0	0	0	0	104493
0	0	0	0	0	0	0	215059
0	0	0	0	178415	178415	178415	743029
0	0	0	0	0	0	0	2602047
0	0	0	0	0	0	0	91794
0	0	0	0	0	0	0	153911
0	0	0	0	0	0	0	11026
0	0	0	0	84305	84305	84305	20734
0	0	0	0	0	0	0	155802
0	0	0	0	0	0	0	209315
0	0	0	0	0	0	0	71123



5161	DOSE RANGING STUDY:CGHR	1267948	0	0	1267948	0
5168	PROJ/VERMEER STUDY	626794	0	0	626794	0
5170	SAFETY OF E 2007 IN LEVODOPA	1031336	0	0	1031336	0
5174	CHANGES IN SLEEP WAKEFULNESS-Dr.Mohanku.	49317	0	0	49317	0
5175	SURGICAL TRIAL IN LOBAR INTRACEREBRAL	39125	0	0	39125	0
5176	WOMEN COMPONENT PLAN	59065	0	0	59065	0
5180	COMMUNITY BASED INTRVEN-CV DIS	18308	0	0	18308	0
5182	KERALA REGISTRY FOR EPILEPSY AND PREGNANCY	2441	0	0	2441	0
5184	COMP HEALTH CARE PROJECT ST	1880796	1000000	0	2880796	0
5190	PREVALENCE OF TYPE II DIABETES IN RURAL	42210	0	0	42210	0
5192	TO PROVIDE INFRASTRUCTURE TO AMCHSS	147206	0	0	147206	0
5193	SAFE MOTHERHOOD PROGRAMME	71796	0	0	71796	0
5201	OPEN LABEL TRIAL IN PARKINSON	3129074	0	0	3129074	0
5203	STUDY IN MRI - ISIR	31767	0	0	31767	0
5207	BRAIN MRI STUDIES	6692	0	0	6692	0
5209	MANAGEMENT - CORONARY EVENT	308774	649189	0	957963	0
5210	EMPOWERMENT OF WOMEN	993896	0	0	993896	0
5213	CREATION OF AMC FUND	13983540	0	3127786	17111326	0
5216	PROTOCOL SP921 A MULTICENTRE	1015637	0	0	1015637	0
5217	STUDY ON WORKLOAD ON NURSES	954578	0	0	954578	0
5219	HEALTH IMPACT OF TECHNOLOGY	1045488	0	0	1045488	0
5220	CAPACITY BUILDING WOMEN HEALTH	650101	0	0	650101	0
5221	RESEARCH PROJECT EQUITY ISSUES	19399	0	0	19399	0
5226	ISOLATION, CHARACTERIZATION OF GLIOMAS	357092	0	0	357092	0
5227	MONOTHERAPY/ ACTIVE CONTROL	543853	229721	0	773574	39585
5232	CEREBELLUM AND CORTICAL	31438	0	0	31438	0



0	0	0	0	16496	16496	16496	1251452
0	0	0	0	30900	30900	30900	595894
0	0	0	0	25536	25536	25536	1005800
0	0	0	0	0	0	0	49317
0	0	0	0	0	0	0	39125
0	0	0	0	0	0	0	59065
0	0	0	0	0	0	0	18308
0	0	0	0	0	0	0	2441
0	0	0	0	879317	879317	879317	2001479
0	0	0	0	0	0	0	42210
0	0	0	0	0	0	0	147206
0	0	0	0	0	0	0	71796
0	0	240000	0	0	240000	240000	2889074
0	0	0	0	5584	5584	5584	26183
0	0	0	0	0	0	0	6692
0	0	304987	0	167935	472922	472922	485041
0	0	0	0	993896	993896	993896	0
0	0	0	0	81578	81578	81578	17029748
0	0	0	0	16243	16243	16243	999394
0	0	0	0	0	0	0	954578
0	0	0	0	0	0	0	1045488
0	0	0	0	0	0	0	650101
0	0	0	0	0	0	0	19399
0	0	0	0	91383	91383	91383	265709
0	39585	194638	0	64028	258666	298251	475323
0	0	0	0	0	0	0	31438



5234	IMPROVING LOCALIZATION IN LESION NEGATIVE	-2860415	0	0	-2860415	0
5237	KERALA DIABETES PREVENTION PROGRAM(K-DPP)	353440	0	0	353440	0
5238	IMPROVING LOCALIZATION IN LESION NEGA...	4884	0	0	4884	0
5243	STEROIDS IN CARDIAC SURGERY	265782	39200	0	304982	0
5245	IMPROVING LOCALIZATION IN LESION N..	184938	0	0	184938	0
5246	COMPREHENSIVE HEART FAILURE	100000	0	0	100000	0
5247	A PHASE 3, 12-WEEK, DOUBLE BLIND, PLA...	2052632	0	0	2052632	0
5248	A PHASE 3, DOUBLE BLIND, PLACEBO AND A..	2011004	0	0	2011004	0
5249	CNRS-INDO-FRENCH PROJECT	2521	0	0	2521	0
5252	INDO-US COLLABORATIVE STROKE	475753	0	0	475753	0
5256	HEALTHY LIFE STYLE	4964479	0	0	4964479	0
5263	MITOCHONDRIA SPECIFIC ANTI-OXI	13465	0	0	13465	0
5264	FLUORESCENCE OPTICAL BIOPSY	82	0	0	82	0
5265	DEVELOPING PHYSICIAN EDUCATION	618	0	0	618	0
5267	EVALUATION STUDY OF THE ASHA	190689	0	0	190689	0
5273	INTERNATIONAL STROKE	89360	142436	0	231796	0
5275	ENCODING OF INTERHEMISPHERIC -	1578324	0	0	1578324	0
5277	VASCULAR CONGNITIVE IMPAIRMENT	151870	0	0	151870	0
5279	FAMILY LED REHABILITATION AFTER STROKE..	25860	0	0	25860	0
5281	LDL RECEPTOR ON MACROPHAGES	948	0	0	948	0
5283	RESEARCH INITIATIVE ON FACTORS	312105	0	0	312105	0
5284	INTERNATIONAL STUDY FOR COMPARATIVE	297939	9982	0	307921	0
5286	INDIAN HEART RHYTHM SOCIETY	33300	0	0	33300	32040
5287	STUDY OF CARBAMAZEPINE ...	145041	0	0	145041	0
5289	MITOCHONDRIAL METABOLISM...	538038	0	0	538038	0
5290	CLOSING THE GAP;HEALTH EQUITY	5105211	1663137	0	6768348	0



0	0	0	0	0	0	0	-2860415
0	0	75000	0	251483	326483	326483	26957
0	0	0	0	0	0	0	4884
0	0	0	0	304982	304982	304982	0
0	0	0	0	0	0	0	184938
0	0	0	0	0	0	0	100000
0	0	0	0	91400	91400	91400	1961232
0	0	0	0	642583	642583	642583	1368421
0	0	0	0	0	0	0	2521
0	0	0	0	0	0	0	475753
0	0	0	0	0	0	0	4964479
0	0	0	0	0	0	0	13465
0	0	0	0	0	0	0	82
0	0	0	0	0	0	0	618
0	0	0	0	0	0	0	190689
0	0	218000	7640	2218	227858	227858	3938
0	0	198000	45620	2025	245645	245645	1332679
0	0	0	0	0	0	0	151870
0	0	0	0	0	0	0	25860
0	0	0	0	0	0	0	948
0	0	0	0	312105	312105	312105	0
0	0	148133	11140	22988	182261	182261	125660
0	32040	0	0	0	0	32040	1260
0	0	144252	0	0	144252	144252	789
0	0	0	284822	0	284822	284822	253216
0	0	951885	0	5816463	6768348	6768348	0



5292	A RESTING STATE FMRI & TASK ..	169320	626000	0	795320	0
5293	DECIPHERING LRRK2 GENE	7077	0	0	7077	0
5294	MTP/EC SERVICES OF WOMEN	227053	0	0	227053	0
5296	ELECTROENCEPHALOGRAPHY WORKSHOP	25230	0	0	25230	0
5297	THE HUMAN BRAIN MAPPING PROJ..	292950	0	0	292950	0
5298	MOLECULAR MECHANISMS	505009	0	0	505009	0
5300	ANALYSING FUNCTIONAL NETWORKS	1046483	0	0	1046483	0
5301	IN VITRO BETA AMYLOID UPTAKE	1104252	111180	0	1215432	0
5302	/DISABILITY STUDIES IN EPILEPSY	200458	0	0	200458	0
5303	MITOCHONDRIAL REMODELING	134019	0	0	134019	0
5305	A FAMILY BASED RANDOMIZED	1930156	8797804	77206	10805166	34990
5306	3 DAYS TRAINING	48388	0	0	48388	0
5307	A RESTING FMRI	556068	0	0	556068	0
5308	EPILEPSY CARE THROUGH SCHOOLS	1085902	0	0	1085902	0
5310	KERALA DIABETES PREVENTION	3381256	3330679	0	6711935	0
5313	EQUIPMENT FOR HEART FAILURE	2467976	0	152596	2620572	946870
5314	NON COMMUNICABLE DISEASES	385474	38659474	0	39044948	0
5315	PROSPECTIV SINGLE ARM MUL	411276	326700	0	737976	47400
5317	MERES1 TRIAL A PROSPECTIVE	26595	0	0	26595	19500
5318	APOLIPOPROTEIN B AND A1	350993	0	0	350993	0
5319	ENCORE	20682	0	0	20682	0
5320	EFFECT OF YOGA ON MOTOR CORTEX PLAST	411252	0	533589	944841	0
5321	EFFECT OF YOGA ON NEUROPSYCHOLOGICAL F	415599	800000	10408	1226007	0
5322	PREFRONTAL CORTEX	257863	0	0	257863	0
5323	CHITRA DHWANI	35500	0	0	35500	0
5325	DECIPHERING THE GENERIC	2386620	0	0	2386620	0



0	0	576000	40470	29952	646422	646422	148898
0	0	0	0	0	0	0	7077
0	0	0	0	0	0	0	227053
0	0	0	0	0	0	0	25230
0	0	202000	68650	19337	289987	289987	2963
0	0	21935	481433	1641	505009	505009	0
0	0	259200	43460	59789	362449	362449	684034
0	0	144000	811352	44101	999453	999453	215979
0	0	0	0	101000	101000	101000	99458
0	0	0	0	9600	9600	9600	124419
0	34990	2249129	76810	5863098	8189037	8224027	2581140
0	0	0	0	0	0	0	48388
0	0	0	32380	189019	221399	221399	334669
0	0	405567	380	84189	490136	490136	595766
0	0	1354844	0	3254902	4609746	4609746	2102189
0	946870	0	0	0	0	946870	1673701
0	0	6507618	0	32255697	38763315	38763315	281633
0	47400	0	0	124241	124241	171641	566335
0	19500	0	0	4500	4500	24000	2595
0	0	0	138600	212393	350993	350993	0
0	0	0	0	0	0	0	20682
0	0	720000	56100	168741	944841	944841	0
0	0	535193	83800	206851	825844	825844	400163
0	0	165000	56000	36863	257863	257863	0
0	0	0	0	0	0	0	35500
0	0	0	0	0	0	0	2386620



