SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

TRIVANDRUM - 695 011, KERALA

ANNUAL REPORT

2016-17

Annual Report 2016-17

Sree Chitra Tirunal Institute for Medical Sciences and Technology
Trivandrum

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History

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

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

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

Our Mission

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

Our Vision

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

MESSAGE FROM THE PRESIDENT

In the history of an organization, a year is arguably too short a window of time to actualize an ambitious dream or aspire for an impressive inventory of achievements. Nevertheless, in its tenacious forward trajectory during the past year, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum stayed admirably entrenched in its mandate and surged ahead in the chosen domains of high quality patient care in select specialties, medical device development and health sciences. Even as ongoing programs progressed unhindered, several new ventures were flagged off during the year, seamlessly connecting the different strands of Clinical Medicine, Biomedical Technology and Public Health to produce a unique continuum of indisputable relevance to society.

On the health front, the Institute did remarkably well during the year in key areas such as Epilepsy, Movement Disorders, Stroke, Pediatric Neurology, Neurosurgery, Interventional Cardiology, Pediatric Cardiac Surgery, Cardiac Imaging and Interventional Radiology. The unstinted support of the Department of Science and Technology and the Ministry of Health and Family Welfare, Government of India, through the Pradhan Mantri Swasthya Suraksha Yojana brought the dire need for a new Medical Block from the realm of aspiration to the realm of reality. Needless to say, the munificent gift to the Institute would provide succour to the sick.

Research in Neurology, Cardiology, Molecular Cardiology, Tissue Engineering, Polymers for Clinical Application and Nanotechnology never lagged behind, and there was a significant upswing in the number of publications. The Achutha Menon Centre for Health Science Studies continued its engagement with teaching as well as research in the areas of Non-Communicable diseases, Health Policy and Health Management, attracting research grants from major national and international agencies. As in the past, the Institute was a coveted destination for large numbers of students desiring admission to various academic programs.

Importantly, in keeping with its mandate, the Institute continued to fuel innovation in order to create what is affordable to the sick and the less privileged. The committed faculty took these ideas to the market, moving from 'Vision' to 'Development' and bridging the gap between precept and practice in the vital realm of healthcare. The Silver Jubilee of the clinical use of the TTK-Chitra heart valve, the transfer of technologies for new biomedical products, including the second generation heart valve and vascular graft, the formal launch of the Technology Research Centre for Biomedical Devices and flagging off of many new projects were momentous events of the past year. They spoke of an incredible journey through time, a journey of innovation that commenced in the seventies and flourished through the toughest of challenges. Alongside the inexorable passage of time, the journey continues, gaining in strength and substance.

While all of this is impressive by any reckoning, there is a need to note that there are strong winds of change blowing across the world, and across our country as well. Our continued success in the years to come would depend on how well we adjust to these changes. As someone insightfully remarked: "Change has a bad reputation in our society, but that isn't all bad – not by any means. In fact, change is necessary in life – to keep us moving, to keep us growing, to keep us interested". An inflexible mindset, frozen in time, is detrimental not just to progress but to our very existence as an organization in a fast changing world.

To maintain its position of pre-eminence, Sree Chitra needs to tailor its Mission to meet the demands of the times and excel in the areas of Device Development, Healthcare Delivery and Biomedical Research. As individuals, and as an institution, we will be held increasingly accountable, and the need to perform and fulfill our social obligations will be felt more than ever before in recent history. Our lives will be determined by whether we can envision hopes and dreams of the future even during these times when the world is caught up in a vortex of change. Let us work together and usher in a new era in our history. Let us reaffirm our faith and reassure ourselves that the best is yet to be. An apt way to conclude a presidential message is perhaps to exhort you not to underestimate the impact you can make in the contemporary world of science and medicine. Remember what Pablo Picasso said: "I am always doing things I can't do, that's how I get to do them".

My best wishes to every member of the Chitra family!

K M Chandrasekhar

2016-17: A Retrospect

Prof Asha Kishore, Director, SCTIMST

Expectations are integral to life. They fuel our dreams and hopes in ways that propel our lives to desired destinations. During the past year, the Institute had set its sights high, in consonance with the core values that inform its Mission as a unique organization. Not surprisingly, creditable past performance had brought in its wake the burden of high expectations and the consequent need to do better than before. Nonetheless, as I pen this report, I am justifiably pleased over where we stand today in terms of institutional progress during the year and the directions we have charted for the future. This report is a testimony to my conviction.

Sree Chitra Tirunal Institute is unique because it blends the practice of modern medicine with technology development, research in the frontier areas of cardiac and neuro sciences and engagement with public health within a single institutional framework. The total number of academic faculty as of now is 135 of which 83 are clinicians and 52 are scientists. A total of 2800 students and senior residents have graduated from here. Over 3200 research publications have emerged from the Institute in all these years. Forty biomedical devices and products have already been transferred to industry, which include the two versions of the renowned Chitra heart valve. The Institute has filed 205 patents and sealed 110, 93 in India and 17 in the US, Japan and Europe.

Continued patronage of the Central and State governments and the Department of Science and Technology has been a timeless benediction for the Institute. The Department of Science and Technology took cognizance of our difficulties in meeting the rising capital expenditure of the hospital and supported us from within the limits of their budget. They readily partnered with the Ministry of Health and Family Welfare to support the new hospital block and generously funded the Technical Research Centre initiative and the Technology Business Incubator of the Institute. There was also a significant increase in the annual allocation for the Institute during the year. As many as 16 research projects, funded by DST, progressed well during the year. DST has also expressed interest in supporting the proposal for a Medical Devices Research Park. The Institute is deeply indebted to the Department and Prof Ashutosh Sharma, the esteemed Secretary of the Department.

During 2016-17, the hospital continued to offer high quality patient care in the select specialties and sub-specialties of Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences and Interventional Radiology. High up on the Institute's priorities in the area of healthcare were the treatment of complex heart diseases, pediatric congenital cardiac problems, interventional cardiology, cardiac electrophysiology, comprehensive heart failure care, cardiac and thoracic surgery, treatment of brain tumours, epilepsy, developmenal brain disorders, movement disorders, neuromuscular disorders, sleep disorders, Parkinsonism, stroke and pediatric neurology. A Heart Failure Intermediate ICU was made fully operational and is all set to initiate the cardiac transplant program. A congenital heart surgery intermediate ICU, designed to increase the turnover of paediatric cardiac surgery patients, was inaugurated in August 2016 and was fully equipped. A paediatric neurology facility, in collaboration with the National Institute for Speech and Hearing, Trivandrum, was on track.

The Institute never swerved from its primary focus on biomedical technology during the year. At the first Technology Conclave in November 2016, three new medical technologies, and technology documents for the second-generation cardiovascular products, tilting disc heart valve and gel-coated vascular graft, were transferred to industry. The Institute is recognized as a Technical Research Centre for Biomedical Devices by DST. The Centre was launched by the Hon'ble Minister of State for Science and Technology and Earth Sciences, Shri Y S Chowdary, in November 2016. DST has sanctioned 100 crores over 5 years. Thirty three devices in 5 major medical domains have been short-listed and 29 have been approved by multi-tiered review committees and initiated.

The Achutha Menon Centre undertook technical responsibility for the projects on Prevention and Control of Non-communicable Diseases, Kerala Diabetes Prevention Program, and the Kerala Health Survey of the Government of Kerala. The project titled: "Closing the gap: health equity research" was funded by the International Development Research Centre, Canada.

Academic life at the Institute flourished and contributed substantially to human resource development. The 31 academic courses offered by the Institute attracted aspirants from all over the country. 138 candidates were offered admission to various programs last year. The candidates admitted to these programs were from 48 Indian universities, institutions or boards, which testified to the eclectic character of the Institute. Additionally, candidates sponsored by Government and Autonomous Institutions or Health Sector Organizations were offered short-term training. The Institute continued with popular affiliated programs such as Master of Public Health in Epidemiology, Master of Science in Engineering, Bio-engineering and Biomedical Sciences and PhD in Public Health offered at the National Institute of Epidemiology, Chennai, Christian Medical College, Vellore, IIITMK Trivandrum, and the Indian Institute of Public Health, New Delhi. The Institute also runs 2 joint programs, offering MTech in Clinical Engineering and PhD with IIT Madras and CMC Vellore.

The number of publications from the Institute rose sharply from 150 in 2015-16 to 223 during 2016-17, out of which 166 were in international journals. During the year, 2 patents were granted and 8 new patent applications were filed. The Institute established collaborative R & D projects with educational and research institutions in India and abroad. The overseas institutions included the Graduate School of Medicine, Osaka City University, Toyo University, Japan, Aarhus University Denmark, University of Southern Denmark, University of Tubingen Germany and the Laboratory of Cardiovascular Science, NIA/NIH, USA.

Twenty two new research projects received extramural funding during the year, out of which 6 were international collaborative projects. The total outlay for new and ongoing projects as on 31/03/2017 amounted to Rs 47.14 Crores. The Ministry of Electronics and Information Technology agreed to substantially support the Rs 12 Crore proposal of the Institute for implementing e-delivery system for health care management and research. It will be a robust and dedicated system for the next 25 years, providing quick data access for medical research, training and teaching. Video conferencing-based patient consultation, mobile health apps to track vital signs/chronic disease/sleep monitoring and so on will be developed.

It is a matter of great joy that the good effort by the faculty and students of the Institute was rewarded appropriately during the year. Prof Unnikrishnan of the Department of Cardiovascular & Thoracic Surgery won the coveted Dr B C Roy National Award under the Eminent Medical Teacher category for 2016. Dr Lizymol of the Department of Biomaterials Science and Technology won the 7th National Award for Technology Innovation from the Ministry of Chemicals & Fertilizers, Government of India. Dr Jayasree was admitted as Fellow of the Royal Society of Chemistry. She also received the MRSI Medal for 2017. Dr Rekha of the Biomedical Technology Wing received the Developing Country Scholarship Award at the World Biomaterials Congress. Twenty seven of our students were awarded the best paper and best poster award last year at various scientific meetings. The Institute salutes them for bringing laurels in good measure.

Looking back, the achievements of the Institute over the years have been commendable. Achievement, however, is about looking forward and we must use it as a touchstone for reflection, asking ourselves what we would do next, in the years ahead, to make the most powerful and positive difference in the world. It is pertinent to stress at this point that the Institute was created to be unique and not just run-of-the-mill. In the early seventies, an entrepreneurial medical technology sector, an inevitable offshoot of the grand alliance between medicine and technology, was non-existent in India, and complex surgeries of the heart and brain were performed in very few centres. Today, all of that has changed, and any claim to uniqueness is bound to face formidable challenges. Make no mistake, to stay unique, and not just one among equals, we should continue to do what others don't in the domains of healthcare delivery, medical device development, public health and cutting edge research in cardiac and neuro sciences. We need to offer, in our chosen domains, what is less readily available elsewhere in the country and present an inspiring model for other institutions to emulate. We need to re-affirm the fundamental values and purposes that we stand for in the rapidly changing ambience of a global and digital world – a world longing to improve human lives, a highly competitive world in which imagination and innovation will feed the future. We at Chitra are blessed with a great deal of talent, a rich repertoire of experience, well-defined goals, an abiding sense of commitment to our calling and a robust infrastructure. We cannot ask for more. We must, in the unmatched words of Shakespeare, "take the current when it serves, or lose our ventures". We have no choice.

Asha Kishore

Highlights of the Year

- **Sanction of a new super speciality block**
  The Ministry of Health and Family Welfare, in partnership with the Department of Science and Technology, sanctioned funding for a new super speciality block for the Hospital Wing under the Pradhan Mantri Swasthya Suraksha Yojana. The contribution of DST will be Rs 110 Crores and that of the Ministry of Health and Family Welfare Rs 120 Crores.

- **Launch of Technical Research Centre**
  The Institute is recognized as Technical Research Centre for Biomedical Devices by the Department of Science and Technology, Government of India. The Centre was launched by the Minister of State for Science and Technology and Earth Sciences, Shri Y S Chowdary, in November 2016. The DST-funded Rs 100 crore project will be executed over 5 years. 33 devices in 5 major medical domains were short-listed of which 29 were approved by the multi-tiered review committees and initiated during the year.

- **New ventures in Cardiology and Cardiothoracic Surgery**
  - The newly-constructed Congenital Heart Surgery Intermediate Care Unit was inaugurated on 22 August 2016. The ICU was equipped with CSR funds from Aspinwall and Local Area Development Scheme funds from Hon'ble Member of Parliament, Shri Suresh Gopi.
  - The nine-bed dedicated Heart Failure ICU started functioning with facilities like extracorporeal membrane oxygenation system and positive pressure ventilation to treat post-transplant patients. Tata Trusts has contributed Rs 3.17 Crores for the Heart Failure ICU, Cardiac Transplant Programme and an Advanced Cardiac Life Support Ambulance to the Institute. Mr Ramadorai, former Vice-chairman, TATA Trusts, inaugurated the ICU and flagged off the fully-equipped Advanced Cardiac Life Support Ambulance on 17 February 2017.
  - The Heart Team, comprising cardiologists and cardiac surgeons, initiated the trans-catheter aortic valve implantation programme and performed two surgeries successfully.

- **Comprehensive Care Centre for Neurodevelopmental Disorders**
  MoUs were signed with Shri Raju Hormis of the Federal Bank and the National Institute of Speech and Hearing, Trivandrum, for the establishment of a 'Comprehensive Care Centre for Neurodevelopmental Disorders', with a contribution of Rs 2.19 Crores from the Federal Bank.

- **Projects on Prevention and Control of Non-communicable Diseases**
  AMCHSS undertook technical responsibilities for the projects on Prevention and Control of Non-communicable Diseases, Kerala Diabetes Prevention Program, and Kerala Health Survey of the Government of Kerala.

- The Ministry of Electronics and Information Technology, Government of India, sanctioned Rs 8.94 Crores for an e-Delivery System for Health Care Management and Research at the Institute.

- A new proposal for setting up a Medical Devices Research Park, with the support of the Kerala State Industrial Development Corporation, Government of Kerala, was submitted to NITI Aayog with the approval of the Governing Body and DST.

- Generous donations were received for patient welfare services and improvement of Institute facilities. The Institute received a donation of Rs 80 Lakhs from TATA Elxsi Ltd. for 2016-17 toward treatment of patients from financially weaker sections of the society. Dr T S Ravi Kumar Foundation, USA, donated Rs 16.77 Lakhs for the augmentation of research and clinical activities of the Comprehensive Care Centre for Movement Disorders.

♦ Many important events were organized

- Convocation Ceremony of 32nd batch of graduants of SCTIMST was conducted on 27 May 2016. NITI Aayog Vice-chairman, Dr Arvind Panagariya, was the Chief Guest. Dr P Balaram, Former Director, Indian Institute of Science, was the Guest of Honour. 93 Degrees, 38 Diplomas and 15 PhDs were awarded during 2016-17.
- Fourth G Parthasarathy Oration was delivered on 17 February 2017 by Shri Subramonian Ramadorai, Former Vice-chairman, Tata Consultancy Services.
- National Science Day 2017 was celebrated on 27 February 2017 at the Central Institute on Mental Retardation, Thiruvananthapuram. The theme of National Science Day 2017 was "Science and Technology for Specially abled Persons".

♦ New facilities

- The construction of the new hostel building for senior residents and students in the residential campus was completed and inaugurated by Shri Y S Chowdary in November 2016.
- SWASTHY, a new building in the campus, was inaugurated by the Hon'ble President of the Institute, Shri K M Chandrasekhar, on 27 May 2016. The building accommodates a yoga centre, convention hall, gymnasium, staff canteen and co-operative society office.

♦ Awards and Honours

- Dr M Unnikrishnan, Professor (Senior Grade), Cardiovascular and Thoracic Surgery, was awarded the prestigious Dr B C Roy Award under the category of "Eminent Medical Teacher-2016" on 28 March 2017 by the Hon'ble President of India at the Rashtrapathi Bhavan, New Delhi.
- Dr Lizymol of the Department of Biomaterials Science and Technology won the 7th National Award for Technology Innovation from the Ministry of Chemicals & Fertilizers, Government of India.
- Dr Jayasree was admitted Fellow of the Royal Society of Chemistry. She also received the MRSI Medal for 2017.
- The Department of Transfusion Medicine received the State Award for achieving 100% voluntary blood donation. SCTIMST is the first blood bank to achieve this in the state, and first hospital-based blood bank to do so in the country.
- The Cardiac Electrophysiology Division received international recognition when Asia Pacific Heart Rhythm Society cited the Divisional activities as an example of state-of-the-art services in developing countries in its monthly newsletter in November 2016.
- Dr Suresh Nair, Professor (Senior Grade), Neurosurgery, was elected Secretary of World Federation of Skull Base Societies during the 7th International Congress of the World Federation of Skull Base Surgery Congress in Osaka, Japan, in June 2016.
- Dr Rekha of the Biomedical Technology Wing received the Developing Country Scholarship Award at the World Biomaterials Congress in Montreal, Canada, in May 2016.

♦ Publications, projects, patents

- The number of publications from the Institute rose sharply from 150 in 2015-16 to 223 during 2016-17, out of which 166 were in international journals.
- Twenty two new research projects received extramural funding during the year, out of which 6 were international collaborative projects. The total outlay for new and ongoing projects as on 31/03/2017 amounted to Rs 47.14 Crores.
- In the previous year, 8 Indian patent applications were filed of which two were granted. One design registration was also filed.

♦ Technology transfers

- Three technology transfer agreements were signed on 19 November 2016 with M/s Surgiwear Ltd., Shajehanpur, UP – (i) Calcium sulfate cement, (ii) Process for gluteraldehyde-treated bovine pericardium, and (iii) Polyvinyl alcohol sponge.
- Technology documents of the second-generation cardiovascular products, tilting disc heart valve and gel-coated vascular graft, were transferred to M/s TTK Healthcare Ltd., Trivandrum.

♦ The following MoUs and agreements were executed

- An MoU was signed between the Institute and the Department of Health and Family Welfare, Government of Kerala, for the conduct of the Kerala Health Surveillance Project. The Achutha Menon Centre for Health Science Studies will provide technical expertise.
- An MoU was signed between the Institute and the National Centre for Disease Informatics and Research, Bangalore, for the implementation of high quality survey and data collection for monitoring the National Non-communicable Diseases targets. The Institute will be responsible for the survey in Kerala and Karnataka.
- An MoU was signed on 11 August 2016 with Bhabha Atomic Research Centre, Mumbai, as part of collaboration with the Division of Medical Instrumentation for the development of medical devices like deep brain stimulation system for movement disorders and depth electrodes.
- The Division of Artificial Internal Organs executed MoUs with CSIR-NAL for development of NiTi shape memory alloy-based medical devices and with TTK Healthcare Ltd. for development of annuloplasty ring.
- An MoU was signed between TIMed and TiE Kerala Chapter to facilitate mentoring of TIMed incubatees by members of TiE Kerala.
- As part of ongoing collaboration between the Division of Dental Products with DRDO on the project titled "Development of dental restorative based on inorganic-organic hybrid resin for Barodontalgia", an MoU was signed to execute in vivo toxicological evaluation and pre-clinical studies.
- An MoU was signed between the Institute and the Mission Director, National Health Mission, for comprehensive evaluation of the activities of the Mission in Kerala.

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

- DST has partnered with the Ministry of Health and Family Welfare to support a new super speciality block for the Hospital Wing. The contribution of DST will be Rs 110 Crores.
- The Institute is recognized as Technical Research Centre for Biomedical Devices by DST. DST supports the venture with Rs 100 Crores over 5 years.
- The Institute received Rs 140.93 Crores as grant-in-aid for salary, general expenditure and creation of capital assets during the year, which was a significant increase over the previous year.
- DST supports 16 research projects besides projects under the Technical Research Centre.
- DST and the Governing Body approved submission of a proposal for a Medical Devices Research Park, in collaboration with the Kerala State Industrial Development Corporation, to NITI Aayog.

The Convocation Ceremony of 32nd batch of graduants of SCTIMST. Dr Arvind Panagariya, NITI Aayog Vice-chairman, was the Chief Guest and Dr P Balaram, Former Director, Indian Institute of Science, was the Guest of Honour.

The graduants with the dignitaries after the Convocation Ceremony

Shri Subramonian Ramadorai, Former Vice-chairman, Tata Consultancy Services delivering the Fourth G Parthasarathy Oration on 17 February 2017

Launch of Technical Research Centre for Biomedical Devices by Shri Y S Chowdary, the Hon'ble Minister of State for Science and Technology and Earth Sciences, in November 2016

Newly-commissioned Heart Failure Intensive Care Unit

Inauguration of SWASTHY by the Hon'ble President of the Institute, Shri K M Chandrasekhar, on 27 May 2016

Inauguration of the new hostel building by Shri Y S Chowdary, the Hon'ble Minister of State for Science and Technology and Earth Sciences, in November 2016

Meeting of the President's Committee, chaired by Prof M S Valiathan

Meeting of the Research Council, chaired by Prof P Balaram, Former Director, IISc Bangalore

National Advisory Committee

Signing of MoU between SCTIMST and SITRA for development of medical textiles

Inauguration of the "International Nurses' Week"

Independence Day celebrations 2016

Republic Day celebrations 2017

Swachh Bharat Campaign. Planting of sapling by Shri Thomas Isaac, the Hon'ble Finance Minister, Government of Kerala, on the occasion of Gandhi Jayanthi at SCTIMST.

International Yoga Day celebrations 2016

Commemorating the birth anniversary of Sri Sardar Vallabhai Patel as "Rashtriya Ekta Diwas" on 31 October 2016

HOSPITAL WING

HOSPITAL ADMINISTRATION

The annual statistics of hospital services for the year are shown in Figures 1-7. During the year, various services in Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences & Interventional Radiology registered 18298 new patients (Figure 1). A total of 11773 patients were admitted for treatment including surgical and interventional procedures (Figure 1). The newly registered patients and hospital admissions are steadily increasing every year. Outpatient services registered 168887 patients for review in various departments, including specialty clinics (Figure 2). Thus, there was a significant increase in the number of newly registered patients and those reporting for follow-up. The Institute provided free treatment to 3.1% of the patients and subsidized treatment to 47.5% based on socio-economic status.

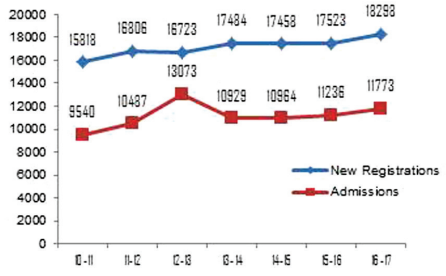


Figure 1. Trends of new registrations and admissions

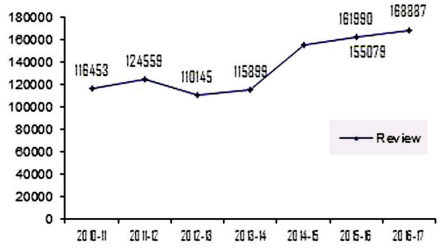


Figure 2. Trend of review outpatient visits

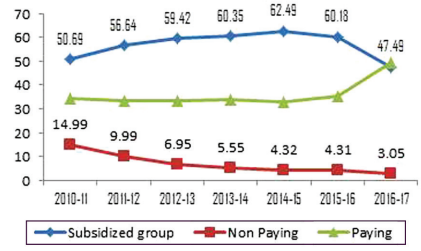


Figure 3. Trends of paying, non-paying and subsidized treatment groups among inpatients

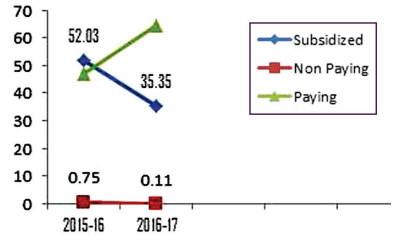


Figure 4. Trends of paying, non-paying and subsidized treatment groups among outpatients

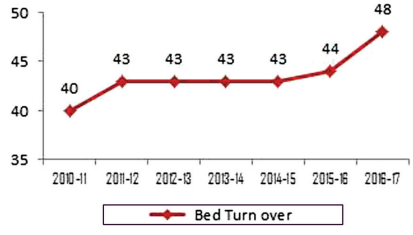


Figure 5. Bed turnover trend

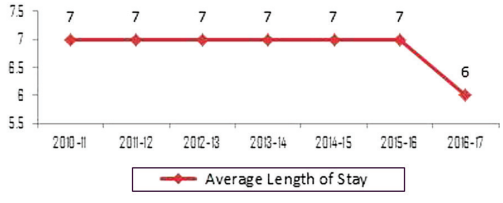


Figure 6. Average length of hospital stay

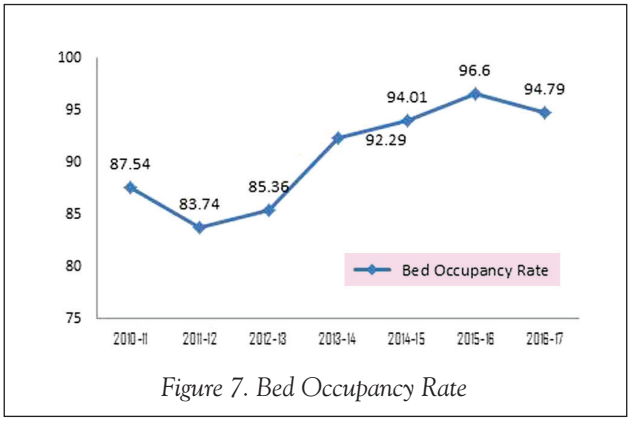


Figure 7. Bed Occupancy Rate

In addition, the bed occupancy rate and bed turnover increased while keeping the average length of stay at 6 days, indicating stretching of the facilities to accommodate ever-increasing patient load.

Activities

The number of patients who availed various financial schemes is as follows:

Scheme	No. of Patients	
	IP	OP
Rashtriya Bal Swasthya Karyakram	2379	41951
CGHS	180	4386
Karunya	2870	0
CHIS PLUS	1509	0
Thalolam	572	0
Other Schemes	103	83
Total	**7613**	**46420**

Major equipment purchased during 2016-17 are indicated in the Table below:

Equipment	Approximate cost (Rs.)
Cath Lab System – Single Plane	3,47,53,136
Echocardiography System High End Portable	43,00,000
Extra Corporeal Membrane Oxygenator with Accessories	36,63,000
Giraffe Warmer	33,47,000
Cryomicrotome (Cryostat) with Accessories	25,38,660
Midas Rex MR7 Pneumatic Neuro Drill Motor	23,80,952
Double Dome OT Light	20,50,000
Nitric Oxide Delivery System	19,06,520
Mobile Operating Table	17,29,858
Intellivue MX700 Monitor	16,43,809
GE Case Stress Test System	13,31,200
Endonasal Debrider (Consol)	12,79,999

Infection Control Programme

The Infection Control Unit with the infection control nurse regularly carried out surveillance activities in the hospital and facilitated infection control. Infection Control Committee and Team met regularly to monitor the activities.

Staff Welfare Programmes

1. SWASTHY building was inaugurated by the Hon'ble President of the Institute, Shri K M Chandrasekhar, on 27 May 2016. The building accommodates a yoga centre, convention hall, gymnasium, staff canteen and co-operative society office.
2. The Institute started yoga classes for staff on 30 May 2016 at SWASTHY. The International Yoga Day was celebrated on 21 June 2016 with a special yoga class.
3. A fully equipped gymnasium was inaugurated on

16 February 2017 with the financial support of the State Bank of Travancore.

4. A screening camp was conducted for female staff of Hospital Wing in association with SNEHITA Women's Health Foundation on 21 January 2017.

National Knowledge Network

The Institute is connected to the National Knowledge Network and has participated in 22 CMEs, 4 Tele Education sessions, 27 meetings/discussions and 7 international Workshops/training, which were organized by Institutions like AIIMS, New Delhi, ISRO, Ahmedabad, Siraj Hospital-Thailand, Sankara Nethralaya and University of Melbourne.

New Initiatives

1. The newly-constructed Congenital Heart Surgery Intermediate Care Unit (CHIMCU) was inaugurated by Dr Jaganmohan A Tharakan, Head, Department of Cardiology, on 22 August 2016.
2. An MoU for Rs 2.19 Crores was signed between SCTIMST and Federal Bank Hormis Memorial Foundation for establishing a Comprehensive Centre for Cognitive Rehabilitation of children with neurodevelopmental disorders.
3. Sri Suresh Gopi, Hon'ble MP (RS) handed four GE-Giraffe Infant Warmer Bed Units (worth Rs 33.4 Lakhs) to the Congenital Heart Surgery Division on 16 February 2017 under the Government of India Member of Parliament Local Area Development Scheme, 2016-17.
4. The Heart Failure ICU was inaugurated by Shri Ramadorai, Former Vice- chairman, Tata Consultancy Services on 17 February 2017. Tata Trusts also contributed Rs 1.17 Crore and an Advanced Cardiac Life Support Ambulance to the Institute.
5. The Ministry of Electronics and Information Technology, Government of India, sanctioned Rs 8.94 Crores for e-Delivery System for Health Care Management and Research at the Institute.

Events organized by the Department

1. Hand Hygiene Day was observed on 5 May 2016 with TV displays on the importance of hand hygiene, ward visits, distribution of badges and awareness programme for the staff.
2. The Institute celebrated Swachh Bharat Mission on 2 October 2016. Saplings were planted in the Institute in association with Centre for Creative Excellence. Dr Thomas Isaac, Hon'ble Finance Minister, Government of Kerala, inaugurated the function and Sri Prasanth, Hon'ble Mayor, Trivandrum Corporation, and Dr Babu Paul IAS (Rtd.) were present.
3. Rashtriya Ekta Diwas was celebrated on 31 October 2016 with pledge taking ceremony in Auditorium II.
4. The Director and staff offered floral tribute in connection with 104th Birth Anniversary of His Highness Sree Padmanabhadasa Sree Chithira Tirunal Balarama Varma on 07 November 2016.