5326	NEURO DEVELOPMENTAL DISORDERS	1751056	1948000	134726	3833782	187237
5327	MOVEMENT DISORDER	2048215	0	0	2048215	0
5329	E-DELIVERY FOR HEALTH CARE	19871256	44493474	49938	64414668	26151403
5331	MONTREAL CONGNITIVE MOCA-M	16614	347500	0	364114	0
5332	HYPOXIA AND MINERALISATION	153133	923277	0	1076410	0
5333	ELETROENCEPHALOGRAPHIC	423686	822992	0	1246678	0
5334	SURVEY FOR MONITORING THE NATIONAL NCD TARGETS	1836138	0	0	1836138	0
5335	AUGMENTING PAEDIATRIC SURGERY	1813447	2038036	0	3851483	0
5336	ESTABLISHMENT OF THE INDIAN STROKE CLINICAL TRIAL NETWORK (INSTRUCT)	865085	1071525	0	1936610	0
5337	SECONDARY PREVENTION BY STROKE	118939	590000	0	708939	10990
5338	ESTABLISHMENT OF A BIOREPOSITORY	2008066	802646	0	2810712	1240083
5339	ANTENATAL EXPOSURE	25000	0	0	25000	0
5340	STRUCTURAL AND FUNCTIONAL IMAGING	583613	650000	12792	1246405	0
5341	SLEEP APNEA	380752	0	0	380752	0
5342	TRIVANDRUM HEART FAILURE	296850	353050	0	649900	67650
5343	BRAIN IRON DEPOSITION	327631	426000	0	753631	77754
5344	IMPROVEMENT OF SECONDARY	636642	0	0	636642	9540
5345	MOBILE TELEMEDICINE PROJECT	56222000	0	0	56222000	0
5346	DISEASE RISK FACTORS	1292113	0	0	1292113	0
5347	UNDERSTANDING PHENOTYPES	158630	1787806	1586	1948022	0
5348	PROSPECTIVE STUDY OF PATIENTS	618000	0	0	618000	0
5349	FRACTIONAL FLOW REVERSE	0	54679	0	54679	4900
5350	ICMR-THSTI FORMS	579933	0	0	579933	9898
5351	INFLAMMATORY BIOMARKERS	100000	0	0	100000	0
5352	HYPER ACUTE STROKE	11705	0	0	11705	0
5353	PROSPECTIVE OBSERVATIONAL	300000	0	0	300000	0



0	187237	999281	0	441532	1440813	1628050	2205732
0	0	198000	0	0	198000	198000	1850215
0	26151403	0	0	700705	700705	26852108	37562560
0	0	360000	0	3844	363844	363844	270
0	0	660000	100540	232775	993315	993315	83095
0	0	843561	66600	270990	1181151	1181151	65527
0	0	315198	0	1520940	1836138	1836138	0
0	0	2104992	0	281480	2386472	2386472	1465011
0	0	1070838	0	296090	1366928	1366928	569682
0	10990	0	0	29096	29096	40086	668853
0	1240083	708193	211662	94726	1014581	2254664	556048
0	0	0	0	4050	4050	4050	20950
0	0	560893	216218	135222	912333	912333	334072
0	0	0	0	27500	27500	27500	353252
0	67650	326030	0	35665	361695	429345	220555
0	77754	320842	93810	21104	435756	513510	240121
0	9540	402879	0	139698	542577	552117	84525
0	0	2631269	0	12451286	15082555	15082555	41139445
0	0	88065	878458	0	966523	966523	325590
0	0	600000	362780	415382	1378162	1378162	569860
0	0	387200	0	61800	449000	449000	169000
0	4900	0	0	0	0	4900	49779
0	9898	0	0	463320	463320	473218	106715
0	0	0	0	40500	40500	40500	59500
0	0	0	0	4048	4048	4048	7657
0	0	0	0	30000	30000	30000	270000



5354	WORKSITE BASED LIFESTYLE	0	1323000	0	1323000	0
5355	REGIONAL TRC FOR HEALTH ASSESSMENT	4023700	0	0	4023700	0
5356	AROGYAM NETWORK (KIRAN)	25830000	0	0	25830000	0
6055	MOVEMENT DISORDER SURGERY	0			0	0
5357	MOLECULAR, CLINICORADIOLOGIC AND PATHOLOGICAL CHARACTERIZATION OF OLIGODENDROGLIOMAS WITH CIC AND FUBP1 MUTATIONS (EMR/2016/005832)	0	1169000	0	1169000	0
5358	AN OBLIGATE ROLE FOR DISCOIDIN DOMAIN RECEPTOR 2 IN CELL CYCLE PROGRESSION AND APOPTOSIS RESISTANCE IN CARDIAC FIBROBLASTS	0	1300000	0	1300000	0
5359	THREE DIMENSIONAL PRINTING IN CONGENITAL HEART DISEASE	0	2404453	0	2404453	0
5360	DESIALYLATION-DRIVEN UPTAKE OF LIPOPROTEIN(A) TO ENDOTHELIAL CELLS AND MONOCYTES / MACROPHAGES IN DIABETIC CARDIOVASCULAR PATIENTS: IS IMMUNE COMPLEX WITH NATURAL ANTIBODIES A VEHICLE?	0	1166000	0	1166000	183874
5361	IMPROVING STROKE CARE IN INDIA (IMPROVISE)	0	2273070	0	2273070	0
5362	AYURVEDIC TREATMENT IN THE REHABILITATION OF ISCHEMIC STROKE PATIENTS IN INDIA: A RANDOMIZED CONTROLLED TRIAL (RESTORE)	0	5829850	0	5829850	0
5363	NATIONAL HEART FAILURE REGISTRY	0	3091420	0	3091420	149047
5365	NATIONAL ENVIRONMENTAL HEALTH PROFILE	0	1819000	0	1819000	80797
5366	IMPACT OF MEASLES ,RUBELLA VACCINATION CAMPAIGN ON POPULATION IMMUNITY IN INDIA (IMRV STUDY)	0	2747000	0	2747000	0
5367	EVALUATION OF INTERMEDIATE TERM CARDIAC AND NEURODEVELOPMENTAL OUTCOMES OF CHILDREN UNDERGOING CORRECTIVE ARTERIAL SWITCH OPERATION FOR COMPLETE TRANSPOSITION OF GREAT ARTERIES	0	0	281480	281480	42350
5368	VIRTUAL REALITY-BASED SOLUTION FOR EFFECTIVE NEUROANATOMY TEACHING	0	2917600	0	2917600	0
5369	WORKSHOP ON BRAIN CONNECTIVITY ANALYSIS AND CONFERENCE ON BRAIN COMPUTER INTERFACE	0	100000	122000	222000	0
5370	TRANSCRIPTIONAL AND TRANSLATIONAL REGULATION OF PERIOSTIN AND ITS INTERACTION WITH DDR2 IN CARDIAC FIBROSIS	0	648000	0	648000	0



0	0	312639	0	8782	321421	321421	1001579
0	0	1792263	0	249946	2042209	2042209	1981491
0	0	2271193	0	1376359	3647552	3647552	22182448
0	0	0	0	0	0	0	0
0	0	0	0	86592	86592	86592	1082408
0	0	232064	573621	82202	887887	887887	412113
0	0	85920	0	94000	179920	179920	2224533
0	183874	60000	372648	115354	548002	731876	434124
0	0	244893	0	243737	488630	488630	1784440
0	0	282200	0	1341866	1624066	1624066	4205784
0	149047	414600	0	455172	869772	1018819	2072601
0	80797	124000	0	163782	287782	368579	1450421
0	0	655400	0	192543	847943	847943	1899057
0	42350	55742	34000	0	89742	132092	149388
0	0	30085	0	206019	236104	236104	2681496
0	0	0	0	125527	125527	125527	96473
0	0	116126	0	58000	174126	174126	473874



5371	GENERAL ANESTHESIA VS SEDATION-COGNITIVE DECLINE IN ELDERLY – A RANDOMIZED CONTROLLED TRIAL IN PATIENTS WITH CHRONIC SUBDURAL HEMATOMA (GAS-CDE)	0	1308000	0	1308000	0
5372	VAJRA FACULTY SCHEME	0	1123200	0	1123200	0
5374	RISK ANALYSIS OF DEMENTIA	0	3642000	0	3642000	0
5375	CARE IN HEART FAILURE	0	2814240	0	2814240	0
5376	CARE IN HEART FAILURE	0	4207800	0	4207800	0
5377	CARE IN HEART FAILURE	0	588000	0	588000	0
5378	CARE IN HEART FAILURE	0	407500	0	407500	0
5379	CARE IN HEART FAILURE	0	1797500	0	1797500	0
5380	CARE IN HEART FAILURE	0	502500	0	502500	0
5382	CARE IN HEART FAILURE	0	1658200	0	1658200	0
6058	ATHIYANOOR SCT ACTION/DR.K.R.T	21006	0	0	21006	0
6077	TECHNICAL ADVISORY COMMITTEE	0	210800	0	210800	0
6080	COMPREHENSIVE PAIN CLINIC	309250	18000	0	327250	0
6091	PUBLIC HEALTH DOCUMENTATION -	79578	0	0	79578	0
6093	EVALUATION OF VASCULAR GRAFT	13960	0	0	13960	0
6098	RESEARCH ON MEDICAL TOURISM	46684	0	0	46684	0
6102	SELECTIVE SUB-TEMPORAL SELF	59890	0	0	59890	0
6103	DEVELOPMENT OF A FLEXIBLE ARM	25000	0	0	25000	0
6104	HEALTH TECHNOLOGY ASSESSMENT	504422	0	0	504422	0
6106	DEVELOPMENT OF AUTONOMIC FUNCTION MONITOR BASED ON COMBINED HEART RATE VARIABILITY(HRV) AND GALVANIC SKIN CONDUCTANCE	0	153767	0	153767	0
6107	ROLE OF RESTING STATE FUNCTIONAL MRI IN PATIENTS WITH INTRACRANIAL DURAL ARTERIO VENOUS FISTULA	0	11140	0	11140	0
7101	ADVANCE TO P I	0	0	1658600	1658600	0
		199903635	158265201	43905365	402074201	29335907
	OTHER PROJECTS				0	



0	0	20322	0	80000	100322	100322	1207678
0	0	0	0	1030621	1030621	1030621	92579
0	0	0	0	0	0	0	3642000
0	0	0	0	0	0	0	2814240
0	0	0	0	0	0	0	4207800
0	0	0	0	0	0	0	588000
0	0	0	0	0	0	0	407500
0	0	0	0	0	0	0	1797500
0	0	0	0	0	0	0	502500
0	0	0	0	0	0	0	1658200
0	0	0	0	21006	21006	21006	0
0	0	210800	0	0	210800	210800	0
0	0	0	0	327250	327250	327250	0
0	0	0	0	79578	79578	79578	0
0	0	0	0	13960	13960	13960	0
0	0	0	0	46684	46684	46684	0
0	0	0	0	59890	59890	59890	0
0	0	0	0	25000	25000	25000	0
0	0	0	0	504422	504422	504422	0
0	0	139117	0	14650	153767	153767	0
0	0	0	11140	0	11140	11140	0
0	0	0	0	1658600	1658600	1658600	0
0	29335907	35239986	5160134	116808818	157208938	186544845	215529356



1014	NEW PENSION SCHEME	8071317		184452894	192524211		
1301	EMPLOYEES PENSION FUND	67133121		386250337	453383458		
1075	PATIENT WELFARE FUND	8947320		1309925	10257245		
		0			0		
1078	DR. RICHARD A CASH & DR K MOHANDAS AWARD	177388		75913	253301		
1080	STAFF BENEVOLENT FUND	5259148		3751585	9010733		
1081	CONTINUUM - SPECIAL CME PUBLICATION FUND - HOSPITAL	51707			51707		
1096	PEDIATRIC WELFARE FUND	50000			50000		
1099	CSR GRANT - REVENUE	0		550000	550000		
	TOTAL (B)	89690001	0	576390654	666080655		0



				182097923	182097923	182097923	10426288
				292299643	292299643	292299643	161083815
				238809	238809	238809	10018436
							0
				0	0	0	253301
				2637940	2637940	2637940	6372793
				51707	51707	51707	0
				50000	50000	50000	0
					0	0	550000
0	0	0	0	477376022	477376022	477376022	188704633