Staff

Hospital Administration

Dr Sarada C, Medical Superintendent
Dr Kavita Raja, Associate Medical Superintendent
Dr S K Jawahar, Deputy Medical Superintendent
Ms Deepthi Bhaskar, Assistant Administrative Officer (OMS) - A

Physical Medicine

Dr Nandakumaran Nair U, Visiting Professor

Nursing Services

Ms Valsala Kumari C, Nursing Officer - A
Ms Saraswathy Amma C, Nursing Superintendent
Ms Padmaja Devi S S, Senior Nursing Supervisor
Ms Thresiamma John, Senior Nursing Supervisor

Central Sterile Services Department

Ms Sujamani R Nair, Chief Ward Sister

Infection Control Unit & Biomedical Waste Management
Ms Shiny Biju, Infection Control Nurse

Construction Wing
Col. Vijayan Pillai K, Construction Engineer

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

Dietary
Ms Leena Thomas, Senior Dietician - B
Ms Jyothi Lekshmy S, Assistant Dietician - B

Laundry
Mr Umesh Sankar S, Laundry Supervisor - B

Medical Social Services
Dr Usha Kandaswamy, Scientific Officer, In-charge,

OPD
Dr Jayachandran D, Scientific Officer
Ms Rosamma Manuel, Junior Scientific Officer

Medical Records
Mr Thampi N G, Senior Medical Records Officer - B

Pharmacy
Ms Rosily Joseph, Chief Pharmacist

Transport
Mr Saji M S, Transport-in-Charge

MEDICAL RECORDS DEPARTMENT

The Medical Records Department continued to have an important role in advanced health care, assisting academic and research activities, and maintaining confidentiality of health information. It shares responsibility in the efficient management of hospital services.

Activities

1. Documenting and updation of patient data
2. Digitization of medical records
3. Implementation of Electronic Medical Records
4. Processing registrations and admissions, and maintenance of staggered appointment system
5. Performing ICD-coding and indexing of diseases and procedures
6. Providing health care statistics for academic, research and administrative activities
7. Maintenance of online and manual patient care-centered correspondence
8. Processing insurance claims and social security schemes, and issue of certificates to patients
9. Reporting of hospitalized overseas patients to Foreigners' Regional Registration Officer and deaths to Corporation of Thiruvananthapuram
10. Conducting academic programme in Medical Records Science

Statistics

New Registration	18298
Admissions	11773
Reviews	168887
Bed occupancy rate	94.79%
Bed turnover rate	48 patients
Average length of stay	6 days
Records released for study / research	8657
Certificates processed / issued	8623
Insurance claims processed	372
Records scanned and uploaded	38611
Electronic Medical Records processed	73044

Geographic distribution of patients

	Outpatient	Inpatient
Kerala	14515	9486
Tamil Nadu	2865	1497
Karnataka	41	31
Andhra Pradesh	25	19
Telangana	16	10
Maharashtra	61	54
Other states of India	692	610
Outside India	83	36
Total	18298	11743

New Initiatives

Implementation of Electronic Medical Records system for all clinical services

Staff

N G Thampi, Senior Medical Records Officer and Assistant PIO (patient care)
Jesudin M Arul Radjvy, Medical Records Officer

NURSING SERVICE DIVISION

Activities

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

All nurses were provided in-house training on a weekly basis, and Diploma in Cardiovascular and Thoracic Nursing, and Neuro Nursing students underwent rigorous training. The staff and students participated in Workshops and conferences at State and National levelss. The Division also trained about 140 postgraduate observers from other Institutions.

The Division supported the introduction of Electronic Medical Records (EMR) and the online billing system.

New Initiatives

1. Release of new manual titled "Cardiac Surgery ICU Nursing Manual"
2. Updation of the "Sree Chitra Nursing Manual", incorporating the latest developments in nursing care

Events organized by the Department

1. International Nurses Week was celebrated with a series of academic programmes including quiz, paper presentations, seminars and guest lectures.
2. CPR Training with hands-on experience was given to 163 nurses.

Faculty

Ms Valsala Kumari C, Nursing Officer - A
Ms Saraswathi Amma C, Nursing Superintendent
Ms Padmaja Devi S S, Senior Nursing Supervisor
Ms Thresiamma John, Senior Nursing Supervisor

DEPARTMENT OF ANAESTHESIOLOGY

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

DIVISION OF NEUROANAESTHESIA

The Division is mainly involved in the perioperative anaesthetic management of patients with neurological illness presenting for neurosurgery, as well as neuroradiological interventional procedures. In addition, various diagnostic procedures like Magnetic Resonance Imaging (MRI) and CT scans were also carried out under anaesthesia when needed. Neuroanaesthesia team also provided round-the-clock services in the various intensive care units (ICUs) of the hospital like neurosurgical, neuromedical, interventional radiology, and acute stroke unit. The team was involved in the airway, ventilation and hemodynamic management of patients in the ICUs. They performed percutaneous tracheostomy, placement of invasive lines including plasmapheresis, and provide anaesthesia services for muscle and skin biopsies. The team was actively involved in the periprocedural management of acute stroke patients in the stroke unit, interventional radiology suite, as well as in the operation theatre.

Academic activities of the Division were meticulously executed and included didactic lectures, clinical case discussions, journal clubs, and pros and cons sessions. Practical sessions on various airway gadgets, intraoperative echocardiography, evoked potential monitoring, and transcranial doppler were some of the highly specialized areas of teaching. In addition, interactive academic sessions between various neuroscience departments were conducted. Institute Ethics Committee-approved, funded and non-funded projects were carried out by the residents and faculty.

Activities

Anaesthesia was provided for the following surgeries and procedures:

Location/Procedure	Number
Neurosurgery operation theatre	1357
CT and MRI for ventilated patients	400
MRI under general anaesthesia/ sedation	300
Neuroradiology suite	176
Skin and muscle biopsies	25

New Initiatives

1. Home ventilator therapy for patients requiring long-term mechanical ventilation as in neuromuscular diseases was established. It is a part of neuro-rehabilitative process in which the relatives of the patients are taught how to provide mechanical ventilation at home and take care of needs of patients. During the year, two patients with motor neuron disease were provided home ventilation.
2. The Division conceptualized the programme of ultrasound training for anaesthesiologist for ICU management of patients and fund acquisition was initiated.

Awards and Honours

1. Dr Ajay Prasad Hrishi was awarded MNAMS in Anaesthesia by National Academy of Medical Sciences, New Delhi.
2. Dr Ajay Prasad Hrishi was awarded MIMSA, International Medical Sciences Academy, New Delhi.
3. Drs Nilima RM and S Manikandan received the first and second prizes, respectively, in poster presentation at the AIIMS Neuroanesthesia CME held in October 2016 at Delhi.

DIVISION OF CARDIAC ANAESTHESIA

The Division provides cardiothoracic and vascular anaesthesia, intensive care and high quality periprocedural care. The Division conducted quality resident training programmes in cardiothoracic and vascular anaesthesia and promoted clinical and biomedical technology research. The Division aimed to have structured initiatives like Anaesthesia Critical Care Programme, Comprehensive Heart Failure Programme and Minimally Invasive Cardiac Surgical Programme, in collaboration with Departments of Cardiothoracic Surgery and Cardiology. Other initiatives included transesophageal echocardiography (TEE) laboratory for surgical patients, fellowship courses in TEE and programme on hybrid procedures in collaboration with Vascular Surgery and Interventional Radiology.

Activities

Anaesthesia was administered for the following surgeries and procedures:

Location/Procedure	Number
Adult cardiac surgical operation theatre (open heart, closed heart, thoracic and vascular surgeries)	1283
Paediatric cardiac surgical operation theatre	732
Cardiac Catheterization Laboratory	491
Electrophysiology Laboratory	44
Cardiac CT/aortogram/pulmonary angiogram	110
Cardiac Magnetic Resonance Imaging	49
Cardiac Medical and Paediatric Surgical ICUs	39
Digital Subtraction Angiography Laboratory (endovascular stenting of aortic aneurysm, embolization/stenting of blood vessels)	29
Percutaneous tracheostomy	7

The Division purchased an Anaesthesia Workstation costing Rs 17 Lakhs.

New Initiatives

1. Cardiac Anaesthesia residents accepted additional responsibilities in adult and paediatric surgical intensive care units since January 2017.
2. Anaesthetists started using ultrasonography to predict optimal endotracheal tube size in paediatric patients undergoing cardiac surgery under general anaesthesia.

Awards and Honours

1. Dr Kirubanand received first prize for paper presentation "Bedside lung ultrasound versus chest x-ray for the detection of lung pathology in adult cardiothoracic vascular patients" at the 19th Annual National Conference of Indian Association of Cardiovascular Thoracic Anesthesiologists (IACTA), 16-19 February 2017, Pune.
2. Dr Rajesh M G received first prize for his paper titled, "Atypical presentation of Abnormal Left Coronary Artery from Pulmonary Artery (ALCAPA) in adolescent age: Role of TEE in evaluation and management" at the 11th Annual Perioperative and Critical Care Transesophageal Echocardiography Workshop, 3-5 March 2017, conducted by Society of TEE & Department of Anaesthesia and Intensive Care, PGIMER, Chandigarh.

Faculty

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

DEPARTMENT OF BIOCHEMISTRY

The Department of Biochemistry comprises: the Central Clinical Laboratory and the Research Division. The Central Clinical Laboratory undertakes the laboratory diagnostics of the Institute in areas of biochemistry, haematology and clinical pathology. The research division addreses the molecular basis of disease processes affecting the vascular system leading to neurological and cardiovascular disorders. Three main areas have been under investigation: a) identifying macromolecules involved in carbohydrate-dependent biological recognition events including immune complex formation and elucidating the basis of their vascular inflammatory potential, b) study of dysfunctional and structurally-modified plasma high-density lipoproteins and their contribution to atherosclerotic heart disease, and c) the role of mitochondrial dysfunction in metabolic syndrome, leading to cardiovascular disorders.

Activities

The Central Clinical Laboratory performed 918151 investigations during the year, which was marginally higher than the previous year. Fully automated, state-of-the-art equipments used in the laboratory include Dade-Behring/ Siemens RXL, Olympus AU 400 Clinical Chemistry analyzers, Beckman 5 part and IRIS I-COUNT differential haematology analyzers, Roche U 411 urine analyzer and Amax (Germany) coagulation analyzer. The category-wise break-up of the tests is as below:

Category	Number
General Chemistry	391829
Hematology & Coagulation	353702
Clinical Pathology	149326
Automated Blood Gas	23268
Neurochemistry	26
Total Investigations	**918151**

Research Programmes

The Research Division, with three faculty members continued to train 10 PhD students in various stages of their programme. The activities included seminars, mid-course comprehensive examinations, PhD thesis preparation and open defence.

The following doctoral students successfully completed the open defence of their PhD thesis:

1. Ms Sini S for her work titled "Biochemical and molecular basis for the pro-atherogenic property of dysfunctional high-density lipoprotein" on 20 January 2017
2. Ms Reema George for her work titled "Cellular and molecular influences on pro-thrombotic and pro-inflammatory states in young patients with coronary artery disease" on 6 March 2017
3. Ms Genu George for her work titled "Immune complex formation between dietary and microbial polysaccharides and anti-carbohydrate antibodies" in August 2016

The following research projects are ongoing in the Department:

1. ***Two new albumin-associated O-glycosylated plasma proteins (AOP1 and AOP2) that also bind anti-carbohydrate antibodies to form antibody-AOP1/AOP2-albumin triplet detected in circulation***

   Two albumin-associated O-glycosylated plasma proteins (AOP1 and AOP2) of molecular weight around 100 kDa were newly detected. Either of them bridged between albumin on one side and anti-galactoside (anti-Gal) or anti-glucan (ABG) antibody on the other. All anti-Gal or ABG molecules in circulation existed as triplet.

2. ***Albumin-associated O-glycosylated plasma proteins and not albumin is receptor for amyloid*** β

   Earlier reports of albumin accounting for > 90%

of amyloid β binding in plasma used commercial albumin heavily contaminated with AOP1 and AOP2. We showed that pure AOP1 and AOP2, their albumin complex or triplet were ligands for amyloid β and that pure albumin was inert towards amyloid β. Nearly 40% of plasma albumin was bound to AOP1 or AOP2.

3. ***Anti-Gal/ABG-AOP1/AOP2-albumin triplet attach to host macrophages and deliver AOP1/AOP2 to cell interior***
De novo triplet constructed using fluorescently-labeled AOP1/AOP2 bound to human macrophages, and delivered AOP1 and AOP2 to cell interior utilizing LRP family of receptors on the cells as ligands. Since brain cells are the richest in LRP-type receptors, triplets may be natural vehicles for delivery of amyloid βbinding AOP1/AOP2 to these cells. Earlier studies underlined this assumption since albumin (contaminated with AOP1/AOP2) could prevent amyloid βaggregation in vitro and retard cognitive decline in vivo.

4. ***Plasma ABG-AOP1/AOP2-albumin triplet titre falls in diabetes, stroke and Alzheimer's disease patients***
As expected, ABG triplets were sharply reduced in the hyperglycemic sera received in central clinical laboratory of the Department. Further, our pilot studies indicated that sera of Alzheimer's disease and stroke patients were significantly low in triplet titre, suggesting reduced delivery of AOP1/AOP2 through triplets as possible reason for impaired amyloid handling in these conditions.

5. ***Plasma anti-Gal and ABG antibodies bind to alpha-synuclein and tau***
Our in vitro studies showed that these antibodies accommodated O-glycan regions of alpha -synuclein and tau at their binding sites. Since synthetic anti-tau antibodies were shown to suppress tau aggregation, these natural antibodies hold promise for immunotherapy

6. ***Molecular basis for the pro-atherogenic property of dysfunctional high-density lipoprotein (HDL)*** [INSPIRE-PhD programme]
Atherosclerotic heart disease is a complex disease in which the lesion development is the consequence of a number of factors including, lifestyle and abnormal lipids. An abundance of epidemiological evidence identified low level of HDL-cholesterol as an independent risk factor for coronary artery disease (CAD). Recent data, including ours, identified functional impairment in HDL derived from CAD patients, unlike HDL from healthy subjects, indicating that all HDL is not functionally equivalent due to alteration in its content of proteins, lipids and their oxidation products. In addition, HDL characterization demonstrated for the first time the association of matrix metalloproteinase-9 (MMP-9) with dysfunctional HDL particle (Figure 8). Since MMP-9 plays an important role in atherosclerotic plaque formation, as well as its destabilization, the formation of HDL-MMP-9 complex may have important clinical implications. Investigation of the effects of dysfunctional HDL on human macrophage functions relevant to atherosclerosis revealed that, unlike HDL from healthy subjects, HDL from patients with established CAD was totally dysfunctional and unable to exert its anti-atherogenic functions, including anti-oxidative, anti-inflammatory and reverse cholesterol transport activities. Dysfunctional HDL from CAD patients induced lipid accumulation in macrophages leading to formation of macrophage-foam cells, the characteristic pathological cells in atherosclerotic plaques. Elucidating the mechanism controlling the intracellular transport of lipids mediated by dysfunctional-HDL demonstrated a novel CD36-ERK/MAPK-dependent pathway. These findings: a) demonstrated that HDL from CAD patients was not atheroprotective, b) suggested a novel molecular link that can enhance the risk of atherolcletrotic CAD in subjects with dysfunctional HDL, and c) highlighted the need for functional assay of HDL for better prediction of cardiovascular risk.

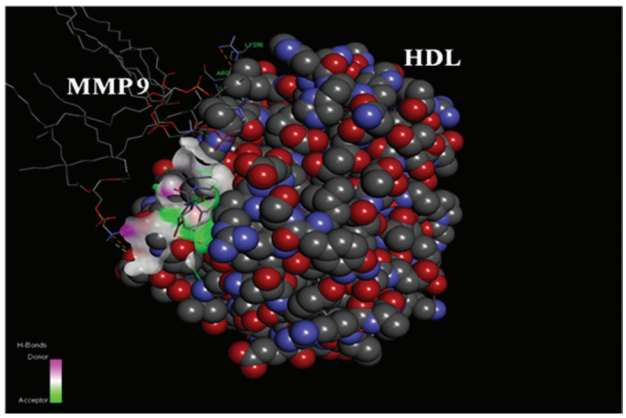


Figure 8. Docked structure showing interaction between HDL and MMP-9 using automated docking software-ZDOCK protocol. Biomolecular modeling and docking techniques carried out using the MMP-9 molecular model 1GKC and HDL model 3K2S (from Protein Data Bank). Docking result showing interacting residues between HDL active site and MMP-9 (represented as CPK- Ball-like structure)

7. ***Cellular and molecular influences on pro-thrombotic and pro-inflammatory states in young patients with coronary artery disease***

[Collaborative research project with Department of Cardiology]

There is rising incidence and prevalence of atherosclerotic vascular disease in India and other developing world. Indians are also reported to have higher prevalence of the risk factors CAD at younger age. The factors responsible for premature CAD in Indian subjects could be multiple. Since CAD involves the bidirectional processes of thrombosis and inflammation, a case-control study was carried out to assess the role of thrombotic and atherogenic factors in young patients with angiography-proven CAD on treatment with statins and anti-platelet drugs. The findings revealed that thrombotic factors, including fibrinogen, Lipoprotein(a), and platelet activation factors such as P-selectin were significantly elevated in patients compared to controls, with a concomitant reduction in the anti-thrombotic factor, antithrombin-III, even though the patients were on treatment with anti-atherosclerotic drugs. Patients also had low level of HDL-cholesterol as the only form of dyslipidemia. In addition, smokers, whether patients or controls, were found to have higher activated platelets in circulation, which can trigger monocyte/ endothelial cell activation and release of thrombotic and inflammatory factors. Furthermore, characterization of peripheral blood monocytes in terms of the expression of surface receptors, CD14+ and CD16+, determined by flow cytometry demonstrated a trend towards increased percentage of non-classical monocytes [CD14+CD16+] in CAD patients, compared to controls. Moreover, a remarkable increase in non-classical monocytes was observed in patients with acute coronary syndrome than that in CAD patients with effort angina, indicating a pro-inflammatory state. The identification of this association raises the possibility of using monocyte phenotypes as therapeutic targets.

8. ***Amino acid analysis in blood***

A HPLC technique was standardized to accurately detect and quantify amino acids and their derivatives in physiological samples relevant to metabolic errors for clinical diagnosis using the newly-procured amino acid analyzer (HITACHI) and initiated analysis of control samples.

9. ***Changes in autophagic, redox and metabolic status of cardiac cells due to hyperglycemia and subsequent interventions***

Metabolic changes in the diabetic heart, with emphasis on mitochondrial function is one of the focus areas of the Department (Figure 9). The changes in protein expression of different metabolic regulators like AMPK/ Akt, autophagy regulators like Ulk1/Beclin/mTOR and autophagy markers like LC3IIb were investigated. Further, the effects of interventions such as resveratrol, nitrite/nitrate and chloroquine were investigated in a rodent model of diabetes. Another area of focus was the effet of maternal hyperglycemia on the offspring. The mitochondrial function was assessed by High Resolution Respirometry, mitochondrial complex activity and expression levels, mitochondrial copy number and ATP content.

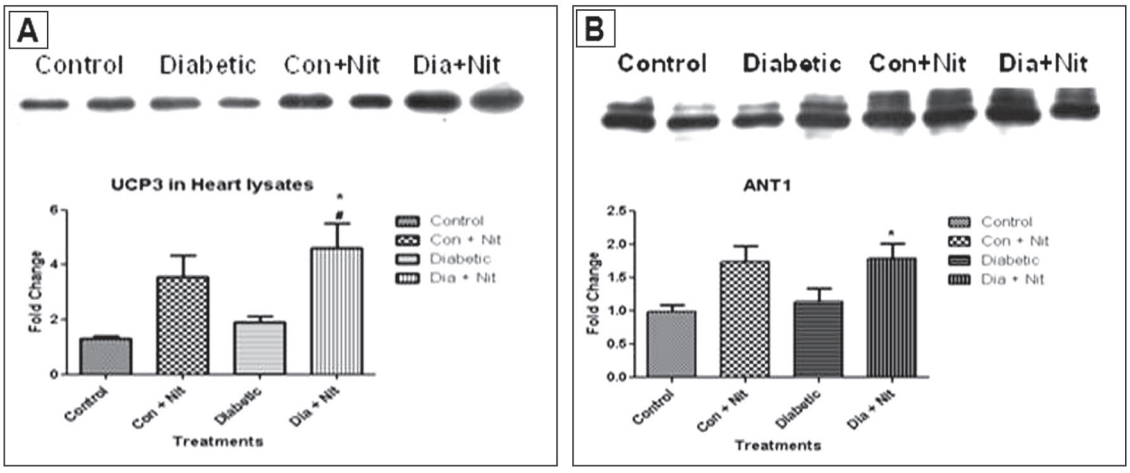


Figure 9. Expression of Uncoupling Protein (UCP3) (A) and Adenine Nucleotide (ANT1) (B) in mouse hearts 8 week old mice were divided into four groups: Control, Control+ nitrite, Diabetic, Diabetic + nitrite (,# - Denote p<0.05 Control group vs. Diabetic group)*

10. Effect of oxidative stress on phagocytosis of Amyloid-β by macrophages from Alzheimer's disease patients

Peripheral blood macrophages in Alzheimer's disease (AD) patients have been reported to have decreased Amyloid-β (Aβ) phagocytic efficiency. We focused on the role of age-associated oxidative stress and inflammation in affecting the phagocytic potential of AD macrophages (Figure 10). We identified that increased oxidative stress could potentially affect the efficiency of phagocytosis and also contributed to increased inflammation which further decreases phagocytosis through decreased expression of Aβ receptors. The involvement of novel proteins in regulating inflammation mediated by Aβ-induced oxidative

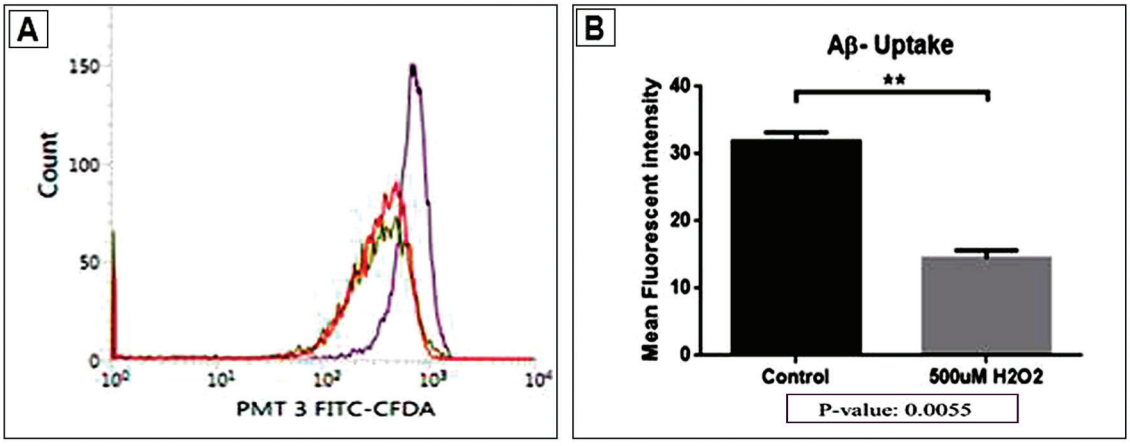


Figure 10. A. FACS data showing increased fluorescent intensity in differentiated THP-1 cell lines treated with Aβ indicating increased oxidative stress induced by Aβ in macrophages. B. Graphical representation showing decreased phagocytosis of FITC-labelled Aβ by differentiated THP-1 macrophage cell lines after inducing oxidative stress with 500 μM H2O2

stress was identified. We are further analyzing the downstream pathways contributing to oxidative stress-mediated phagocytosis inefficiency.

Awards and Honours

Dr Srinivas G was elected Member of the National Academy of Medical Sciences.

Faculty

Dr Appukuttan P S, Professor (Senior Grade) and Head of the Department
Dr Jayakumari N, Professor
Dr Srinivas G, Scientist F

Technical

Mr Thomas T A, Scientific Officer (Lab)
Ms Jayasree K K, Scientific Officer (Lab)
Dr Geetha M, Junior Scientific Officer (Lab)
Mr Rajamohanan K, Junior Technical Officer (Lab)
Mr Sajeevan Sagaram, Technical Assistant (Lab) - A
Ms Vijayalekshmi L, Junior Technical Officer (Lab)
Mr Radhakrishnan B, Junior Technical Officer (Lab)
Mr Sreenivas N C, Junior Technical Officer (Lab)
Ms Sumitha K C, Technical Assistant (Lab) - B
Mr Santhosh Kumar R, Technical Assistant (Lab) - A
Ms Sheeja M, Technical Assistant (Lab) - A
Ms Sreedevi V S, Technical Assistant (Lab) - A
Dr Deepa D, Technical Assistant (Lab) - A
Ms Sreekala Balan P, Technical Assistant (Lab) - A
Ms Manju G Nair, Technical Assistant (Lab) - A

DEPARTMENT OF CARDIOLOGY

The Department of Cardiology provides state-of-the-art patient care along with research and academic programmes. The training programmes include DM cardiology, post-DM fellowships and postgraduate DCLT. During 2016-17, the Department conducted various Workshops, initiated new research programmes and published numerous papers in international journals. There was an emphasis on training and further advancement of the three sub-specialties within the Department. The sub-specialties are: Adult Cardiology and Intervention, Cardiac Electrophysiology and Paediatric Cardiology.

Activities

DIVISION OF ADULT CARDIOLOGY AND INTERVENTION

The Division deals with coronary intervention, and interventions for structural and valvular heart diseases. About 800 coronary interventions were performed during the year maintaining its position as a major interventional centre. Coronary interventions were guided by state-of-the-art technologies like IVUS (Intravascular Ultrasound), OCT (Optical Coherence Tomography) and FFR (Fractional Flow Reserve) estimations. Left main interventions and rotablations were routinely performed. Structural heart disease interventions such as device closure of paravalvular leaks and percutaneous closure of congenital and acquired defects like Ruptured Sinus of Valsalva (RSOV) were also carried out. We continued to be a large volume centre for balloon mitral valvotomy, performing around 150 cases during the year. The emphasis was on developing trans-aortic valve interventions and two such interventions were performed.

DIVISION OF CARDIAC ELECTROPHYSIOLOGY

The Division continued to be one of the best interventional electrophysiology centres in the country for management of cardiac arrhythmias. More than 400 ablations and electrophysiology procedures were performed, which was one of the largest in the country. In addition, the number of device implantations (including ICDs and cardiac resynchronization devices) was close to 260. The Institute has been using the 3D electroanatomical mapping systems, CARTO 3 and Ensite Velocity to aid complex ablation procedures. The request from the Asia Pacific Heart Rhythm Society (APHRS) for an additional seat for Postdoctoral Fellowship in Electrophysiology is under process. The Electrophysiology Division received international recognition when APHRS cited the Divisional activities as an example of the state-of-the-art services in developing countries in its monthly newsletter in November 2016.

DIVISION OF PAEDIATRIC CARDIOLOGY

The Division caters to the entire spectrum of congenital heart disease (CHD) patients from fetus to adult. The spectrum of device closure cases broadened from closure of simple defects like ASD and PDA to more complex procedures including closure of VSD, coronary arterio-venous fistula (CAVF) and RSOV. In association with congenital heart surgeons and anaesthetists, the number of procedures (elective and emergency) for critically-ill newborns with CHD was improved in a major way. The emergency neonatal procedures included balloon atrial septostomy, ductal stenting and balloon valvotomies. The Division is now focusing on developing a comprehensive infant neonate clinic.

The other activities of the Department included:

1. Comprehensive heart failure intervention programme
2. Heart failure 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 procedures performed by the Department during 2016-17 are listed below:

Adult interventions

Procedure	Number
Coronary angioplasty	786
Coronary angiogram	1638
Cardiac catheterization	49
PDA device closure (Adult)	7
RSOV device closures	1
Balloon mitral valvotomy	109
Device closure of valve leaks	1
Alcohol septal ablation	4
Pericardial aspiration	5
Total	**2600**

Electrophysiology procedures

Procedure	Number
3D electro anatomical mapping and ablation	114
Atrial tachycardia and flutter	*48*
Ventricular tachycardia – outflow tracts	*28*
Ventricular tachycardia – Fascicular VT	*12*
Ventricular tachycardia – Scar related	*8*
Ventricular tachycardia – Other	*18*
Conventional mapping and ablation	307
Ablation of SVT – AVNRT	*134*
Ablation of SVT – AVRT	*95*
Electrophysiological study	*78*
Device implantation procedures	256
Total	**677**

Paediatric cardiology procedures

Procedure	Number
Device closure of atrial septal defect (ASD DC)	223
Device closure of ventricular septal defect (VSD DC)	8
Device closure of patent ductus arteriosus (PDA DC)	76
Balloon pulmonary valvotomy (BPV)	15
Balloon aortic valvotomy (BAV)	6
Balloon atrial septostomy (BAS)	22
Balloon dilatation of coarctation of aorta (BCoA)	6
Patent ductus arteriosus stenting (PDA stenting)	12
Coarctation stenting	6
Coiling of aorto-pulmonary collateral	2
Cardiac catheterization	86
Total	**462**

Research Programmes

The research areas included:

1. Heart Failure Registry: The only organized heart failure clinic in the state of Kerala has registered around 600 patients who were on regular follow-up.
2. Evaluation of Bio-vascular scaffolds was part of an Indian multi-centric trial that was completed

and presented as a Late breaking clinical trial at the Transcatheter Cardiovascular Therapeutics (TCT), USA.
3. VT ablation using 3D
4. Electrical remodeling in CRT patients
5. Post-operative Fontan evaluation
6. Post-arterial switch operation (ASO) evaluation

Product Development

The Department has ongoing projects on development of ASD devices and pulmonary valve in collaboration with other Divisions of the hospital and BMT Wing.