BMT PROJECTS

PROJ#	NAME OF GRANTEE/PRINCIPAL INVESTIGATOR	FUND-WISE BREAK UP			TOTAL	UTILISATION
		OPENING BALANCE	ADDITIONS TO FUND	GRANTS	OTHER RECEIPTS	CAPITAL EXPENDITURE
5000	PROJECT SUSPENSE	3482848	0	70582390	74065238	0
5057	DYNAMIC ORTHOPAEDIC PVT LTD, HYDROXY	6788	0	0	6788	0
5089	DETEC & TREAT OF CANCER BY LASER	3959	0	0	3959	0
7000	MISCELLANEOUS PROJECT	30944	0	0	30944	0
7001	PRO;SAHAJANAND VASCU;DR.AURTHUR	78109	0	0	78109	0
7002	Dr.TOMS LABORATORY, Dr. K.KRISHNAN	13876	0	0	13876	0
7003	PROJ:D.S.T. DR.PV. MOHANAN	2537	0	0	2537	0
7004	PROJ:ATMRF:DR LISSY KRISHNAN	551	0	0	551	0
7005	PROJECT:DYNAMIC ORTHOPAEDICS	13656	0	0	13656	0
7006	PROJ: D.S.T. D.S.NAGESH	181074	0	0	181074	0
7008	NMITLI, PROJECT C.S.I.R	1	0	0	1	0
7009	CHITOSAN BASED WOUND DRESSING	4762	0	0	4762	0
7011	DST-FAB: CLINICALLY/SIG:SHAPE OF HEVA	213826	0	0	213826	0
7014	AUROLAB,ARAVIND EYE HOSPITAL	13674	0	0	13674	0
7015	TTK.HEALTHCARE.DEVELOPMENT OF VALV	39424	0	0	39424	0
7016	INDO-GERMAN COMMITTEE MEETING-DST	5407	0	0	5407	0
7017	HINDUSTAN LATEX.EVALU:BLOOD BAG	-184966	0	320490	135524	0
7018	ALL INDIA COUNCIL FOR TECHNI:EDU:SH	186450	0	940190	1126640	0
7019	DST.NIRANJAN	69847	0	0	69847	0
7020	IFCPAR-DR.JAYAKRISHNAN	188	0	0	188	0



						TOTAL EXPENDITURE	NET BALANCE
REVENUE EXPENDITURE							
OTHERS	TOTAL	SALARIES/WAGES	RENT/CONSUMABLES	OTHER ADMN EXP	TOTAL		
0	0	0	0	68504767	68504767	68504767	5560471
0	0	0	0	0	0	0	6788
0	0	0	0	0	0	0	3959
0	0	0	0	0	0	0	30944
0	0	0	0	0	0	0	78109
0	0	0	0	0	0	0	13876
0	0	0	0	0	0	0	2537
0	0	0	0	0	0	0	551
0	0	0	0	0	0	0	13656
0	0	0	0	0	0	0	181074
0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	4762
0	0	0	0	0	0	0	213826
0	0	0	0	0	0	0	13674
0	0	0	0	0	0	0	39424
0	0	0	0	0	0	0	5407
0	0	0	84235	19504	103739	103739	31785
0	0	0	535595	0	535595	535595	591045
0	0	0	0	0	0	0	69847
0	0	0	0	0	0	0	188



7022	DST-LBFDPSBC-DR.SHARMA	79385	0	0	79385	0
7023	DEV: HYDRO-CEPHALUS-HINDUSTAN LATEX	45510	0	0	45510	0
7026	DEV.HEART VALVE-DST.MURALEE	2522	0	0	2522	0
7027	STED-DR T V KUMARY-IN VITRO	5089	0	0	5089	0
7029	DONERG/LIFE SCIENCE BOARD	6876	0	0	6876	0
7031	DBT/DR P V MOHAN/DEV IN VITRO PYRO	79064	0	0	79064	0
7032	DST. DR. ANNINE/BONE REGENERATION	29166	0	0	29166	0
7033	BIOFUNCTIONAL EVALUATION DR. UMASANKER	72581	0	0	72581	0
7034	DST. DR. NIRMALA RACHEL	14664	0	0	14664	0
7035	DST-H.K.VARMA	95433	0	0	95433	0
7037	INVIVO EVALUATION/ STED/DR. LISSY	6205	0	0	6205	0
7039	JNC/ASR/DR. MOHANAN/STUDY OF ACCUTE.....	44684	0	0	44684	0
7040	BIOMED/ C.V. MURALEEDHARAN	44000	0	0	44000	0
7041	CSIR-GRANT-ASHA S MATHEW,PHD STUDENT	55973	0	0	55973	0
7042	CSIR-GRANT-BERNADETTE K. MADATHIL,PHD	25870	0	0	25870	0
7043	CSIR-GRANT-SAILAJA.G.S.SRF	9067	0	0	9067	0
7044	LISI NO TRIAL TRIAL MERIND	21673	0	0	21673	0
7045	NIRMALA RACHEL, CSIR	14063	0	0	14063	0
7047	U.G.C. GRANT- RESEARCH FELLOW	300935	0	0	300935	0
7048	CSIR GRANT- JOSENA JOSEPH	47473	0	0	47473	0
7049	CSIR GRANT - MARY VARGHESE	35837	0	0	35837	0
7050	INTEREST-PROJECT ACCOUNT	3899003	0	3416472	7315475	0
7051	CSIR GRANT - MANITHA B NAIR	12062	0	0	12062	0
7052	DBT/DR.PRABHA/DEV. OF TEMP - RES - CO-OLY	0	0	0	0	0
7053	DR.SREENIVASAN/DEVEL.OF TEMPRES.CO-OLY	22619	0	0	22619	0
7054	DST-DR.ANOOP-DIFF:EXPR:RAT BRAIN.....	44434	0	0	44434	0



0	0	0	0	0	0	0	79385
0	0	0	0	0	0	0	45510
0	0	0	0	0	0	0	2522
0	0	0	0	0	0	0	5089
0	0	0	0	0	0	0	6876
0	0	0	0	0	0	0	79064
0	0	0	0	0	0	0	29166
0	0	0	0	0	0	0	72581
0	0	0	0	0	0	0	14664
0	0	0	0	0	0	0	95433
0	0	0	0	0	0	0	6205
0	0	0	0	0	0	0	44684
0	0	0	0	0	0	0	44000
0	0	0	0	0	0	0	55973
0	0	0	0	0	0	0	25870
0	0	0	0	0	0	0	9067
0	0	0	0	0	0	0	21673
0	0	0	0	0	0	0	14063
0	0	0	0	0	0	0	300935
0	0	0	0	0	0	0	47473
0	0	0	0	0	0	0	35837
0	0	0	0	470839	470839	470839	6844636
0	0	0	0	0	0	0	12062
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	22619
0	0	0	0	0	0	0	44434



7055	CSIR-NMITLI SCHEME-C.V.MURALEEDHARAN	756552	0	0	756552	0
7057	DST - PROJECT.DR.JAYABALAN	14471	0	0	14471	0
7059	DBT-DR. PRABHA D NAIR, ISLET IMMUN.....	67574	0	0	67574	0
7060	ICMR PROJECT/ SUDHAKAR MUTHALEE	124392	0	0	124392	0
7062	DR. LIZY-SAHAJA:EVA "STENT" IN VITRO.....	101675	0	0	101675	0
7065	DR.T.V.KUMARI,DBT.BIOGENE	38659	0	0	38659	0
7069	VSSC - PROJECT. D.S. NAGESH	153302	0	0	153302	0
7070	CHO PROJECT - 5146 JAYASREE	-872	0	0	-872	0
7071	STEC-PROJECT: DR.MAYA NANDKUMAR	375	0	0	375	0
7072	SAHAJANAND MED.TECH. C.V.MURALIDHARAN	76292	0	0	76292	0
7074	STUDY PROJECT: CLRI- DR.MOHAN	289303	0	0	289303	0
7075	STUDY PROJECT - BIOSYNC SCI	11935	0	0	11935	0
7076	ARROW INTERNATIONAL : DR.UMASHANKAR	399773	0	0	399773	0
7080	DBT-DR.MAYA- TISSUE ENGINEERING HYBRID	10518	0	0	10518	0
7081	USV LTD. MUMBAI - DR.MOHAN	88349	0	0	88349	0
7082	INDO-US JOINT PROJECT	878	0	0	878	0
7083	ARROW HAEMO DIALYSIS	30882	0	0	30882	0
7085	DR.R.V.THAMPAN - CSIR	26381	0	0	26381	0
7086	HORMONE RELEASING INTRA DEVICES	-86027	0	0	-86027	0
7087	CSIR - KALADHAR - BST	39103	0	0	39103	0
7092	PROJ/7092/SEA FOOD	1993	0	0	1993	0
7093	PROJ/7093/CSIR GRANT-LPA	50562	0	0	50562	0
7095	PROJ/7095/CSIR GRANT-VIOLA.B.MORRIS	22072	0	0	22072	0
7097	PROJ/7097/ACCELERATED AGEING	270261	0	14738	284999	0
7099	PROJ/7099/BCL	7011	0	0	7011	0
7100	PROJ/7100/ITR PROGRAMME	4079	0	0	4079	0



0	0	0	0	0	0	0	756552
0	0	0	0	0	0	0	14471
0	0	0	0	0	0	0	67574
0	0	0	0	0	0	0	124392
0	0	0	0	0	0	0	101675
0	0	0	0	0	0	0	38659
0	0	0	0	0	0	0	153302
0	0	0	0	0	0	0	-872
0	0	0	0	0	0	0	375
0	0	0	0	0	0	0	76292
0	0	0	0	0	0	0	289303
0	0	0	0	0	0	0	11935
0	0	0	0	0	0	0	399773
0	0	0	0	0	0	0	10518
0	0	0	0	0	0	0	88349
0	0	0	0	0	0	0	878
0	0	0	0	0	0	0	30882
0	0	0	0	0	0	0	26381
0	0	0	0	0	0	0	-86027
0	0	0	0	0	0	0	39103
0	0	0	0	0	0	0	1993
0	0	0	0	0	0	0	50562
0	0	0	0	0	0	0	22072
0	0	0	165350	0	165350	165350	119649
0	0	0	0	0	0	0	7011
0	0	0	0	0	0	0	4079



7101	PROJ/7101/CSIR/SONIA.T.A	2650	0	0	2650	0
7103	PROJ/7103/CSIR/VIDYARAJ	5682	0	0	5682	0
7105	PROJ/7105/CSIR/ARJUN NAMBOODIRI	26821	0	0	26821	0
7107	PROJ/7107/CSIR/NEENA & 2 FELLOWS	34082	0	0	34082	0
7108	PROJ/7108/CSIR/FRANCIS.B.FERNANDEZ	2154	0	0	2154	0
7110	PROJ/7110/CSIR/DEEPA.R	10919	0	0	10919	0
7111	PROJ/7111/CSIR/SHEEJA LIZA EASO	6353	0	0	6353	0
7113	KSCSTE -GT-RATHIKALA	-86	0	86	0	0
7200	JOINT PROGRAME/M.TECH	513438	0	0	513438	0
7210	PROJ/7210/CSIR/SOMA DEY	1641	0	0	1641	0
7220	COST OF ANIMAL FEED	3048847	0	436998	3485845	0
7230	PROJ/7230/CSIR/MANJU.S	12421	0	0	12421	0
7250	PROJ/7250/CSIR/KIRAN.S.NAIR	15281	0	0	15281	0
7260	PROJ/7260/STOX083Y09/DR.PV.MOHANAN	149985	0	0	149985	0
7290	PROJ/7290/CSIR/RAKHI.A	19584	0	0	19584	0
7300	PROJ/7300/CSIR FELLOW ARYA SARASWATHY	-7	0	7	0	0
7330	Y.M.THASNEEM - UGC GRANT	7195	0	0	7195	0
7350	UGC GRANT - LAXMI.R.NAIR	105823	0	0	105823	0
7370	VALIDATION OF ETO STERILZATION SYSTEM-	275765	147888	244248	667901	244248
7375	ICMR PROJECT- Ms. Renu Ramesh	32250	0	0	32250	0
7385	CSIR GRANT - CAROLINE DIANA SHERLY	1322	0	0	1322	0
7390	TOXICITY STUDY OF MATIRIALS Dr. P V Mohanan	1567268	717600	0	2284868	0
7395	RAISNG ANTIBODIES IN RABBITS - DR V S HARIKRISH	586245	0	60200	646445	0
7400	CSIR GRANT :SHAIJU S NAZEER	3333	0	0	3333	0
7402	PROOF OF CONCEPT STUDY - DR UMA SHANKAR	100747	0	0	100747	0



0	0	0	0	0	0	0	2650
0	0	0	0	0	0	0	5682
0	0	0	0	0	0	0	26821
0	0	0	0	0	0	0	34082
0	0	0	0	0	0	0	2154
0	0	0	0	0	0	0	10919
0	0	0	0	0	0	0	6353
0	0	0	0	0	0	0	0
0	0	0	23510		23510	23510	489928
0	0	0	0	0	0	0	1641
0	0	0	111708	0	111708	111708	3374137
0	0	0	0	0	0	0	12421
0	0	0	0	0	0	0	15281
0	0	0	0	0	0	0	149985
0	0	0	0	0	0	0	19584
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	7195
0	0	105823	0	0	105823	105823	0
0	244248	18000	280958	0	298958	543206	124695
0	0	0	0	0	0	0	32250
0	0	0	0	0	0	0	1322
0	0	0	81200	0	81200	81200	2203668
0	0	0	186911	0	186911	186911	459534
0	0	0	0	0	0	0	3333
0	0	0	0	0	0	0	100747



7403	ICMR GRANT - PARVATHY R S	54274	141067	0	195341	0
7404	BIOFUNCTIONAL AND HISTOLO - DR UMA SHANKAR	761369	0	0	761369	0
7405	IN VITRO EVALUATION OF CELL- DR T V KUMAR	407580	0	318255	725835	0
7406	CSIR GRANT - R ARATHI	6135	0	0	6135	0
7407	TRSF MESENCHYMAL STEM CELL	1686	0	0	1686	0
7409	SRUTHI PHD STUDENT UGC	9292	0	0	9292	0
7411	DEV POLY ADHESIVE & POTT	206140	0	0	206140	0
7412	REMYA K CSIR FELLOW	19900	0	0	19900	0
7413	"PROJ/7413/ANTIMICROBIAL ACTIVITY"	89586	0	0	89586	0
7414	"PROJ/7414/EFFECT OF NANOGRAPHENE MOUSE.."	14620	389600	0	404220	0
7415	"PROJ/7415/AXONAL GUIDANCE"	18450	0	0	18450	0
7416	"PROJ/7416/PULMONARY FIBROSIS"	23661	0	0	23661	0
7417	"PROJ/7417/INVITRO & INVIVO EVALUATION"	13000	380000	0	393000	0
7418	"PROJ/7418/THE NATURE OF FOREIGN BODY ..."	8730	350000	0	358730	0
7419	PROJ/7419/DETERMINATION OF TOXICITY	52516	0	0	52516	0
7421	PROJ/7421/FIBRIN BASED MATRIX	68655	399600	10452	478707	0
7422	PROJ/7422/HISTOPATHOLOGICAL EVALUATION	190721	300100	0	490821	0
7423	PROJ/7423/TRACKING CARDIAC STEM	35153	20000	0	55153	0
7424	PROJ/7424/SYNAPTIC PROTEOME	37741	0	0	37741	0
7425	PROJ/7425/BIOENGINEERED SKIN AFT FOR ...	110000	358800	0	468800	0
7426	PROJ/7426/POLYMERIC MICRO NEEDLES	162000	0	0	162000	0
7427	PROJ/7427/ANIONIC POLYSACCHARIDE BASED .	16660	0	0	16660	0
7428	PROJ/7428/BACTERIAL RESISTANCE	46301	368000	0	414301	0
7429	PROJ/7429/BIORESORBABLE POLYMER MESH	101326	0	0	101326	0



0	0	0	26038	0	26038	26038	169303
0	0	0	0	0	0	0	761369
0	0	0	0	162073	162073	162073	563763
0	0	0	0	0	0	0	6135
0	0	0	0	0	0	0	1686
0	0	0	0	0	0	0	9292
0	0	0	0	0	0	0	206140
0	0	0	0	0	0	0	19900
0	0	0	0	0	0	0	89586
0	0	369600	0	0	369600	369600	34620
0	0	0	0	0	0	0	18450
0	0	0	12638	0	12638	12638	11023
0	0	353000	12871	0	365871	365871	27129
0	0	330000	3496	0	333496	333496	25234
0	0	0	0	0	0	0	52516
0	0	376452	8313	0	384765	384765	93942
0	0	0	97956	0	97956	97956	392865
0	0	0	3000	0	3000	3000	52153
0	0	0	13208	0	13208	13208	24533
0	0	311300	0	0	311300	311300	157500
0	0	0	0	0	0	0	162000
0	0	0	16457	0	16457	16457	203
0	0	349000	23425	0	372425	372425	41876
0	0	0	0	0	0	0	101326



7430	PROJ/7430/TEST OF CRANIAL FIXATION	0	513000	0	513000	0
7431	PROJ/7431/SHELL NACRE	0	176333	0	176333	0
8004	PROJ/8004/PROGRAM SUPPORT & TISSUE	-278345	0	0	-278345	0
8005	PROJ/8005/PROGRAM SUPPORT & TISSUE	-98722	0	0	-98722	0
8006	PROJ/8006/BIOCONJUGATION NANO MAT.	139019	0	0	139019	0
8008	PROJ/8008/CSIR GRANT-PADMAJA.PNAMBI	12990	0	0	12990	0
8009	PROJ/8009/DBT/DR.T.V.ANILKUMAR/DE... TISSUE	-310641	0	0	-310641	0
8011	PROJ/8011/NANOFRONT/DR.NIRANJAN/ INTRAMAS	139900	0	0	139900	0
8012	PROJ/8012/VSSC/DR.NIRANJAN/DESIGN STUDIES	2148623	0	0	2148623	0
8014	PROJ/8014/DBT/DR.ROY JOSEPH/DEV... .V.GRAFT	-17063	0	0	-17063	0
8015	PROJ/8015/DR.ANOOPKUMAR/PROGRAMME...	12581	0	0	12581	0
8019	PROJ/8019/STEC/DR.PRAMESH	82284	0	0	82284	0
8020	PROJ/8020/CSIR/DR.LISSY KRISHNAN	19974	0	0	19974	0
8021	PROJ/8021/ANGIOGENESIS EXP/ DR.UMASHANKAR	79036	0	0	79036	0
8022	AIR POLLUTION CONTROL.....SUJESH (AMC)	-306	0	306	0	0
8023	PROJ/8023/KSCSTE/DR.H.K.VARMA	76545	0	0	76545	0
8024	PROJ/8024/IIT/DR.PR.ANILKUMAR	2935	0	0	2935	0
8026	PROJ/8026/	3339	0	0	3339	0
8027	PROJ/8027/DR.PV.MOHANAN	79732	0	0	79732	0
8028	PROJ/8028/DR.DIKSHA PAINULY	22332	0	0	22332	0
8031	PROJ/8031	-309053	0	0	-309053	0
8032	PROJ/8032/O.S.N.NAIR	128471	0	0	128471	0
8033	PROJ/8033/DEV. OF IRON OXIDE- DR.R.S.JAYASREE	-7146	0	0	-7146	0
8034	PROJ/8034/FLURO PASSI...DR.ROY JOSEPH	710196	0	0	710196	0



0	0	0	0	0	0	0	513000
0	0	168000	0	0	168000	168000	8333
0	0	0	0	0	0	0	-278345
0	0	0	0	0	0	0	-98722
0	0	0	0	0	0	0	139019
0	0	0	0	0	0	0	12990
0	0	0	0	0	0	0	-310641
0	0	0	0	0	0	0	139900
0	0	0	0	0	0	0	2148623
0	0	0	0	0	0	0	-17063
0	0	0	0	0	0	0	12581
0	0	0	0	0	0	0	82284
0	0	0	0	0	0	0	19974
0	0	0	0	0	0	0	79036
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	76545
0	0	0	0	0	0	0	2935
0	0	0	0	0	0	0	3339
0	0	0	0	0	0	0	79732
0	0	0	0	0	0	0	22332
0	0	0	0	0	0	0	-309053
0	0	0	0	0	0	0	128471
0	0	0	0	0	0	0	-7146
0	0	0	13557	0	13557	13557	696639



8035	PROJ/EVALN OF SEWING RING-DR. UMASHANKAR	22201	0	0	22201	0
8038	PROJ/DEV OF MISSION PROGRAM - DR.GSB	1182223	0	0	1182223	0
8040	PROJ/SYNTHESIS OF OXIDE-DR.H.K.VARMA	1475	0	0	1475	0
8041	PROJ/DEV OF NANO DEVICES DNA-DR.C.PSHARMA	-6255	0	0	-6255	0
8046	PROJ/DIFF. OF ADULT PRO - DR.ASHA.S.MATHEW	739755	0	0	739755	0
8049	PROJ/NEW VISION BIOMAT-DR.C.PSHARMA	-44861	0	0	-44861	0
8052	PROJ/ROLE OF TRANSFORMN GROWTH-DR. ANOOP	79053	0	0	79053	0
8054	PROJ/MUSCULOSKELETAL STEM CELL/ DR.PDNAIR	600989	0	93764	694753	0
8055	MUSCULOSKELETAL STEM CELLS/ DR.H.K.VARMA	3	0	0	3	0
8059	PROJ/CELL SHEET ENGG-DR.PR.ANILKUMAR	108000	0	0	108000	0
8062	PROJ/ACCELERATED AGEING../MR.C.V.MURALI	213728	0	0	213728	0
8064	NONVIRAL GENE DELIVERY VECTORS-DR.REKHA	33801	0	0	33801	0
8066	TO INVESTIGATE THE EFFECTS OF/ DR.GULIA	-999	0	1000	1	0
8067	QUANTUM DOT CONJUGATED -DR.R.S.JAYASREE	-5090	0	0	-5090	0
8068	INSPIRE RESEARCH PROJECT -DR.BINDU.P.NAI R	3957	0	0	3957	0
8069	PROJ/8069/STUDIES BIODEGRADABLE	1425	0	0	1425	0
8070	PROJ/8070/PINSPIRE FACULTY AWARD-DR.SHIV	1088241	0	0	1088241	0
8071	PROJ/8071/REGEN .OF INTERVERTEBRAL DISC	5840	0	0	5840	0
8072	PROJ/8072/NANO CALCIUM PHOSPHATE	15412	0	0	15412	0
8074	PRODUCTION OF NOVEL NANO INDO-UK DR.CPS	303180	0	0	303180	0
8075	D.S.T. INSPIRE FELLOWSHIP-ASWATHY.B.S.	10489	0	0	10489	0
8077	HOME BASED VITAL SIGNS - DR.NIRANJAN.D.	204510	0	0	204510	0
8079	DOSE RANGING STUDY FOR DES / DR.SABAREES	731710	0	0	731710	0
8080	PROJ/8080/DETECTION OF ZINC IN EPILEPTIC	-36952	0	44300	7348	0