New Initiatives

1. ***Trivandrum heart failure cohort***
   The ICMR has sanctioned funds for the Trivandrum Heart Failure Cohort, the first ever heart failure registry in the country which captured all admissions with heart failure in Trivandrum urban area and Athiyannoor block panchayat, a rural area in Trivandrum district. The 1205 patients enrolled in the registry are being followed up as a cohort.
2. ***Heart Failure ICU***
   The nine-bed dedicated Heart Failure ICU started functioning. A cubicle with positive pressure ventilation to treat post-transplant patients is also part of the ICU. Shri Ramadorai, former Vice-chairman, TATA Trusts, inaugurated the ICU and flagged off the fully-equipped Advanced Cardiac Life Support Ambulance on 17 February 2017.
3. ***Cardiac Transplant Programme***
   The Cardiac Transplant Programme was initiated using funds of Rs 3.16 Crores allocated by TATA Trust. The necessary infrastructure is in place and the related equipment is being purchased.
4. ***3D VT ablation programme***
   The ablation of ischemia-related VT was performed under 3D mapping with the Ensite and CARTO mapping systems.
5. ***Cardiac electrical device implantation programme***
   Under the programme, newer versions of the LV endocardial screw in lead were successfully evaluated.
6. ***Device implantation in the neonate programme***
   The neonatal device implantation programme included PDA and coarctation stenting and VSD closures.

Events organized by the Department

1. "Back to Basics" - A simulator-based coronary intervention training programme was organised on 14-15 January 2017.
2. A Workshop on Epicardial Ablation of Ventricular Arrhythmias was conducted on 29 June 2016.
3. A Workshop on Cardiac Resynchronization Therapy was organised on 31 January 2017.

Awards and Honours

1. Dr Ajitkumar V K continued to serve in the Medical Devices Advisory committee and Biotechnology Industry Research Council, Ministry of Science & Technology, Government of India.
2. Dr Ajitkumar V K was elected President of the Society for Coronary Imaging.
3. Dr Ajitkumar V K was selected Member of the Editorial Boards of The Cardiologist and Madridge Journal of Cardiology.
4. Dr Ajitkumar V K continued as Member of the Editorial Board of Indian Pacing and Electrophysiology Journal.
5. Dr Ajitkumar V K was selected Member of the Academic, Technology Transfer, and Technology Research Committees of SCTIMST.
6. Dr Sivasankaran S was invited by the Food Safety and Security Authority of India to be part of the expert group on fat, sugar and salt to frame national recommendations.
7. Dr S Sivasankaran was invited by the Department of Health, Kerala, as member of the expert committee to provide recommendations to set targets for Non-communicable Disease Control as part of the United Nations Sustainable Development Goals 2030 headed by Dr Thankappan K R.
8. Dr Krishnamoorthy K M was elected Fellow of Royal College of Physicians, Edinburgh.
9. Dr Harikrishnan S was nominated Member of the Committee for Price Control of Cardiac Stents, a part of the National List of Essential Medicines (NLEM) Committee.

10. Dr Narayanan Namboodiri continued to serve as the honorary Editor-in-Chief of Indian Pacing and Electrophysiology Journal.
11. Dr Narayanan Namboodiri continued to serve as sub-committee Member of the Guidelines and Writing Group, Asia Pacific Heart Rhythm Society.
12. Dr Narayanan Namboodiri received the "Award of Excellence in Cardiac Electrophysiology" of the Indian Heart Rhythm Society at the annual conference held in November 2016 at New Delhi.
13. Dr Bijulal S was an invited member of the Data and Safety Monitoring Board of the European clinical trial comparing sirolimus-eluting thin strut stent with everolimus-eluting stent.

Faculty

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

Paramedical/Technical Staff

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 functions as three Divisions - adult cardiac surgery, paediatric cardiac surgery and thoracic and vascular surgery. The Paediatric Cardiac Surgical programme saw improvement in facilities with the addition of intensive care beds and baby warmers (donated by Mr Suresh Gopi, Member of Parliament, Rajya Sabha). The Extra Corporeal Membrane Oxygenation system (ECMO), received as part of TATA Trust-funded Heart Failure Programme, was successfully initiated and the system was used in two neonatal patients. The Heart Team, comprising cardiologists and cardiac surgeons, initiated the Trans-catheter Aortic Valve Implantation Programme and performed two surgeries successfully. The Endovascular Aneurysm Programme with 27 cases during the year continued to be one of the best in the state with excellent clinical outcomes. The Heart Failure and Cardiac Transplant Programmes listed two patients for heart transplant.

Activities

In 2016-2017, adult and paediatric cardiac surgery divisions performed cardiovascular and thoracic operations as detailed in the Table below:

Type	Number
Adult cardiac surgeries	
Open Heart	963
Closed Heart	508
Congenital cardiac surgeries	
Open Heart	522

Adult Cardiac Surgeries

The open heart surgeries performed included:

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

The closed heart surgeries performed included:

1. Surgeries for complex aortic aneurysms and aortoiliac occlusive diseases
2. Lung surgery
3. Beating heart surgeries
4. Coarctation repair- adult and paediatric
5. PDA division- adult and paediatric
6. BT shunt operation
7. Carotid endarterectomies

Paediatric Cardiac Surgeries

The open heart surgeries performed included:

1. Transposition of the Great Arteries operations - Switch and Sennings
2. Norwood operation for Hypoplastic Left Heart Syndrome, including hybrid Norwood
3. Surgeries for Tetralogy of Fallot
4. Ventricular Septal Defect and Atrial Septal Defect closures
5. Intra-cardiac repair for atrioventricular canal defects
6. Rastelli operation
7. Single Ventricular Repair procedures like Glenn and Fontan
8. Neonatal Arch Repair
9. Truncus repair
10. Hybrid procedures - Hybrid VSD closure, hybrid PA stenting

DIVISION OF VASCULAR AND THORACIC SURGERY

During the year, the Division performed vascular and thoracic surgeries as indicated in the Table below.

Surgery	Number
Carotid endarterectomies	51
Open aortic aneurysm repairs	32
Endovascular aneurysm repairs (included 16 hybrid endovascular repairs due to complex aortic pathologies)	27
General thoracic procedures (lung resections, thymectomies and complex mediastinal tumours)	53

Awards and Honours

1. Dr M Unnikrishnan was awarded the prestigious Dr B C Roy Award under the category of "Eminent Medical Teacher-2016" on 28 March 2017 by the Hon'ble President of India at Rashtrapathi Bhavan, New Delhi.
2. Dr P Shivanesan received second prize in paper presentation and third prize in poster presentation categories at the 23rd Annual Conference of the Vascular Society of India, Bangalore.

Faculty

Dr K Jayakumar, Professor (Senior Grade) and Head of the Department
Dr M Unnikrishnan, Professor (Senior Grade)
Dr Baiju S Dharan, Additional Professor
Dr Vivek V Pillai, Additional Professor
Dr Varghese T Panicker, Additional Professor
Dr Sreekumar R C, Additional Professor
Dr Sabarinath Menon, Associate Professor
Dr Bineesh K R, Assistant Professor
Dr Sudip Dutta Barua, Assistant Professor
Dr Sowmya Remanan, Assistant Professor

Technical (Perfusion Division)

Ms Beegum Thaslim
Mr Monsy Sam
Ms Maya L
Mr Sujith V M
Mr Don Sebastian
Mr Shanu P S

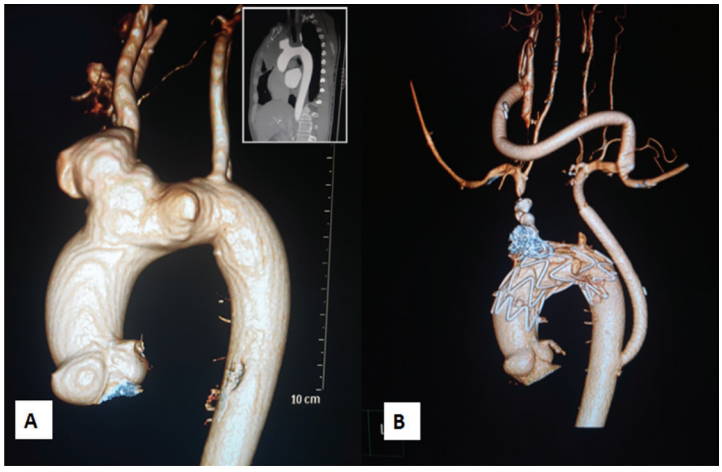


Figure 11. Complex contained aortic arch aneurysm corrected by hybrid endovascular aneurysm repair. A. CT angiogram showing aneurysm of the innominate artery and the arch (Inset - presence of retrosternal hematoma suggesting the contained rupture of the aneurysm). B. Post op picture showing retrograde DTA to left SCA bypass with left SCA to right CCA bypass and TEVAR successfully excluding the aneurysm.

Figure 12. Patient on ECMO

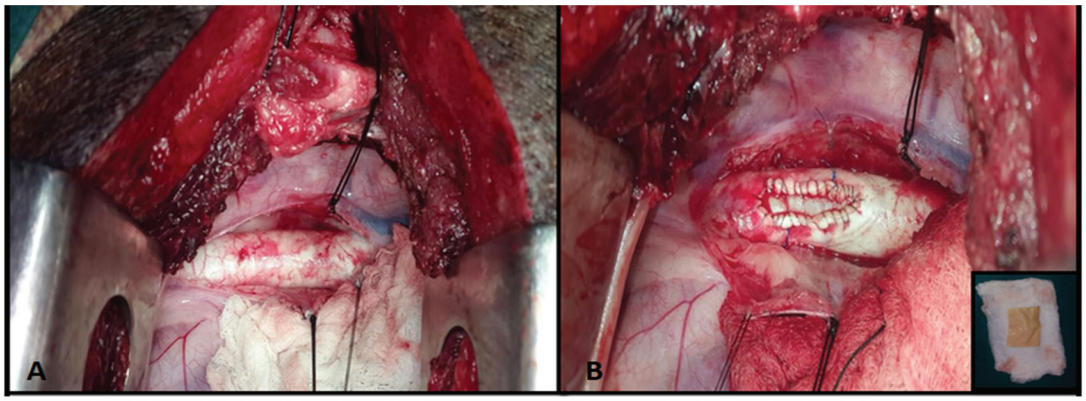


Figure 13. Decellularised buffalo pericardial patch study in pig
A. Descending thoracic aorta of the pig exposed via left thoracotomy. B. Decellularised buffalo pericardiaum sutured to the aorta (Inset - prepared buffalo pericardium before patching)

DIVISION OF CLINICAL ENGINEERING

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

Activities

The Division ensured proper equipment management by promoting the use of standard-based approach which imparted a safer, more efficient and high quality management of all medical equipment. Safe and effective patient care was ensured by selecting suitable equipment, offering technical support, and organizing teaching and training programmes on medical equipment to staff. The Division also devised strategies for appropriate calibration, inspection, maintenance and repair services, an essential part of ensuring the safety and reliability of medical equipment.

The Clinical Engineers in their role as medical technology experts carried out activities involved in various stages of equipment life cycle such as pre-purchase evaluation, equipment recommendation, purchasing assistance, incoming inspection, service contract management, user training, maintenance, performance testing, calibration, biomedical networking and user error tracking.

The new computerized maintenance management system was improved with the help of the Computer Division and new programmes were added.

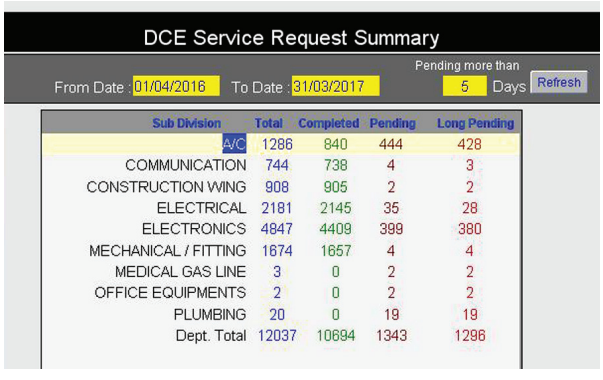
Major installations in 2016-17

The Division ensured proper installation of the following equipment:

Equipment name	Number	Department
Multiparameter Monitor, Efficia CM10	8	CHICU
Ventilator, Drager EvitaV300	2	Cardiology
Defibrillator, Heart Start XL	1	CHICU
Motorized Electric Bed	3	Cardiology
Pneumatic Neuro Drill Motor	1	Neurosurgery
Biphasic Defibrillator	1	Cardiology
12 Channel ECG Recorder	1	Cardiology
Echocardiography System	1	Cardiology
Ventilator, Servo-I	4	Neurology ICU
Endonasal Debrider	1	Neurosurgery
Cryomicrotome	1	Pathology
Laboratory Centrifuge	2	Biochemistry
Infant Warmer, Giraffe	4	CHICU
Blood Collection Monitor, D 601	1	Transfusion Medicine
Mobile Operating Table	1	PSOT
Microstream Capnography	4	Anaesthesiology
Combination therapy unit, Sonoplus 492	1	Physical Medicine & Rehabilitation
Monitor, Intellivue MX700	2	Cardiology

New Initiatives

Design of a user-friendly screen for 'Service Request Summary' (Figure 14). In this, all the details of total jobs received, jobs completed, jobs pending and long-pending jobs within the specified period of all sub-divisions in DCE are available for decision-making. This screen can be viewed by any authorized person in the Institute through the intranet.



Sub Division	Total	Completed	Pending	Long Pending
A/C	1286	840	444	428
COMMUNICATION	744	738	4	3
CONSTRUCTION WING	908	905	2	2
ELECTRICAL	2181	2145	35	28
ELECTRONICS	4847	4409	399	380
MECHANICAL / FITTING	1674	1657	4	4
MEDICAL GAS LINE	3	0	2	2
OFFICE EQUIPMENTS	2	0	2	2
PLUMBING	20	0	19	19
Dept. Total	12037	10694	1343	1296

Figure 14. Screen shot of the service request summary

Events organized by the Department

Seven "Hospital Equipment Awareness Training Series (HEATS)" Workshops for imparting advanced technical training on various medical equipment were organized, the details of which are given below:

HEATS-16	I. Introduction to Clinical Engineering & case study II. Defibrillator	4 April 2016
HEATS-17	I. O2 & CO2 Analyzers II. Case studies in anaesthesia machine	11 April 2016
HEATS-18	Live demonstration and maintenance of syringe pump, ventilator and portable X-ray machine	18 April 2016
HEATS-19	Management studies	25 April 2016
HEATS-20	Demonstration of data management system in DCE for inventory control and equipment maintenance	7 May 2016
HEATS-21	Training on ECMO machine	16 August 2016
HEATS-22	Training on ECHO machine with its advanced features	18 February 2017

Awards and Honours

Mr Koruthu P Varughese received an award for the presentation at the Regional Conference of the IEEE EMBS, 4-8 December 2016, Kuala Lumpur, Malaysia.

Staff

Mr Koruthu P Varughese, Engineer G and Head of the Department (Acting)
Mr Mohanlal G, Engineer G
Mr Madhusoodanan Pillai B, Scientist Engineer F
Mr Manoj G S, Engineer C
Mr Ganesh P, Junior Engineer (Electrical)

DIVISION OF CELLULAR AND MOLECULAR CARDIOLOGY

The Division aims at carrying out basic and applied research in Cardiology. Currently, the focus is on understanding molecular mechanisms of pathological cardiac remodeling that would eventually help identify strategies for prevention of heart disease. Investigations are carried out using animal models and cell cultures.