0	0	0	3400	0	3400	3400	18801
0	0	0	0	0	0	0	1182223
0	0	0	0	0	0	0	1475
0	0	0	0	0	0	0	-6255
0	0	0	0	0	0	0	739755
0	0	0	0	0	0	0	-44861
0	0	0	79053	0	79053	79053	0
0	0	0	610092	0	610092	610092	84661
0	0	0	0	0	0	0	3
0	0	0	0	0	0	0	108000
0	0	0	0	0	0	0	213728
0	0	0	0	0	0	0	33801
0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	-5090
0	0	0	0	0	0	0	3957
0	0	0	0	0	0	0	1425
0	0	0	615360	0	615360	615360	472881
0	0	0	0	0	0	0	5840
0	0	0	0	0	0	0	15412
0	0	0	0	0	0	0	303180
0	0	0	10489	0	10489	10489	0
0	0	0	0	0	0	0	204510
0	0	0	0	0	0	0	731710
0	0	0	7347	0	7347	7347	1



8081	EXPLORING THE POTENTIAL OF ISLET-DR.PRABH	583819	0	6761	590580	0
8082	ASSESSMENT OF CERAMIC CONSTRUCTS - FRANC	37118	0	0	37118	0
8083	IN VITRO OSTEOARTHRITIC-DR.NEETHUMOHAN	8295	0	0	8295	0
8084	ROLE OF NMDA- DR.PRADEEP PUNNAKKAL-RAM	1121335	2000167	1250878	4372380	0
8085	PROJ/8085/ELECTROCHEMICALLY ASSISTED	40	0	0	40	0
8086	PROJ/8086/GOLD NANORODS FOR THERAPY	89739	0	0	89739	0
8087	PROJ/8087/CONTROLLED DELIVERY	38074	0	0	38074	0
8088	PROJ/8088/CANCER TISSUE ENGINEERING A 3D	98	0	0	98	0
8089	DO PLATELETS IN PATIENTS -DR.ANUGYABHAT	91537	0	25673	117210	0
8090	INSPIRE FELLOW PHD KEERTHI S JRF	1084	380000	0	381084	0
8091	"BIORESORBABLE NANO BI- DR. H K VARMA "	0	0	0	0	0
8092	BIOLOGICAL STRUCTURES	10914	0	10000	20914	0
8093	DR.HKVARMA-A NEW DRUG-CERAMIC MOD SUPER	1	0	0	1	0
8094	ALTERNATE	25579	0	15775	41354	0
8095	DEV RAPID UTI DR. MAYA - DST	8173	0	0	8173	0
8096	PREP OF HYDROGEL -DR AKHILA RAJAN	134143	0	7220	141364	0
8097	MULTIFUNCN - DBT SUNITHA PREM	939418	0	800	940218	0
8098	HOW ACTIN FILAMENT STRUCTU DR RENU MOH	1129	0	0	1129	0
8099	INSPIRE FELLOW RESHMA S	10749	439880	0	450629	0
8100	DETAILED ...CONDITIONS- ARUN ANIRUDHAN	477521	0	0	477521	0
8102	"ENGINEERING BIOMIMETIC.... NICHE TARA.S"	62483	0	0	62483	0
8103	"CORNEAL REGENERATIVE THERAPY...Dr.ANNIE JOHN"	583709	0	1742	585451	0
8104	"PROJ/8104/CORNEAL REGENERATIVE THERAPY"	0	0	0	0	0
8105	"PROJ/8105/STUDY IN MOLECULAR MECHANISM"	12251	0	0	12251	0



0	0	172452	176560	0	349012	349012	241568
0	0	0	0	0	0	0	37118
0	0	0	0	0	0	0	8295
0	0	1327800	1423282	0	2751082	2751082	1621298
0	0	0	0	0	0	0	40
0	0		71112	0	71112	71112	18627
0	0	0	11494	0	11494	11494	26581
0	0	0	0	0	0	0	98
0	0	0	117210	0	117210	117210	0
0	0	360000	12638	0	372638	372638	8446
0	0	0	0	0	0	0	0
0	0	0	20914	0	20914	20914	0
0	0	0	0	0	0	0	1
0	0	0	40452	0	40452	40452	902
0	0	0	0	0	0	0	8173
0	0	0	141363	0	141363	141363	0
0	0	520161	51879	0	572040	572040	368177
0	0	0	0	0	0	0	1129
0	0	419880	16892	0	436772	436772	13857
0	0	141009	299951	0	440960	440960	36561
0	0	0	8258	0	8258	8258	54225
0	0	25274	36950	0	62224	62224	523227
0	0	0	0	0	0	0	0
0	0	0	0	12250	12250	12250	1



8106	PROJ/8106/MECHANISM OF ANGIOGENESIS	20000	0	0	20000	0
8107	"PROJ/8107/MECHANO-BIOLOGY"	210755	2100000	0	2310755	23701
8108	"PROJ/8108/DEVELOPMENT OF A DENTAL RES..."	44556	0	0	44556	0
8109	PROJ/8109/CHRONIC WOUND HEALING	251496	0	0	251496	0
8110	"PROJ/8110/TO ALLEVIATE COGNITIVE DEFECTS"	538422	0	6894	545316	0
8111	"PROJ/8111/FILAMENT STRUCTURES"	578443	1795273	38657	2412373	0
8112	"PROJ/8112/DEVELOPMENT THYROID COLLAR"	0	0	0	0	0
8113	"PROJ/8113/TREATMENT OF BONE DEFECTS"	139800	0	0	139800	0
8114	"PROJ/8114/NANO PARTICLES WITH CELLS"	79552	426426	0	505978	0
8115	PROJ/8115/TECHNOLOGY RESEARCH CENTRE	190797647	0	57449635	248247282	15770089
8116	"PROJ/8116/PROGRAMME SUPPORT ON TRAN..."	886680	630000	444	1517123	0
8117	"PROJ/8117/GOLD NANOROD BASED TARGETED"	717141	783200	0	1500341	187391
8118	PROJ/8118/THE ROLE OF NMDA	763679	1214000	4482	1982161	2116
8119	PROJ/8119/MESENCHYMAL STEM CELLS	681194	15565	0	696759	400
8122	PROJ/8122/DEV. OF CENTRIFUGAL BLOOD PUMP	3280072	0	256	3280328	645855
8123	PROJ/8123/DEV.OF LEFT VENTRICULAR DEVICE	11750646	800000	11317	12561963	1061692
8124	PROJ/8124/DEV. OF AORTIC STENT GRAFT	8043671	870000	23728	8937399	757634
8125	PROJ/8125/DEV. OF DEEP BRAIN STIMULATOR	11244961	0	1866	11246827	1455922
8126	PROJ/8126/CARDIOVERTER DEFIBRILLATOR	19011918	0	21288	19033206	1393779
8127	PROJ/8127/DEVELOPMENT OF LEUKODEPLETION	1776678	0	874	1777552	0
8128	PROJ/8128/DEPT. OF ANNULOPLASTY./ MITRALVALVECORRECTION	6345200	0	20095	6365295	0
8129	PROJ/8129/DEVPT.OF BIO PROSTHETICHEART VALVE	14339357	0	30374	14369731	7875472
8130	"PROJ/8130/INTER VERTEBRAL SPACER"	681448	0	19200	700648	113730



0	0	0	0	0	0	0	20000
0	23701	1678103	403507	0	2081610	2105311	205444
0	0	0	0	0	0	0	44556
0	0	154839	117217	0	272056	272056	-20560
0	0	173710	209018	0	382728	382728	162588
0	0	1254790	491111	0	1745901	1745901	666472
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	139800
0	0	392826	7498	0	400324	400324	105654
1585255	17355344	2142179	8561733	0	10703912	28059256	220188027
0	0	345600	358790	0	704390	704390	812733
0	187391	328680	743057	0	1071737	1259128	241213
0	2116	296461	221619	0	518080	520196	1461966
0	400	175000	641696	0	816696	817096	-120337
0	645855	688108	616486	50648	1355242	2001097	1279231
0	1061692	1053968	2828354	320406	4202728	5264420	7297543
0	757634	955171	336990	63751	1355912	2113546	6823853
0	1455922	1137627	803929	162784	2104340	3560263	7686565
0	1393779	1233367	199397	177092	1609856	3003635	16029571
0	0	571786	445249	2570	1019605	1019605	757947
0	0	377862	163000	85100	625962	625962	5739333
0	7875472	1762722	485768	36238	2284728	10160200	4209531
0	113730	107817	117338	9546	234701	348431	352217



8131	PROJ/8131/BIOACTIVE MATERIAL PLATFORM	2294857	0	0	2294857	115495
8132	PROJ/8132/DEV. INTRACRANIAL ELECTRODES	971103	0	0	971103	264230
8133	PROJ/8133/OPTICAL PERIPHERAL NERVE	2586973	0	0	2586973	25195
8134	PROJ/8134/HYDROCEPHALUS SHUNT	0	8030000	1110	8031110	0
8135	PROJ/8135/STANDARDIZATION OF ALBUMIN	1980786	0	371216	2352002	15488
8136	PROJ/8136/DEVELOPMENT OF NOVEL WOUND HEALING MATRIX COMPOSED OF HUMAN-FIBRIN	0	1500000	0	1500000	0
8137	PROJ/8137/3D PRNTNG OF SKIN TISSUE CONSTRUCTS FOR IN-VITRO TESTING&APPLICATIONS	0	14020000	0	14020000	312179
8138	PROJ/8138/DEVLPMT OF PLATFORM TECLGY IMPLANTABLE MICRO INFUSION RECHRGNG SYSTEM	0	7374000	643	7374643	0
8139	PROJ/8139/PARYLENE COATING FOR IMPLANTABLE MEDICAL DEVICES& DELIVERY SYSTEM	0	9574000	0	9574000	0
8140	PROJ/8140/REPAIR OF CARTILAGE INJURY	2211033	0	4629	2215662	0
8141	PROJ/8141/3D PRINTING OF LIVER TISSUE	24858439	0	18955	24877394	17873129
8142	PROJ/8142/DEVELOPMENT OF ASSAY PLATFORM	2207421	0	821	2208242	17404
8143	PROJ/8143/POLYMERIC WOUND	892389	250000	0	1142389	0
8144	PROJ/8144/WOUND HEALING MATRIX	1742240	0	20928	1763168	283689
8145	PROJ/8145/LINT FREE ABSORBENT DRESSING	721492	1095000	12018	1828510	0
8147	PROJ/8147/POINT OF CARE DIAGNOSIS	3590142	0	0	3590142	891737
8148	PROJ/8148/ALGINATE SCAFFOLD	111194	1122400	0	1233594	400137
8149	PROJ/8149/EVALUATION OF PLGC	-70443	275360	0	204918	0
8150	PROJ/8150/DEV. OF OCCLUSION DEVICE	1959111	498000	6404	2463515	34998
8151	PROJ/8151/DEV.EMBOLIZATION DEVICE	1288975	100000	1772	1390747	0
8152	PROJ/8152/DEVELOPMENT OF TITANIUM NITRATE COATED CORONARY STENT	0	5375000	0	5375000	0
8153	PROJ/8153/CHARACTERISATION OF BACILLUS SPECIES-(MRSA)	3736238	5030000	2289	8768527	2173186