Guiding students for PhD is a major academic activity. Three students were awarded PhD. Extramural grants from different funding agencies provided additional support for sustaining the research activities.

Research Programmes

1. ***Molecular mechanisms in cardiac fibroblast growth***

   Cardiac fibroblasts, which constitute about two-thirds of the myocardial cell population, are the principal source of myocardial collagen in addition to several growth factors and cytokines that exert significant paracrine actions on co-resident cells. The ability to phenoconvert into active myofibroblasts upon myocyte loss, proliferate, produce fibrillar collagen and persist in the infarct scar long after the termination of the wound healing process by resisting apoptosis underlies their pivotal role in reparative healing in the short-term and in stromal expansion in the long-term, which causes myocardial stiffness and compromised ventricular compliance. The Division has, over the years, probed the mechanisms that regulate these aspects of cardiac fibroblast growth - cell proliferation, apoptosis resistance and collagen production. The focus has been on Angiotensin II whose regulatory role in collagen expression in cardiac fibroblasts is a major determinant of myocardial tissue response to injury. The long-term goal is to gain insights into the mechanistic basis of myocardial fibrosis and left ventricular dysfunction in pathological states.

This laboratory had recently reported an obligate role for Discoidin Domain Receptor 2 (DDR2), a fibroblast-specific collagen receptor tyrosine kinase, in Angiotenisn II-dependent collagen gene expression in cardiac fibroblasts. During the current year, the molecular pathways downstream of DDR2 that mediate its regulatory role in collagen expression were probed. Specifically, the interplay between the two major collagen receptors, DDR2 and Integrin-β1, in relation to collagen expression was investigated in Angiotensin II-stimulated cardiac fibroblasts using a combination of gene knockdown and knock-in strategies. The findings uncovered a hitherto unknown mechanism of regulation of collagen production in cardiac fibroblasts.

The laboratory also focused on the regulatory role of DDR2 in apoptosis resistance and cell cycle progression in cardiac fibroblasts. Preliminary evidence suggested that DDR2 mediates cardiac fibroblast resistance to apoptosis and proliferation. The regulatory role of DDR2 in these critical aspects of cardiac fibroblast function may establish its centrality in myocardial response to injury, while its specific localization on fibroblasts in the heart may identify it as a potential therapeutic target to prevent tissue fibrosis post injury, as noted in an exclusive editorial on our article last year.

Although the pleiotropic effects of Angiotensin II on cardiovascular cells are well-studied, regulation of the AT1 receptor that mediates Angiotensin II actions remains largely unclear. Moreover, AT1 expression levels vary in disease states, and AT1 receptor antagonists are widely used in clinical practice. Against this backdrop, investigations undertaken during the past year in this laboratory demonstrated that oxidative stress, which is commonly encountered in the myocardium, enhances AT1 receptor gene expression in cardiac fibroblasts by a complex mechanism involving the redox-sensitive transcription factors, NF-κB and AP-1, which are activated by the co-ordinated

action of ERK1/2 MAPK, p38 MAPK and JNK. Importantly, by causally linking oxidative stress to Angiotensin II and AT1 receptor up-regulation in cardiac fibroblasts, this study offers a novel perspective on the pathogenesis of cardiovascular diseases associated with oxidative stress. The findings were published in the prestigious Journal of Molecular and Cellular Cardiology.

Investigations on the role of vascular adventitial fibroblasts in triggering vascular changes associated with diabetes, undertaken in collaboration with the NIH, made impressive progress during the year.

2. ***Modulation of cardiac stem cell characteristics in spontaneously hypertensive rat by the Histamine-2 receptor antagonist, Famotidine***

Cardiac stem cells (CSCs) play a vital role in cardiac homeostasis. Decrease in efficiency of cardiac stem cells is suspected in various cardiac abnormalities. The maintenance of a healthy stem cell population is essential for prevention of adverse cardiac remodeling. Famotidine, a Histamine-2 receptor antagonist, is reported to reduce hypertension-induced hypertrophy and improve cardiac function in Spontaneously Hypertensive Rats (SHR). However, the effect of famotidine on CSCs has not been reported earlier. To examine whether famotidine has a positive effect on CSCs, SHR were treated with the drug and its effect on stem cell function was evaluated. Six-month-old male SHR were treated with famotidine (30 mg/kg/day) for 2 months. The effect of famotidine on CSC migration, proliferation and survival was assessed in CSCs isolated from the atrial tissue of treated rat in comparison with untreated SHR and normotensive Wistar rat. Functional efficiency of CSCs from SHR was compromised compared to Wistar rat. Treatment with famotidine increased the proliferation potential, along with retention of stemness in CSCs of SHR (Figure 15). Famotidine reduced cellular senescence and oxidative stress and enhanced the migration rate (Figure 16). Consequent to treatment with famotidine, the stem cell attributes were comparable to that of Wistar rat. The observations lead to the conclusion that the cardioprotective effect of famotidine is possibly mediated by modulation of stem cell attributes.

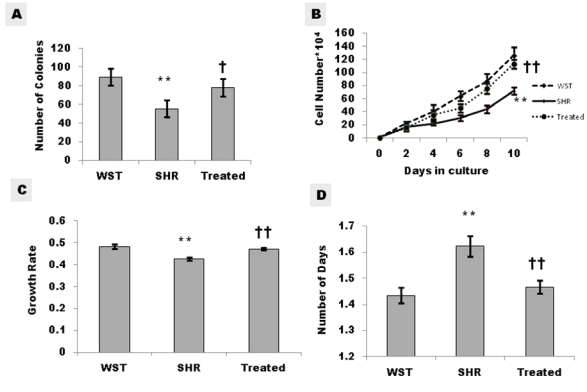


*Figure 15. Effect of famotidine on atrial cardiac stem cells A. Age associated variation in Colony forming units (CFU) B. Growth kinetics of CSCs C. Temporal variation in growth rate D. Age associated variation in Population doubling time (PDT) represented as number of days. Data presented as mean±SD. Variation was analyzed by ANOVA followed by Post-hoc test. (** $p<0.01$ SHR vs WST; †† $p<0.01$ & † $p<0.05$ SHR vs Tempol) (n=6/group)*
WST - Wistar rat, SHR - Untreated Spontaneously Hypertensive rat, Treated - SHR treated with Famotidine (30mg/kg/day for 2 months)

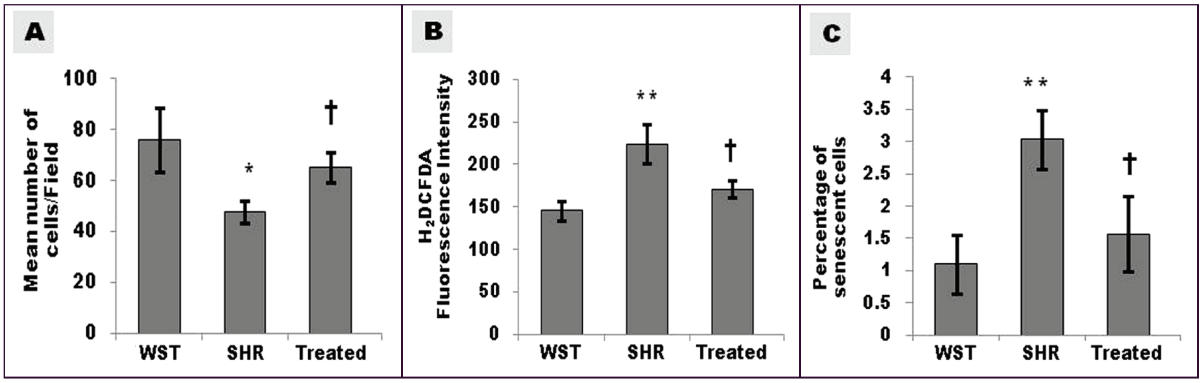


Figure 16. Effect of famotidine on cardiac stem cells
A. Migration potential was assessed by trans-well migration assay. B. ROS levels in CSCs represented as H2DCFDA fluorescence intensity. C. Proportion of sensenscent cells expressed as percentage of the total population.
Data presented as mean±SD. Variation was analysed by ANOVA followed by Post-hoc test.
*(** $p<0.01$ & * $p<0.05$ SHR vs WST; † $p<0.05$ SHR vs Tempol) (n=6/group).*
WST - Wistar rat, SHR - Untreated Spontaneously Hypertensive rat, Treated - SHR treated with Famotidine (30mg/kg/day for 2 months)

3. ***Mitoprotective antioxidant EUK-134 prevents cardiomyocyte hypertrophy and metabolic remodeling in H9C2 cells***

Oxidative stress is an important contributory factor for the development of hypertension-induced cardiac hypertrophy. Mitochondria are the major source of reactive oxygen species. Hence, protecting mitochondria from oxidative damage should be an effective therapeutic strategy for the prevention of hypertensive heart disease. Cardioprotective effect of conventional antioxidants is limited by inadequate protection against mitochondrial oxidative damage. EUK-134 is a salen-manganese complex with superoxide dismutase and catalase activity. The possible role of EUK-134, a mitoprotective antioxidant, in the prevention of cardiomyocyte hypertrophy was tested in hypertrophic H9c2 cells. The cells were stimulated with phenylephrin (50μM), and hypertrophy was assessed by brain natriuretic peptide gene expression and western blotting for calcineurin protein. Enhanced myocardial lipid peroxidation and protein carbonyl content, accompanied by NF-βB gene expression confirmed the presence of oxidative stress in hypertrophic cells. Metabolic shift was evident from reduction in the expression of medium chain acyl CoA dehydrogenase. Mitochondrial oxidative stress was confirmed by the reduced expression of mitochondria-specific antioxidant peroxyredoxin 3 and enhanced mitochondrial superoxide production as evident from staining with MitoSox-red (Figure 17).

Compromised mitochondrial function was apparent from reduced mitochondrial membrane potential. Pretreatment with EUK-134 (10μM) was effective in the prevention of cardiomyocyte hypertrophy, reduction of oxidative stress and prevention of metabolic shift. EUK-134 treatment improved the oxidative status of mitochondria and reversed hypertrophy-induced reduction of mitochondrial membrane potential. EUK-134 is therefore identified as a novel approach to attenuate cardiac hypertrophy. The observation lends scope for the development of EUK-134 as a therapeutic agent in the management of human cardiovascular disease.

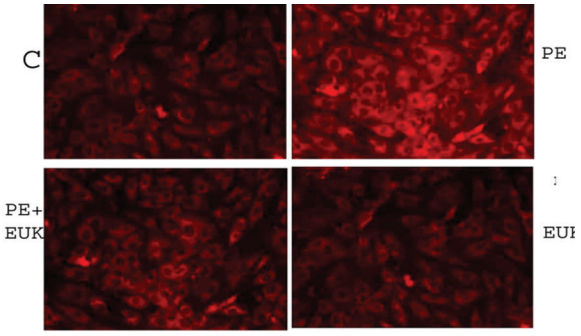


Figure 17. Representative image of H9C2 cells stained with MitoSox Red for visualisation of superoxide content in mitochondria (C-Untreated H9c2 cells, PE-Phenylephrine treated hypertrophied H9c2 cells, PE+EUK-Hypertrophic cardiac cells treated with Antioxidant EUK, EUK-H9c2 cells treated with EUK)

Awards and Honours

Ms Sherin S received the Prof P A Kurup Memorial Award for the Best Oral Presentation at the National Seminar on Recent Biochemical Approaches in Therapeutics, University of Kerala, in February 2017.

Faculty

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

Technical

Ms Remani K, Junior Technical Officer (Laboratory)

COMPUTER DIVISION

The Division co-ordinates the formulation, development, implementation, maintenance and updation of software essential for e-governance at the Institute.

Activities

1. Maintenance and update of software and development of new forms and reports
2. Website (Intranet, Internet) and network management, maintenance, site updates and new development
3. Tuning, backup and maintenance activities of 18 higher end servers
4. Tender publishing, online recruitment of staff and students, update and maintenance of all portals (blood donor, vendor, pension, patient), DSpace, and e-learning, Optical Mark Recognition (OMR) evaluation and form changes for recruitment and academic admissions
5. Report generation for auditors and income tax committee
6. Hardware and software maintenance of servers, storage, routers, switches, scanners, printers (total 1225 devices) with a remarkable uptime of 99.98%
7. Data backup, maintenance of data and network security
8. Monitoring of medical equipment integrated to electronic medical records
9. Training of staff and students

New Initiatives

1. Electronic Medical Records (EMR) for patients in Neurology and Neurosurgery, and integration of EMG and audiometry reports with EMR
2. Development of patient e-consultation API interface and integration of e-consultation with e-payment and EMR
3. Design of a new website for the Institute and a web portal for blood donors
4. Design of softwares for echocardiogram reporting
5. Institution of online payment system for staff, BMT Wing and Project Cell
6. New modules for 7th pay commission fixation and arrears calculation and medicine tender process
7. Integrated document signing module for all web reports
8. Conversion of SCT Net to Oracle 11g

Staff

Dr Geetha G, Scientist G and Head of the Division
Mr Suresh Kumar B, Engineer D
Mr Rejith L R, Programmer
Mr Saji K S, Programmer
Mr Manoj M, Technical Assistant (Computer Programmer)
Mr Anish R, Technical Assistant (Computer Programmer)
Mr Sakilnag P S, Technical Assistant (Computer Programmer)

DEPARTMENT OF IMAGING SCIENCES AND INTERVENTIONAL RADIOLOGY

Neuro Intervention Centre (NIC) was started in January 2013 as a project, comprising an 8-bed neurovascular intensive care unit and state-of-the-art Cath lab. This facility is one of its kind in India for the management of neurovascular diseases. The quality management practices coupled with strong multidisciplinary co-operative directions of NIC contributed significantly toward achieving less than 1% morbidity and mortality. NIC got incorporated into the hospital services after the successful completion of the project in 2016. In our country, there is a dearth of trained interventional neuroradiologists. NIC has contributed significantly to overcoming this deficiency and has set high standards in neuro intervention teaching and clinical training in our Institute.