0	115495	350362	438278	15707	804347	919841	1375016
0	264230	149400	325832	0	475232	739462	231641
0	25195	436697	196421	7300	640418	665614	1921359
0	0	282885	29114	100	312099	312099	7719011
0	15488	0	1385049	122547	1507596	1523084	828919
0	0	0	934508	5017	939525	939525	560475
0	312179	254218	467755	1770	723743	1035922	12984078
0	0	293820	124740	450	419010	419010	6955633
0	0	233400	0	3300	236700	236700	9337300
0	0	447279	587612	90982	1125873	1125873	1089789
0	17873129	450775	1958918	323619	2733312	20606441	4270953
0	17404	589884	651105	6885	1247874	1265278	942964
0	0	253411	42193	0	295604	295604	846785
0	283689	286064	1050632	69562	1406258	1689947	73221
0	0	71845	121143	8540	201528	201528	1626982
0	891737	386748	267837	1880	656465	1548202	2041941
0	400137	248283	45416	65488	359187	759324	474270
0	0	0	145396	55860	201256	201256	3662
0	34998	583200	291367	17738	892305	927303	1536212
0	0	405093	300308	32881	738282	738282	652465
0	0	0	0	0	0	0	5375000
0	2173186	208773	477925	39182	725880	2899066	5869461



8154	PROJ/8154/DEPT.OF BIOMATERIAL SCIENCE & TECHNOLOGY	1307296	190000	16967	1514263	97283
8155	PROJ/8155/DEVPT.OF FLOW DIVERTERTREATMENT OF ANEURYSMS	7166547	680500	2187	7849234	476899
8156	PROJ/8156/RADIOPAQUE POLYMERIC MICROSPHERES OF EMBOLIZATION THERAPY	0	3452000	10137	3462137	0
8157	PROJ/8157/DEVLPMNT OF PLRS&HIGH STAKE DECISION MKNG FROM CONCEPT PDT	0	2660000	0	2660000	1260000
8158	PROJ/8158/PRIMER TECHNOLOGY TNFR TECHNICAL, MKT, FINANCIAL, CL, REGULATORY INPUTS	0	1448000	0	1448000	44388
8159	PROJ/8159/ITI INFRASTRUCTURE UPGRADATION PLAN	6410000	0	0	6410000	1861550
8160	PROJ/8160/TOXICOLOGICAL EVALUATION	4830984	2650000	46570	7527554	0
8161	PROJ/8161/LARGE ANIMAL EVALUATION	6238299	2868000	17005	9123304	0
8162	PROJ/8162/BLOOD COMPATIBILITY	2104264	200000	0	2304264	36435
8163	PROJ/8163/CYTOCOMPATIBILITY	1053557	902000	0	1955557	0
8164	PROJ/8164/HISTOPATHOLOGICAL EVALUATION	2558315	300000	0	2858315	0
8165	PROJ/8165/MICROBIOLOGICAL EVALUATION	1080523	100000	0	1180523	0
8166	PROJ/8166/ANALYTICAL CHARACTERISATION	1321524	680400	19200	2021124	0
8167	PROJ/8167/DESIGN & PROTOTYPING	2935968	1794000	3343	4733311	83100
8168	PROJ/8168/DEVPT OF EQPT FOR PCKG VALIDATION	3906367	0	15145	3921512	346936
8169	PROJ/8169/PREPARATION STD FOR BIOLOGICAL EVALUATION	2949147	0	0	2949147	0
8170	PROJ/8170/ORTHOAEDIC IMPLANTS	363192	0	0	363192	0
8171	PROJ/8171/ENTERIC COATING	176990	0	0	176990	0
8172	PROJ/8172/BIOACTIVE BONE CEMENT	193395	504807	385	698587	0
8173	PROJ/8173/BLOOD BRAIN BARRIER	310679	0	0	310679	0
8174	PROJ/8174/SCAFFOLDS BASED ON SELF-ASSE..	125078	970000	0	1095078	0
8175	PROJ/8175/MUSTER- MUSCULOSKELETAL STEM..	5407074	0	165449	5572523	846567
8176	PROJ/8176/MUSTER- MUSCULOSKELETAL STEM..	2963999	0	0	2963999	0



0	97283	187050	290980	83614	561644	658927	855336
0	476899	728286	309853	786410	1824549	2301447	5547786
0	0	226065	36699	15200	277964	277964	3184173
0	1260000	142000	0	0	142000	1402000	1258000
0	44388	184000	4722	47808	236530	280918	1167082
0	1861550	201000	0	735	201735	2063285	4346715
0	0	629071	350860	0	979931	979931	6547624
0	0	684995	414935	116231	1216161	1216161	7907143
0	36435	168921	222233	5320	396474	432909	1871354
0	0	0	263806	2360	266166	266166	1689391
0	0	180580	564511	2935	748026	748026	2110289
0	0	253200	335601	0	588801	588801	591722
0	0	61936	240000	20000	321936	321936	1699188
0	83100	765439	1733364	99527	2598330	2681430	2051882
0	346936	520930	515745	100	1036775	1383711	2537801
0	0	412826	284451	5566	702843	702843	2246304
0	0	0	279419	48000	327419	327419	35773
0	0	1400	0	0	1400	1400	175590
0	0	272734	382892	0	655626	655626	42961
0	0	0	228477	0	228477	228477	82202
0	0	360000	374126	0	734126	734126	360952
0	846567	918600	2275923	0	3194523	4041090	1531434
0	0	273207	856166	0	1129373	1129373	1834626



8177	PROJ/8177/RADIOPAQUE LIQUID	10620	471252	0	481872	0
8178	PROJ/8178/ANTI SNAKE VENOM (IGY)	10552879	3300000	1165	13854044	7500000
8179	PROJ/8179/DEVELOPMENT OF NOVEL PROTOTYPE	1094728	0	0	1094728	0
8180	PROJ/8180/TO MODEL THE EFFECT OF MUTA...	351838	193000	0	544838	62706
8181	PROJ/8181/VOICE PROSTHESIS	346300	0	0	346300	140118
8182	PROJ/8182/A TISSUE ENGINEERED SKIN SU.	775161	0	0	775161	0
8183	PROJ/8183/CARDIAC MESENCHYMAL CELLS	0	2110000	66815	2176815	0
8184	PROJ/8184/FABRICATION OF A HEAD PHANTOM	0	125000	578	125578	0
8185	PROJ/8185/BLOOD BRAIN BARRIER	0	5498400	0	5498400	0
8186	PROJ/8186/3D PRINTED CELL	0	351000	0	351000	0
8187	PROJ/8187/DEVELOPMENT OF HUMAN-ON-A-CHIP	0	23820780	0	23820780	0
8188	PROJ/8188/EXPERT ADVISORY GROUP	0	800000	0	800000	0
	TOTAL	422587558	126029398	136237586	684854542	64694876
	INTERNAL PROJECTS					
6215	PROJ/6215/PROTOTYPE SAFETYSYSTEM	0	0	299335	299335	0
6216	PROJ/6216/EFFICACY OF HUMAN PROTEINS	0	0	359566	359566	0
6217	PROJ/6217/BIOINKS FOR 3D BIO PRINTING	0	0	318033	318033	0
6218	PROJ/6218/DESIGN OF MEMBRANE OXYGEN-ATOR.	0	0	303954	303954	0
6219	PROJ/6219/A METHOD OF CELL SEEDING	0	0	327993	327993	0
6220	PROJ/6220/ETHYLENE OXIDE (EIO)	0	0	250080	250080	0
6221	PROJ/6221/CIRCULATING TUMOR CELLS	0	0	148047	148047	0
6222	PROJ/6222/MULTIMODALITY SIMULATOR	0	0	126000	126000	0
6223	PROJ/6223/DEVELOPMENT OF A DURAL SUB.	0	0	167378	167378	0
6225	PROJ/6225/POST SURGICAL ADHESIONS	0	0	26057	26057	0
6226	PROJ/6226/SKULL BASE BUTTRESS DEVICE	0	0	24000	24000	0
6227	PROJ/6227/EMERGENCY BANDAGE	0	0	103164	103164	0



0	0	421333	49915	0	471248	471248	10624
0	7500000	2032664	3975464	0	6008128	13508128	345916
0	0	288000	98362	0	386362	386362	708366
0	62706	360000	89298	0	449298	512004	32834
0	140118	0	79485	0	79485	219603	126697
0	0	493167	197467	0	690634	690634	84527
0	0	1057583	599987	0	1657570	1657570	519245
0	0	0	101946	0	101946	101946	23632
0	0	110516	100000	44300	254816	254816	5243584
0	0	181440	13752	0	195192	195192	155808
0	0	0	201300	0	201300	201300	23619480
0	0	0	0	0	0	0	800000
1585255	66280131	38227447	48520163	72224482	158972092	225252223	459602319
0	0	280072	19263	0	299335	299335	0
0	0	192000	167566	0	359566	359566	0
0	0	153600	164433	0	318033	318033	0
0	0	240000	63954	0	303954	303954	0
0	0	165988	162005	0	327993	327993	0
0	0	171562	78518	0	250080	250080	0
0	0	135040	13007	0	148047	148047	0
0	0	126000	0	0	126000	126000	0
0	0	158400	8978	0	167378	167378	0
0	0	26057	0	0	26057	26057	0
0	0	24000	0	0	24000	24000	0
0	0	53264	49900	0	103164	103164	0



6228	PROJ/6228/CEREBRAL MICRODIALYSIS DEVICE	0	0	20586	20586	0
6229	PROJ/6229/REVERSE SUCTION DEVICE	0	0	7548	7548	0
6301	PROJ/6301/KNITTED POLYESTER	0	0	5100	5100	0
6500	OHF PROJECT - DR.ANNIE JOHN	1397	0	0	1397	0
6501	OHF PROJ. - DR. KALADHAR KAMALASANAN	160000	0	0	160000	0
6502	OHF PROJECT DR SACHIN J SHENOY	180000	0	0	180000	0
6504	DEVELOPMENT OF IRON NANO PRACTICLE	6918	0	0	6918	0
6505	REM SLEEP RESTRICTION	16694	0	0	16694	0
2622	OHF- FOR INNOVATIVE PROJECTS	1460000	0	0	1460000	0
2621	IIPC FUND(INDUSTRY INSTITUTE PARTNERSHIP - BMT	260769	0	0	260769	0
	Total of internal projects BMT (C2)	2085778	0	2486842	4572620	0
C	Total of external & internal projects BMT (C1+C2)	424673335	126029398	138724428	689427161	64694876
D	GRAND TOTAL (Hospital projects+other funds+BMT projects)	714266971	284294599	759020448	1757582018	94030783



0	0	0	20586	0	20586	20586	0
0	0	7548	0	0	7548	7548	0
0	0	0	5100	0	5100	5100	0
0	0	0	0	0	0	0	1397
0	0	0	0	0	0	0	160000
0	0	0	0	0	0	0	180000
0	0	0	0	0	0	0	6918
0	0	0	0	0	0	0	16694
0	0	0	0	0	0	0	1460000
0	0	0	0	0	0	0	260769
0	0	1733531	753311	0	2486842	2486842	2085778
1585255	66280131	39960978	49273474	72224482	161458934	227739065	461688097
1585255	95616038	75200964	54433608	666409322	796043894	891659933	865922085



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 4-SECURED LOANS AND BORROWINGS:		2018-2019	2017-2018
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		2018-2019	2017-2018
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:		2018-2019	2017-2018
a) Acceptances secured by hypothecation of capital equipment and other assets		--	--
b) Others			
TOTAL		--	--
SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS		2018-2019	2017-2018
1. Acceptances			
2. Sundry Creditors:			

Sd/-
Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

	a) For Goods	184711375	154350237
	b) Others	0	0
	3. Advances Received	49827131	93105998
	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	7211579	4248352
	6. Other current Liabilities	443116146	273624362
	TOTAL(A)	684866231	525328949
	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	225000	400000
	Emergency Reserve Fund contribution	0	0
	Technology Development Fund contribution	4212341	3017663
	TOTAL(B)	4437341	3417663
	TOTAL(A+B)	689303572	528746612