Activities

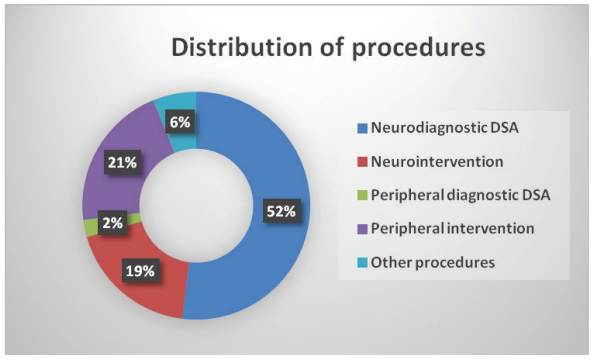


Figure 18. Distribution of procedures in 2016-17

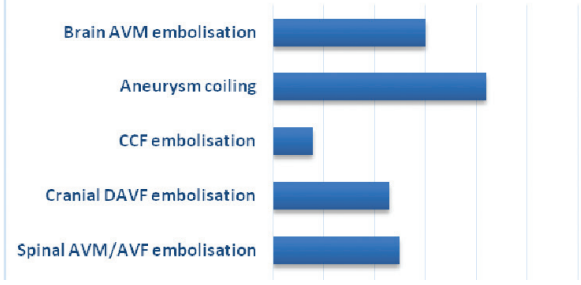


Figure 19. Distribution of neuro intervention procedures in 2016-17

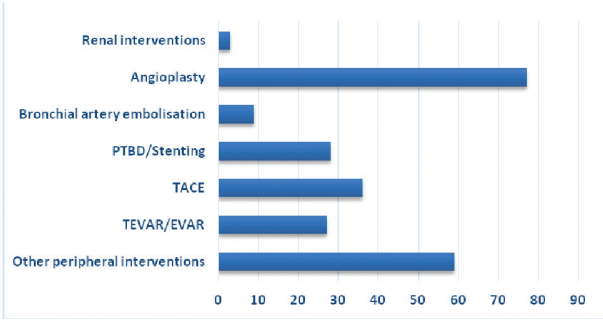


Figure 20. Distribution of peripheral intervention procedures in 2016-17

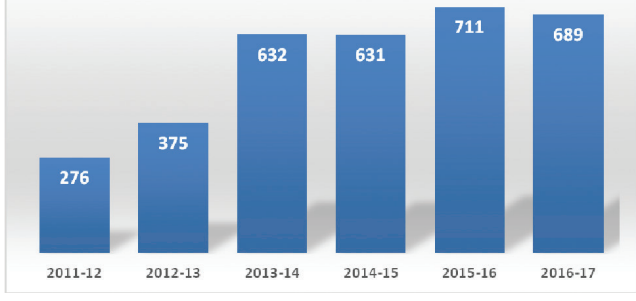


Figure 21. Trend of IP admissions in ISIR in the last 6 years

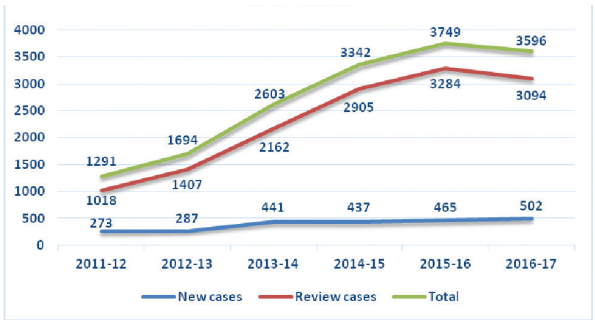


Figure 22. Trend of OP admissions in ISIR in the last 6 years

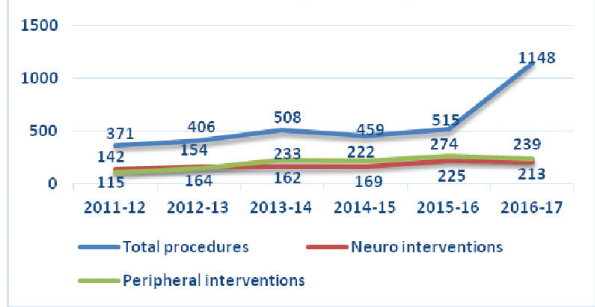


Figure 23. Trends of neuro intervention procedures in the last 6 years

During the year, the mortality and morbidity rates, and hospital-acquired infection rate in the Department were less than 1%. The average length of hospital stay was 5 days and bed occupancy rate was 97.67 %.

The statistics for the imaging complex in 2016-17 are indicated in the Table below:

Imaging procedure	Number
MRI scan	5371
CT scan	8159
Ultrasound scan	3398
X-ray	28628

New Initiatives

Five new procedures initiated this year in the NIC are listed below:

1. Use of new, fully retrievable flow diverter for the treatment of cerebral aneurysms
2. Use of balloon angioplasty in the treatment of cerebral vasospasm
3. Use of low profile stents in the treatment of cerebral aneurysms
4. Use of new, hybrid stents in the treatment of carotid stenosis
5. Use of arterial bifurcation implant for embolization of vein of Galen malformation

Awards and Honours

1. Dr Chinmay Nagesh, second year DM student, secured Certificate of Merit in the 102nd Scientific Assembly and Annual Meeting of Radiological Society of North America for his papers titled 'Arterial Spin Labelling MR Perfusion in Symptomatic Epilepsy: Delineating the Epileptogenic Zone' and '3D Rotational Angiography in the Demonstration of the Dural Vasculature.' Dr Chinmay also secured second prize for the paper 'A Comparative Study of Detachable Tip Microcatheters Versus Conventional Microcatheters in the Embolization of Brain AVMs' at ISVIR 2017, Kolkata.
2. Dr Jospaul Lukas, second year DM resident, secured first prize in the quiz conducted at ISVIR 2017, Kolkata.

Faculty

Dr T R Kapilamoorthy, Professor and Head of the Department
Dr C Kesavadas, Professor
Dr Bejoy Thomas, Professor
Dr E R Jayadevan, Associate Professor
Dr Santhosh Kannath, Associate Professor

Technical staff

Ms Githakumari V, Junior Scientific officer
Mr Alex Jose, Senior Technical Assistant
Ms Sheeba Kumari R, Technical Assistant - B
Mr Johnson C, Technical Assistant - B
Mr Krishna Kumar, Technical Assistant - B
Mr Vikas N, Technical Assistant - B
Mr Mahesh P S, Technical Assistant - B
Mr Joyi K, Technical Assistant - B
Ms Sandhya V, Technical Assistant - B
Mr Babunath B, Technical Assistant - B

DEPARTMENT OF MICROBIOLOGY

The Department provides accurate and quick reports and consultant clinical microbiology services. It liaises with the Hospital Infection Control Unit.

Activities

Bacteriology and Mycology

There were 6 cases of infective endocarditis caused by rare organisms such as, *Wangiella dermatitidis* (Figure 24) and *Abiotropha defectiva*. Other rare isolates included *Brucella melitensis, Burkholderia pseudomallei,* and *Rhizobacterium radiobacter.*

Mycobacterial culture was positive in 12 cases and TB PCR was positive in 2 cases.

Different species of Candida like - *C.parapsilosis, tropicalis, famata, glabrata, haemolunii,* and *Trichosporon asahii* were recovered from various specimens.

Serology

A new Nephelometer was installed in May 2016 and used to perform ASO, CRP, RF, C3 and C4 tests.

Thyroid Function Tests, procalcitonin, and viral serology for HIV, HCV, and HBsAg were also performed. There was an unprecedented increase in procalcitonin testing, with 851 samples during the year.

Molecular Diagnostics

The RT-PCR for encephalitis viruses and tropical fever panel was standardised and 72 samples were tested. Anti-microbial resistance gene detection test was carried out on 36 isolates, with detection of metallobetalactamase in 6 of them.

Research Programmes

For the project on Nosocomial infections due to resistant Gram-negative bacteria, data collection and analysis were completed.

PGDHA study on patient satisfaction was completed.

New Initiatives

1. RT-PCR for encephalitis viruses and tropical fever organisms was introduced.
2. Test for identification of anti-microbial resistance genes was set-up.
3. The proposal for institutionalisation of homograft project was accepted.
4. The existing computer programme was modified to obtain data on sensitivity to antibiotics for each bacterium and to generate the antibiogram for antibiotic policy.

Events organized by the Department

1. The Department helped organise Hand Hygiene Day activities with Hospital Infection Control Unit.
2. The first meeting of reconstituted HICC with 52 members was held in September 2016.

Awards and Honours

Professor Kavita Raja successfully completed PGDHA course from Apollo Medvarsity.

Faculty

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

Technical

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

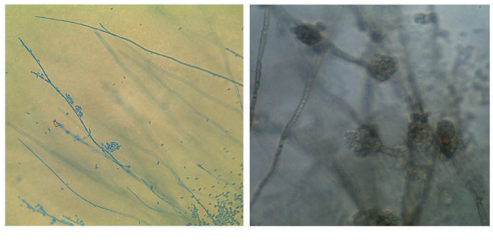


Figure 24. Wangiella dermatitidis isolated from a case of infective endocarditis

DEPARTMENT OF NEUROLOGY

The Department comprises multiple sub-sections, which provide specialized and comprehensive care to patients with various neurological disorders. Apart from daily general neurology outpatient clinics, there are weekly specialty clinics for review of patients.

A total of 50666 outpatients were reviewed in general and specialty outpatient clinics and 3311 inpatient admissions were made in 2016-17 (Figure 25). The average length of inpatient stay was 5 days with a bed occupancy rate of 98.81%, bed turnover of 57, the bed strength in neurology being 60. The mortality rate was 1.03 %.

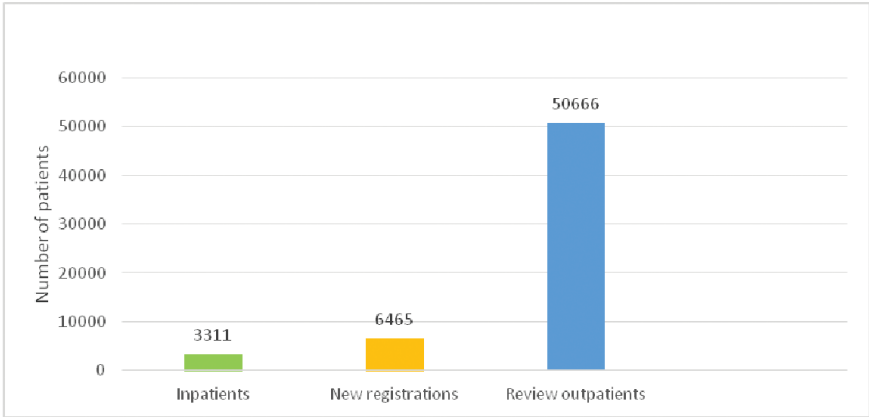


Figure 25. Outpatient and inpatient care in Neurology Department in 2016-17

In 2016-17, the Institute received a major funding from the Federal Bank as part of their corporate social responsibility activities to establish a "Comprehensive Care Centre for Neurodevelopmental Disorders". This project will be implemented in SCTIMST and at the National Institute of Speech and Hearing (NISH) in two phases. An MoU was signed with NISH to facilitate co-operation in research and academic activities.

As part of the move to completely digitize the medical records of the Institute, the Electronic Medical Record system was made fully functional in the Neurology outpatient department from 3 October 2016. The system allows viewing of records related to each patient from a single portal and electronic entry of new details.

The faculty and students of the Department took part in many national and international conferences and received several prestigious awards during the year. Many major research projects were pursued, resulting in notable publications. The Department participated in many outreach programmes and camps as well. The Athiyanoor Clinic outreach programme was attended fortnightly by Neurology consultants and residents.

Neuromedical Intensive Care Unit

Neuromedical Intensive Care Unit (NMICU) is an eight-bed ICU, which delivers high quality neurocritical care to patients with a variety of neurological emergencies like status epilepticus, meningitis, encephalitis, Guillain-Barré Syndrome, and myasthenic crisis.

The ICU had 145 admissions in 2016-17 as indicated in the Table below:

Diagnosis	Number
Status epilepticus	26
Meningitis (Total)	19
Chronic meningitis - Tubercular	*10*
Acute Pyogenic Meningitis	*2*
Aseptic Meningitis	*2*
Carcinomatous Meningitis	*3*
Miscellaneous	*2*
Demyelinating disorders of the CNS (ADEM, MS, NMOSD etc.)	13
Super refractory status	11
Acute stroke	8
Myasthenia gravis with crisis	7
Autoimmune encephalitis	5
Cerebral venous sinus thrombosis	4
CIDP	3
GBS	3
Motor Neuron Disease with respiratory failure	3
Rasmussen's encephalitis	3
Viral encephalitis	1
Others	39

The special treatments and procedures conducted in NMICU during the year are given in the Table below:

Procedure/ Treatment	Number
Plasma Exchange (PLEX)	15
Continuous EEG monitoring	11
IV Immunoglobulin administration	9
Rituximab administration	3

Patient care facilities in NMICU were augmented by the acquisition of four new ventilators and two calf pumps. Efforts are ongoing to establish Neurocritical Care Team comprising neurologists, anaesthesiologists, neurosurgeons, infectious disease specialists, microbiologist and neurocritical care nurses.

COGNITIVE AND BEHAVIOURAL NEUROLOGY SECTION

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

Activities

1. Conducting a Memory and Neurobehavioural Clinic every week that caters to patients with mild cognitive impairment (MCI) and dementias
2. Comprehensive assessment of patients with cognitive problems admitted to the Institute
3. Counseling and psychosocial support for caregivers of patients with dementia
4. Research activities on structural and functional neuroimaging in dementias, as well as development and validation of neuropsychological batteries
5. Conducting cognitive retraining sessions for patients with MCI

The routine activities during the year are listed in the Table below:

Activities	Number
Speech and language evaluation	2084
Neuropsychological testing	1300
Memory and neurobehavioural clinic attendance	480
Audiometric evaluations	319
Speech therapy	220
IQ assessments	152
Counseling sessions	70
Cognitive retraining	27
Video fluoroscopic assessment	20

Research Programmes

A project on "Effects of Yoga meditation on neuropsychological functions and brain connectivity

networks in mild cognitive impairment (MCI) and cognitively normal subjects" was initiated.

New Initiatives

A new facility for cognitive rehabilitation in MCI and early dementias was started.

Events organized by the Department

A public-contact programme related to World Alzheimer's Day was conducted on 21 September 2016. The chief guest was Hon'ble Speaker of Kerala Legislative Assembly, Mr P Sreeramakrishnan and the Chair was Dr M D Nair, Head of Neurology, SCTIMST.

Awards and Honours

1. Ms Sheela Kumari was awarded Doctorate for her work titled "Role of quantitative neuroimaging techniques for the mapping of in vivo brain changes in frontotemporal dementia" on 23 January 2017.
2. The article titled "A hospital-based registry of Creutzfeldt-Jakob disease: Can neuroimaging serve as a surrogate biomarker?" was awarded the 'Best paper in Neurology India Award 2016' at the Annual Conference of Neurological Society of India, Chennai, in December 2016.

COMPREHENSIVE CARE CENTRE FOR MOVEMENT DISORDERS

The Comprehensive Care Centre for Movement Disorders (CCCMD) at SCTIMST has been providing comprehensive medical and surgical management to patients with Parkinson's disease (PD) and other movement disorders, referred from all over the country. The Centre is the pioneer for deep brain stimulation surgery (DBS) in the country and continues to be one among the leading centres in India. The Division trains senior residents in Neurology and conducts post-doctoral fellowship programmes for neurologists from various parts of India in advanced medical and surgical management of movement disorders. PhD programme is conducted to train researchers in cutting-edge research in the basic science aspects of the field.

Several international collaborative and in-house research projects were carried out in the Centre, which covered the clinical, genetic and neurophysiological aspects of movement disorders. Two new externally-funded research projects (funded by the Department of Science and Technology and Indian Council of Medical Research) were initiated while a third one has received technical and financial approval from the Science and Engineering Research Board. Apart from these, Dr T S Ravi Kumar Foundation, USA, donated Rs. 16,77,000/- for the enhancement of research and clinical activities of CCCMD. Four scientific articles were published. The faculty delivered lectures and made scientific presentations in various national and international scientific forums.