Sd/-
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 (01.04.2018)	Additions during the year 2018-19	Deductions during the year 2018-19
A. FIXED ASSETS:			
1. LAND:			
a) Freehold	16894606	0	0
b) Leasehold			
2. BUILDINGS:			
a) On Freehold Land *	47391608	236000	0
b) On Leasehold Land			
c) Ownership Flats/Premises			
d) Superstructures on Land not belonging to the entity	477182357	0	
3. PLANT MACHINERY & EQUIPMENT	2885383625	135923497	41252170
4. Equipment - From Non Monetary grants	1	1	0
4. VEHICLES	8546800	0	
5. FURNITURE, FIXTURES	80985285	4579194	148336
6. OFFICE EQUIPMENT	1236622	0	0
7. COMPUTER/PERIPHERALS	9873840	0	741094
8. ELECTRIC INSTALLATIONS	173017347	238850	166250
9. LIBRARY BOOKS	203573254	2770403	0
10. TUBEWELLS & W.SUPPLY	301965	0	
11. OXYGEN CYLINDERS/GAS PLANT INSTALLATIONS	1441671	557291	
12) KITCHEN/CANTEEN EQUIPMENTS	2523506	573251	70990
13) PAINTINGS	450216	0	
14) SURGICAL EQUIPMENTS	7136375	0	1910352
Total for the year (Total -A)	3915939077	144878487	44289192
Total for the previous year	3799421513	131367631	14850068
Capital Work in Progress (B)	26598791	121301072	0
Total for the year (A+B)	3942537868	266179559	44289192
* Depreciation for item2(a) has been provided along with depreciation on 2(d)			

Sd/-
Financial Adviser

Sd/-
Director



SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

Cost/valuation at the year end (31.03.2019)	DEPRECIATION				NET BLOCK	
	Depreciation as at the beginning of the year (01.04.2018)	Depr on items written off	During the year 2018-19	Total up to the year end (31.03.2019)	As at the end of current year end (31.03.2019)	As at the previous year end (31.03.2018)
16894606	0	0	0	0	16894606	16894606
47627608	0		0	0		
477182357	291304433	0	23350553	314654986	210154979	233269532
2980054953	2108755937	37286219	99001566	2207757503	772297450	776627688
2	1	0	0	2	1	1
8546800	6879795		250051	7129845	1416954	1667005
85416143	44183657	100311	4032969	48216626	37199517	36801628
1236622	1045468		19115	1064583	172039	191154
9132746	8488627	739327	-185949	8302679	830067	1385213
173089947	97733294	81340	7462459	105195753	67894194	75284053
206343657	196272965	0	4028276	200301242	6042415	7300288
301965	218626		8334	226960	75005	83339
1998962	1425240		229489	1654729	344233	16431
3025767	1445536	50489	112583	1558119	1467648	1077969
450216	403124		4709	407833	42382	47092
5226023	6952740	1905385	-1833918	5118822	107201	183635
4016528372	2765109443	40163071	136480238	2901589682	1114938690	1150829634
3915939077	2589269828	13210136	175839614	2765109443	1150829634	1210151684
147899863	0	0	0	0	147899863	0
4164428235	2765109443	40163071	136480238	2901589682	1262838553	1150829634

Sd/-
Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		2018-2019	2017-2018
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	113694398	110141620
	Project funds	640684700	591177821
	TOTAL	816074767	763015110
SCHEDULE 10-INVESTMENTS-OTHERS		2018-2019	2017-2018
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	85362852	79938803
6. Others (to be specified)		--	--
	TOTAL	235362852	229938803
SCHEDULE 11-CURRENT ASSETS, LOANS, ADVANCES ETC		2018-2019	2017-2018
A. CURRENT ASSETS			
1. Inventories:			
	a) Stores and Spares	0	0
	b) Instruments & Loose Tools	0	0
	c) Stock-in trade		
	Store items	70572487	75696488
	Stamps	20377	5185
	Medicine	35285480	20143301
2. Sundry Debtors:			
	a) Debts Outstanding for a period exceeding six months	56994684	30810182
	b) Others	336505661	380674423



2.1 Income tax deducted at source	20986034	18267526
3. Cash balances in hand(including cheques/ drafts and imprest)	1260430	2409722
4. Bank Balances:		
a) With Scheduled Banks:		
-On Current Account	1	1
-On Deposit Accounts(L.C. margin & Commitment deposit)	1031284284	1314267337
-On Savings Accounts	303543008	176597483
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)	1856452446	2018871648
B. LOANS, ADVANCES AND OTHER ASSETS		
1. Loans:		
a) Staff	5588266	6941628
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	703118845	328123883
b) Prepayments		
c) Others	46866583	19462791
3. Income Accrued:	0	0
a) On Investments from Earmarked/ endowment Funds	22529865	28813856
b) On Investments-Others	0	0
c) On Loans and Advances	0	0
d) Others (Royalty)	1291232	2597830
(includes income due unrealised)	0	0
4. Claims Receivable	0	0
From Govt of India on Grant in aid (7th CPC arrears)	417214247	212614247
TOTAL(B)	1196609038	598554234
TOTAL(A+B)	3053061484	2617425882
Savings bank account includes Rs.15/- (GL code No.2410-Synd Bank vikas certificate)		



SCHEDULE 12- INCOME FROM SALES/SERVICES		2018-2019	2017-2018
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		1187453016	1131128019
		0	0
From Projects		7369058	4997569
Testing & Facility charges received		3874913	3698995
TOTAL		1198696987	1139824582
SCHEDULE 13- GRANTS/SUBSIDIES		2018-2019	2017-2018
(Irrevocable Grants & Subsidies Received)			
1. Central Government - Plan		1344142000	1056136000
- Non Plan		0	0
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		1344142000	1056136000
SCHEDULE 14-FEES/SUBSCRIPTIONS		2018-2019	2017-2018
1. Entrance Fees		1680255	609900
2. Annual Fees/ Subscriptions		12309981	10624375
3. Seminar/Program Fees		0	0
4. Consultancy Fees		0	0
5. Examination Fees and others		1781350	1932000
TOTAL		15771586	13166275
SCHEDULE 15- INCOME FROM INVESTMENTS		2018-2019	2017-2018
(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)1. Interest on Sinking Fund	2465497	20145398
	Sinking Fund 2. Withdrawal from	0	0
	Technology Fund 3. Interest on	4210637	2119201
	TOTAL	6676134	22264599
SCHEDULE 16- INCOME FROM ROYALTY,PUBLICATION ETC		2018-2019	2017-2018
	1) Income from Royalty	2905743	4119692
	2) Income from Publications	0	0
	3)Others(Specify)	0	0
	TOTAL	2905743	4119692
SCHEDULE 17- INTEREST EARNED		2018-2019	2017-2018
	1) On Term Deposit		
	a) With Scheduled Banks	33270859	41203928
	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	8276833	11530374
	b) With non-scheduled banks	0	0
	c) Post Office Savings Account	0	0
	d) Others(accrued)	16650590	15490831
	3) On Loans	0	0
	a) Employees/Staff	764106	1908989
	b) Others	0	0
	4) Interest on Debtors and other Receivables		
	TOTAL	58962388	70134122
SCHEDULE 18- OTHER INCOME		2018-2019	2017-2018
	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	2200725	1625576
	3. Fees for Miscellaneous Services	0	0
	4. Miscellaneous Income Rent	87000	370000
	Other Income (including grant receivable from DST for 7th CPC	212295889	225909340
	Prior period income	203675	0
	TOTAL	214787289	227904916
SCHEDULE 20-ESTABLISHMENT EXPENSES		2018-2019	2017-2018
	a) Salaries and Wages	1344109453	1042827957
	b) Allowances and Bonus	15539689	8643984
	c) Contribution to Provident Fund	0	0
	d) Contribution to other fund(specify)	0	0
	e) Staff Welfare Expenses	23598741	19349705
	f) Expenses on Employee's Retirement and Terminal Benefits	433086637	269009891
	g) Others(Specify) PG Training & Academic payments	246983377	205588944
	TOTAL	2063317897	1545420481
SCHEDULES 21- ADMINISTRATIVE EXPENSES		2018-2019	2017-2018
	a) Purchases	706574427	591606818
	b) Concession to Poor patients/Labour and processing expenses	31222254	63198023
	c) Cartage and Carriage Inwards	232784	215468
	d) Electricity and power	58321750	52579128
	e) Water charges	1804222	3368031
	f) Insurance	1109729	244370
	g) Repairs and maintenance	82503011	62124599
	h) Excise duty	0	0
	i) Rent,Rates and Taxes	2110568	390143
	j) Vehicles Running and Maintenance	1143962	899482
	k) Postage,Telephone and Communication Charges	2401037	2452794
	l) Printing and Stationary	20179	80189
	m) Travelling and Conveyence Expenses	3830496	3699388
	n) Expenses on Seminar/Workshop	1680810	1224982
	o) Subscription Expenses	0	85580
	p) Expenses on Fees	0	0
	q) Auditors Renumeration	225000	564012
	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	6141549	9113506
	y) Distribution Expenses	0	0
	z) Advertisement and Publicity	5011757	3968101
	z1) Others(specify)	42773841	88736245
	TOTAL	947107375	884550859
SCHEDULE 23-INTEREST		2018-2019	2017-2018
	a) On Fixed Loans		
	b) Bank Charges)	1115084	120872
	c) Others(specify)	0	0
	TOTAL	1115084	120872

Sd/-
Chief Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE TO RECEIPTS & PAYMENTS ACCOUNTS FOR THE PERIOD FROM 01-04-2018 TO 31-03-2019

RECEIPTS	2018-2019	2017-2018	Payments	2018-2019	2017-2018
	Rs.	Rs.		Rs.	Rs.
I Opening Balances			I Expenses		
a) Cash In Hand	2409722	1156161			
b) Bank Balances			a) Establishment expenses	2510617946	1699996719
I) In Current Account	1	1	b) Administrative Expenses		
ii) In deposit Account			For Purchases	24018449	24374224
iii) Savings Account *	180741358	444797744	Other expenses	87132531	125814314
			Payments made against funds for various		
II Grant Received			Projects		
From Government of India			As Per schedule	204772670	103312385
Under Object head - Creation of Capital assets	623349000	994146000			
Under Object Head - Salary/General scheme	1344142000	1056136000	III Investments & Deposits made		
			a) Out of Earmarked funds	102590354	84101461
			b) Out of own funds		
III Receipts against Earmarked Funds					
			IV Expenditure on Fixed Assets & Capital work		
a) Earmarked funds	301474476	26966393	-in- progress		
b) Own funds					
			a) Purchase of Fixed Assets	39425650	24073916
IV Interest Received			b) Capital work in-progress		
a) On Bank deposits	61157576	35603837	V Refund of Loans		



	b) Loans Advances etc	281087	335100				
	c) On NCMMR funds	156624	141427				
V	Receipts from services			VI	Finance Charges(Bank charges)	1098669	107490
	Receipts from Patient services	1127956441	864819787				
	Other receipts including Royalty	30188255	23045766	VII	Other Payments		
					To Funds/ Deposit- refunds	1701725374	1843884254
VI	Other receipts			VIII	Closing Balance		
	Grant received for Projects	140840420	170612001		a) Cash in hand	1260430	2409722
	Refund of Deposits(LC Margin)				b) Bank Balances		
	Other receipts	1167814620	471055627		i) In current Account	1	1
					iii) Savings Account *	307869507	180741358
	Total	4980511580	4088815843		Total	4980511580	4088815843

*Closing balance of Bank include grant amount received from DST for setting up of NCMMR, Thiruvananthapuram

Sd/-
Financial Adviser

Sd/-
Director



**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

Provident Fund Account For The Year Ended 31-03-2019

Particulars	2018-2019	2017-2018
	[Rupees]	[Rupees]
LIABILITIES		
MEMBERS BALANCE	163725290	216470304
MEMBERS CREDITS [for march]	5181856	3532121
BALANCE DUE TO MEMBERS NOT IN SERVICE		
Under EPF scheme	7696198	7696198
,, GPF ,,	532055	532055
PENSION FUND DUES	0	0
RESERVES&SURPLUS-INTEREST	182483217	154637651
TOTAL	359618616	382868329
ASSETS		
INVESTMENT AT COST	324890331	345078659
DUES TO PF ACCOUNT		
FROM INSTITUTE	5181856	3532121
FROM PF COMMISSIONER	0	8403467
INTEREST ACCRUED NOT DUE	23903639	13696323
BALANCE WITH BANKS		
SBT -GPF A/C	5642790	12157759
TOTAL	359618616	382868329

Sd/-
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 01.04.2018 -31.03.2019

	2018-2019	2017-2018		2018-2019	2017-2018
Receipts	Rs.	Rs.	Payments	Rs.	Rs.
Opening Balance - Bank	4169875	4028448	Audit Fees	0	17250
Grant in aid	0	0	Bank Charges	0	6
Interest earned	156624	158683	Closing Balance - Bank	4326499	4169875
	4326499	4187131		4326499	4187131

**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH

Income & Expenditure Account for the period 01.04.2018-31.03.2019

	2018-19	2017-18		2018-19	2017-18
Expenses	Rs.	Rs.	Income	Rs.	Rs.
Audit Fees	0	17250	Interest	156624	158683
Bank charges	0	6			
Excess of Income over expenditure	156624	139368	Excess of Expenditure over income	0	
	156624	156624		156624	158683

**SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY,
THIRUVANANTHAPURAM**

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH - BALANCE SHEET AS ON 31-03-2019

Particulars	2018-2019	2017-2018
	[Rs]	[Rs]
LIABILITIES		
CAPITAL FUND		
Opening Balance	4169875	4028448
Add: Grant received	0	
Add/Less (-): Excess of Income over Expenditure	156624	158683
TOTAL	4326499	4187131
ASSETS		
BANK BALANCE	4326499	4187131
(Union Bank of India Account No.541502010002675)		
TOTAL	4326499	4187131

Sd/-
Financial Adviser

Sd/-
Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF ACCOUNTS AS AT 31-03-2019

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.

Sd/-

Financial Adviser

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. OVERHEAD 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/-

Director



SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 25-CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES

	Rs. In lakhs	
	2018-19	2017-18
Claims against the Institute not acknowledged as debts	NIL	NIL
Bank Guarantee given by Institute	57.80	45.04
Letters of credit opened on behalf of Institute	1058.90	550.82
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).” During the year 2018-19, Institute received Order-In-Appeal dated 19.09.2018 issued by Commissioner (Appeals) rejecting the appeal filed by the Institute. Institute filed appeal before CESTAT, Bangalore against the above and remitted Rs.0.44 lakh as deposit under section 35F of CE Act

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	4.72	01/04/2009 to 31/03/2012	CESTAT, Bangalore.

2. UNEXPIRED CAPITAL COMMITMENTS

	Rs. in lakh	
	2018-19	2017-18
Estimated value of orders remaining to be executed on Capital Account	176.08	73.37

Construction of new Hospital block	9993.99	15493.91
Completion of Combination Devices Block	2917.00	0.00

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.11000 lakh from DST and Rs.2006.09 lakh from Ministry of Health & Family Welfare.

Administrative approval and expenditure sanction was accorded for the completion of Combinational Devices Block (Originally called as Biology Block) at BMT wing vide letter dated 21.05.2018. The work is being has awarded to CPWD.

Lease obligation for rentals for Plant & Machinery	NIL	NIL
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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	
	2018-19	2017-18
5.1 Value of Imports Capital Goods Stores Spare & Consumables	2023.77	2112.89
5.2 Expenditure in foreign currency Travel Expenses	NIL	NIL
5.3 Earnings: Value of Exports	NIL	NIL



6. Current year Income, net of expenditure, under Institute Ethics Committee has been treated as income of the Institute amounting to Rs.60.85 lakh (previous year Rs.30.62 lakh).
7. Claim for Audit fees by C&AG amounting to Rs.1.65 lakh has been paid during the year. Provision for Audit fees has been made for current year amounting to Rs.2.25 lakh.
8. Accrued Interest on Investment amounting Rs.225.30 lakh (previous year Rs. 278.98 lakh) has been provided in the current year accounts.
9. As pointed out by C&AG, unutilized portion of Grant in Aid(ST General) is shown as current liability.
10. In order to release the pension dues as per the CCS pension rules, an additional amount of Rs.3144.66 lakh has been expended over and above the sanctioned 12% Institute contribution (amounting to Rs.1451.11 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. 4180.49 lakh
Present value of the pensionary liability for serving employees	Rs.12462.54 lakh
Present value of the pensionary liability for Existing pensioners	Rs.19341.45 lakh
Present value of the past service leave encashment	Rs. 4774.85 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
FY 2018-19	Rs. 940.31 lakh

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.50.10 lakh (previous year Rs.66.90 lakh) was transferred to Technology Development Fund. During the year Rs.24.38 lakh has been spent from Technology Development Fund.(Previous year Rs.15.59 lakhs)

14. Overhead Fund Scheme

During the year an amount of Rs. NIL (previous year Rs.NIL) has been transferred 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.2.28 lakh (Previous year Rs.48.37 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 academic staff and pensioners of the Institute with effect from 01.01.2016 vide letter No.AI/1/31/SCTIMST/2017 dated 18th June, 2018. DST agreed to bear 70% of the likely expenditure on implementation of 7th CPC and remaining 30% to be borne by the Institute from its internal resources. The financial commitment (70%) on this account comes to Rs.2046.00 lakh for the period January 2016 to August 2018 and has been fully provided for in the accounts during the year 2018-19 under Establishment Expenses (Schedule 20). Based on the assurance given by DST vide letter dated 18.06.2018 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 31-03-2019, and Income & Expenditure Account for the year ended on that date.

Sd/-
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 2019

1. We have audited the Balance Sheet of the Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram as at 31 March 2019, 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.68.93 crore

The actuarial valuation of the year 2018-19 (Paragraph 11 of Schedule 25) and the liability towards gratuity, pension and accumulated leave encashment were Rs. 41.80 crore, Rs. 318.04 crore and Rs. 47.75 crore respectively.

Against the liability of Rs. 407.59 crore as on 31 March 2019 Institute has created Pension Fund amounting to Rs. 16.11 crore only. This has resulted in understatement of Schedule-7: Current Liabilities and Provisions by Rs. 391.48 crore and understatement of expenses account (Schedule-20: Establishment Expenses).

A.2 SCTIMST did not make provisions of Rs. 81.23 lakh in the account towards the payment of NPS contribution, electricity charges, etc. pertaining to the year 2018-19. Thus, the Institute understated its expenditure as well as current liabilities each by Rs.81.23 lakh since institute did not account the liability towards NPS and Electricity charges on accrual basis.



A.3 Fixed Assets (Schedule 8) Rs.126.28 crore

SCTIMST accounted the computers, software and printers under the head 'Equipment' and provided depreciation at the rate of 15 per cent instead of the head 'Computer and peripherals' at the rate of 40 per cent. Similarly, the purchase of Air Conditioners is accounted under the head 'Equipment' in lieu of 'Furniture and Fixtures' and provided depreciation at the rate of 15 per cent against 10 per cent. Thus, Computer/Peripherals, Furniture, Fixtures under Schedule-8: Fixed Assets overstated by Rs. 3.39 lakh (Rs.3.48- Rs. 0.09) and depreciation understated to the same extent.

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.

- 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 2019; and
- b. In so far as it relates to Income & Expenditure Account of the deficit for the year ended on that date.

Sd/-

(B) Income and Expenditure Account

Interest Earned (Schedule 17) Rs. 5.89 crore

B.1 As per sanction order towards construction of 'New Hospital Block' the interest earned shall be adjusted against future release of grant. Institute however, credited the interest as their income. Thus, the income of the institute (Schedule-17: Interest Earned) was overstated by Rs. 1.74 crore and Schedule-7: Current Liabilities and Provisions understated to the same extent.

1 NPS Contribution Rs.44.09 lakh and Electricity charges Rs.37.14 lakh

Director General of Audit
(Scientific Departments)

(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,



REPLY TO SEPARATE AUDIT REPORT OF THE COMPTROLLER & AUDITOR GENERAL OF INDIA ON THE ACCOUNTS OF SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY (SCTIMST), THIRUVANANTHAPURAM FOR THE YEAR ENDED 31 MARCH 2019.

Audit Para No. & date	Audit Para	Reply of the Institute
A. Balance Sheet: A.1 Current Liabilities and Provisions (Schedule-7) Rs.68.93 Crore	<p>The actuarial valuation for the year 2018-19 (Paragraph 11 of Schedule 25) and the liability towards gratuity, pension and accumulated leave encashment were Rs.41.80 crore, Rs.318.04 crore and Rs.47.75 crore respectively.</p> <p>Against the liability of Rs.407.59 crore as on 31 March 2019 Institute has created Pension Fund amounting to Rs.16.11 crore only. This has resulted in understatement of Schedule-7: Current Liabilities and Provisions by Rs.391.48 crore and understatement of expenses account (Schedule-20: Establishment Expenses).</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 after considering the financial position of the Institute, 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.</p>
A.2	<p>SCTIMST did not make provision of Rs.81.23 lakh in the account towards the payment of NPS contribution, electricity charges etc. pertaining to the year 2018-19. Thus, the Institute understated its expenditure as well as current liabilities each by Rs.81.23 lakh since institute did not account the liability towards NPS and Electricity charges on accrual basis.</p>	<p>Since 12 months Employer's contribution on account of NPS and 12 months electricity charges have been debited in the accounts there is no understatement of expenditure as well as liability.</p>



<p>A.3 Fixed Assets (Schedule 8) Rs.126.28 crore</p>	<p>SCTIMST accounted the computers, software and printers under the head 'Equipment' and provided depreciation at the rate 15 per cent instead of the head 'Computer and peripherals' at the rate of 40 per cent. Similarly, the purchase of Air Conditioners is accounted under the head 'Equipment' in lieu of 'Furniture and Fixtures' and provided depreciation at the rate of 15 percent against 10 percent. Thus, Computer/ Peripherals, Furniture, Fixtures under Schedule-8: Fixed Assets overstated by Rs.3.39 lakh (Rs.3.48 - Rs.0.09) and depreciation understated to the same extent.</p>	<p>The understatement as well as overstatement of fixed assets due to misclassification of assets is negligible i.e. Rs. Rs.3.20 lakh, (ie. 0.23 % of the total depreciation charges for 2018-19) based on the materiality concept.</p>
<p>(B) Income and expenditure Account B.1 Interest earned (Schedule 17) Rs.5.89 crore</p>	<ul style="list-style-type: none"> As per sanction order towards construction of 'New Hospital Block' the interest earned shall be adjusted against future release of grant. Institute however, credited the interest as their income. Thus, the income of the institute (Schedule-17: Interest Earned) was overstated by Rs.1.74 crore and Schedule-7: Current Liabilities and Provisions understated to the same extent. 	<p>The interest earned on the fixed deposit opened out of funds received for New Hospital Block has been rightly accounted as liability and is part of Schedule 7 of the Balance Sheet. Therefore there is no overstatement.</p>
<p>(C) Management letter</p>	<p>Deficiencies which have not been included in the Draft Separate Audit Report have been brought to the notice of Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram through a Draft Management letter issued separately for remedial/corrective action.</p>	<p>The observations mentioned in the Management letter have been noted for future guidance as well as remedial/corrective action.</p>