Activities

The clinical activities included weekly movement disorders clinic offering comprehensive care (medical management, physiotherapy and rehabilitation, counselling) to patients with PD and other movement disorders, surgical programme (DBS and other surgical treatments for patients with PD and various other movement disorders) and the Botulinum Toxin Injection Clinic. In addition, the motor physiology laboratory under the CCCMD performed electrophysiological investigations like tremor analysis. More than 550 referrals were received through the General Neurology OPD, from all over the country, for the management of patients with PD and other movement disorders. The weekly Movement Disorders Review Clinic had more than 2400 patient visits, which is a 30% increase over the previous year. Thirty-eight patients underwent DBS surgeries/Pulse Generator replacements. The DBS surgeries were done with state-of-the-art microelectrode recording techniques to ensure accuracy of the electrode placement in the brain (Figure 26). These patients needed regular programming sessions and 68 such DBS programming sessions were conducted for patients on follow-up. Nearly 300 sessions of botulinum toxin therapy were conducted for patients with focal and segmental dystonia, spasticity and hemifacial spasm. Around 40 transcranial magnetic stimulation and other electrophysiological studies were conducted in

the motor physiology laboratory.

Research Programmes

A new research project aimed at examining the physiological basis of the salutary effects of yoga on the neural control of movements was initiated. This project, funded by the SATYAM Programme of the DST, also aims to examine the beneficial effects of yoga in patients with PD (Figures 27 & 28). Another 3-year project, funded by the ICMR and initiated during the year, aims at a longitudinal follow-up of cognitive functions in patients with PD using a compendium of Neuropsychological tests including the Montreal Cognitive Assessment (MoCA) whose Malayalam adaptation had been validated and published earlier. Financial approval was obtained from the Science and Engineering Research Board for a third new initiative, in collaboration with the All India Institute of Medical Sciences, to address the development of an automated tremor analysis system to differentiate different types of diseases causing tremor, analysing patient's hand-drawn Archimedes spirals.

In addition to these three newly-initiated research projects, several externally-funded and in-house research projects were ongoing. The collaborative project with the University of Tubingen, Germany (funded by the Michael J Fox Foundation, USA) is aimed at elucidating the genetic perturbations underlying Parkinson's Disease in the Indian population. The project "Cerebellar control of synaptic depotentiation at the primary motor cortex and implications for levodopa-induced dyskinesias" examined whether the loss of depotentiation of motor cortex synapses that occurs in dyskinetic PD patients can be restored by cerebellar stimulation. The study is expected to advance our understanding of the role of cerebellum in the genesis of levodopa-induced dyskinesias in PD a step forward. Another study, "Encoding interhemispheric interactions: a window to the pathophysiology of dystonia", funded by the Dystonia Medical Research Foundation USA, explored the mechanisms underlying focal hand dystonia. The connections between the cerebellum and the basal ganglia, and their alterations in various stages of PD, were studied in the project "Resting state connectivity between the basal ganglia and cerebellum in health and Parkinson's disease: a combined functional magnetic resonance and diffusion tensor imaging study". Other internally-funded and non-funded projects examined changes in impulsivity following DBS surgery for PD, prevalence of non-motor fluctuations in PD and the impact of DBS on non-motor fluctuations.

Many scientific findings of high relevance to the pathogenesis and management of movement disorders emerged from the completed research projects. A study in CCCMD demonstrated that spermine, a polyamine, was able to prevent manganese-induced neurodegeneration in worm (Caenorhabditis elegans) models expressing alpha-synuclein, providing insight into the interactions between alpha-synuclein and polyamines (Figure 29). The protein alpha-synuclein contributes to the pathogenesis of several neurodegenerative disorders, including PD. These findings open a new avenue for research on neuro-protective interventions in PD and other neurodegenerative diseases. In a study which measured the plasticity of motor cortex and its cerebellar modulation in drug-naïve PD patients who were longitudinally followed up, it was found that measurement of motor cortex plasticity at baseline could identify patients developing early motor complications. In another completed research project, certain variants of dopamine receptor gene (p.Ser9Gly (rs6280) CT genotype) were found to be associated with impulse control disorders in PD patients undergoing treatment. In a study using a computational spiking network model of basal ganglia, sub-thalamic stimulation was noted to lead to impulsive decision making in PD. Position of the electrode and stimulation intensity were found to influence impulsivity, explaining the variable effects of STN-DBS on impulsivity reported in patients.

Product Development

Deep Brain Stimulators are costly and currently imported. A project to develop the deep brain stimulation technology, including the clinical team

of the CCCMD, and the engineering and scientific teams of Biomedical Technology Wing, had been initiated in the previous year. The prototype and work procedure were developed, and charge distribution and conductivity studies in phantom models were undertaken. The Bhabha Atomic Research Centre is collaborating with SCTIMST and an MoU was signed for the same on 11 August 2016.

Events organized by the Department

An awareness programme and interactive session on Parkinson's Disease aimed at the patients and caregivers was conducted on 11 April 2016 at SCTIMST.

Awards and Honours

The research paper titled "The decade after subthalamic stimulation in advanced Parkinson's disease: A balancing act", published in Neurology India, received the Neurology India Award for the best surgical paper of 2016.

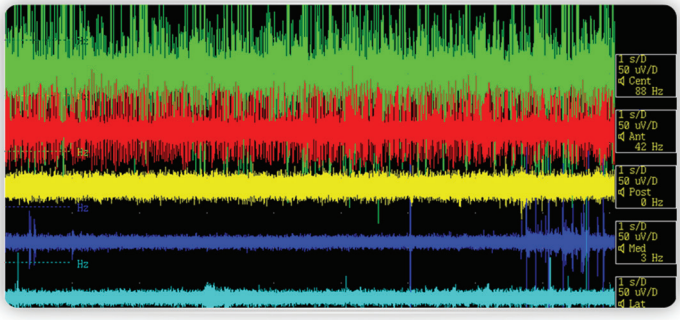


Figure 26. Micro-electrode recording from the subthalamic nucleus of the brain in a patient undergoing Deep Brain Stimulation surgery for Parkinson's Disease

Figure 27. Yoga training to patients with Parkinson's Disease

Figure 28. Motor physiology experiments conducted in the Motor Physiology Laboratory, as part of the SATYAM project to explore the effects of Yoga on motor cortex plasticity, motor learning and motor deficits of Parkinson's Disease

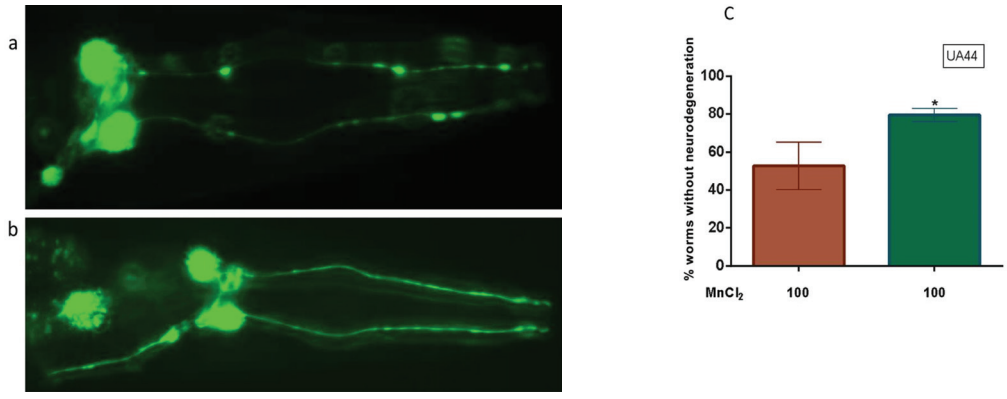


Figure 29. (a) Representative image of Caenorhabditis elegans expressing alpha-synuclein tagged to Green Fluorescent Protein, showing neurodegeneration upon exposure to manganese chloride (MnCl2) as evident from breaks and blebs in the dendrites (b) Representative image of a worm showing normal dendrite when exposed to MnCl2 in presence of spermine (c) The graph shows that the percentage of worms without neurodegeneration are significantly high in the group treated with spermine

COMPREHENSIVE CENTRE FOR SLEEP DISORDERS

Comprehensive Centre for sleep disorders under the Department of Neurology conducts weekly Sleep Clinics for the diagnosis of patients with sleep disorders and follow-up of patients on Continuous Positive Airway Pressure (CPAP) therapy. In addition, it has a two-bed sleep laboratory and conducts 16-20 sleep studies per month on an average, including diagnostic polysomnographies and CPAP titrations.

Activities

The summary of the services provided by the Centre during the year is in the Table below:

Services	Number
Sleep Clinic visits	560
Total number of sleep studies	198
Polysomnography	122
CPAP titrations	65
Multiple sleep latency test	11

Research Programmes

A study titled "Do cardiovascular patients with obstructive sleep apnea have adverse perioperative outcomes - a prospective study" was initiated in February 2017 in collaboration with Anaesthesia and Cardiovascular and Thoracic Surgery Departments.

New Initiatives

The Centre initiated a patient education programme before Sleep Clinic every day for 30 minutes. The programme is conducted by a medical social worker who educates patients on sleep disorders and their management.

COMPREHENSIVE CARE CENTRE FOR STROKE

The Stroke Centre, in addition to delivering high quality clinical services to patients with acute and subacute stroke, also conducts research and was part of several international and national collaborations during the year.

Activities

The Stroke Centre has a seven-bed ICU with facilities for hyperacute care of stroke patients, including intravenous thrombolysis and mechanical revascularisation in collaboration with Interventional Radiology Department. The Centre is one of the leading centres for surgical and endovascular carotid revascularisation and Moyamoya revascularisation. The Section conducts a weekly outpatient clinic for stroke patients in addition to providing comprehensive rehabilitation services to stroke survivors, integrating physiotherapy and speech therapy with special thrust on caregiver-based long-term rehabilitation.

The services provided by the Centre during the year are tabulated below:

Service	Number
Outpatients	3052
Stroke admissions	495
Carotid endarterectomy	50
Intravenous thrombolysis	30
Mechanical thrombectomy	18
Moyamoya revascularisation	18
Intracerebral hematoma evacuation	6
Carotid artery stenting	5
Decompressive craniectomy	2

Research Programmes

1. The study titled "Head Post Trial", which is an international trial evaluating the head position of acute stroke patients, completed recruitment of patients in November 2016.

2. The ATTEND trial, a multi-centre study of caregiver-based rehabilitation in stroke, was completed and the completion report was submitted to IEC in September 2016.
3. Stroke Centre is part of the Indian Stroke Clinical Trial Network funded by the ICMR and is in the initial phase of the study "Secondary Prevention by Structured Semi-Interactive Stroke Prevention Package in India (SPRINT INDIA)". Our Centre is the national coordinating centre for the South Indian sites in the trial.

In addition to the many externally-funded projects, the Centre also had several ongoing and completed intramural projects in 2016-17

The ongoing studies are:

1. Impact of cerebral microbleeds on hematoma volume, expansion and outcomes in ICH-a, a retrospective study
2. Effective combined visual auditory sensory stimulation in hemi-neglect syndrome following right hemispheric ischemic stroke
3. Economic and social burden of stroke

The completed studies were:

1. A study of vascular risk factors as a predictor of white matter disease in patients with acute ischemic stroke
2. Anticoagulant versus antiplatelet in extracranial carotid and vertebral dissection
3. Utility of high resolution contrast enhanced MRI for intracranial vessel wall imaging in differentiating intracranial vasculopathy in Indian population
4. Short-term and long-term risk of vascular events following early treatment of TIA and minor stroke
5. Clinical presentation and long-term outcome of patients with atherosclerotic extracranial bilateral internal carotid artery occlusion
6. CT Swirl sign as a predictor of hematoma expansion and outcome in spontaneous intracerebral haemorrhage

New Initiatives

An MoU was signed with John Hunters Hospital, Australia, in July 2016 for extension of the study, INSPIRE, a CT perfusion registry of stroke patients.

Awards and Honours

Dr Veena Vedartam, Neurology senior resident, received the best paper award at the Annual Conference of the Indian Stroke Association, March 2017, Amritsar.

NEUROMUSCULAR DIVISION

The Neuromuscular Division caters to two broad groups of disorders: (a) the neuromuscular disorders which include anterior horn cell diseases, neuropathies, myopathies and neuromuscular junction disorders, and (b) acquired central nervous system demyelinating disorders like multiple sclerosis and neuromyelitis optica spectrum disorders. The patient care services include a weekly Neuromuscular Clinic and neurorehabilitation meeting in addition to routine management of these patients 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 two post-doctoral fellows during 2016-17. The consultants and fellows participated in various national and international conferences as faculty and delegates.

Activities

The Neuromuscular Clinic functions on Tuesday of every week. In 2016-17, the Clinic recorded 1766 patients which is a 5% increment over last year. A patient management conference focussing on rehabilitation of patients with significant physical disability was organized on all Tuesday afternoons. The session was attended by Neurology consultants, physiatrist, speech therapist, occupational therapist, medical social worker, post-doctoral fellow and neurology residents.

The Multiple Sclerosis (MS) Clinic was started with the aim of streamlining management and follow-up of patients with multiple sclerosis and functioned on the second Tuesday of every month. The Clinic specifically addressed disease- modifying therapy, rehabilitation needs and social problems in multiple sclerosis. In addition, other central nervous system demyelinating disorders like neuromyelitis optica were also reviewed in the clinic. The clinic had 117 patients during the year.

The routine studies conducted in the electrophysiology laboratory during the year are summarized in the Table below. Significant advancement was made in the field of single fibre EMG, with axonal stimulation single fibre EMG (SFEMG) studies being done routinely. A student project to standardize the values of jitter in normal controls and myasthenia gravis in our population was approved by the Institute Ethics Committee. Other advanced electrophysiological studies of interest performed were mandibular repetitive nerve stimulation and paired blink reflex studies.

Study	Number
Nerve conduction studies	1292
Electromyography	800
Visual evoked potential	454
Brainstem auditory evoked potential	191
Repetitive nerve stimulation	137
Somatosensory evoked potential	103
Single fibre EMG	27
Blink reflex studies	26

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

Procedure	Number
Genetic studies	74
IV immunoglobulin	57
PLEX	15
Nerve biopsy	15
Muscle biopsy	11
Thymectomy (for myasthenia gravis)	5

Research Programmes

The intramural projects completed in 2016 were student projects on "A clinical study on the utility of nerve biopsy in peripheral neuropathy" by Dr Jitesh Goel, under the guidance of Dr M D Nair and "Association of HLA - DRB1 *1501 tagging rs3135388 gene polymorphism with multiple sclerosis susceptibility" by Dr Arun K, under the guidance of Dr C Sarada and Dr Moinak Bannerjee.

"Guillain-Barré Syndrome - predictors of outcome" was an ongoing observational study to identify the prognostic factors in patients admitted in the acute stage of all forms of Guillain-Barre Syndrome. A comparative study on voluntary versus axonal stimulation single fibre EMG was newly initiated which aims to standardize the jitter values in stimulated SFEMG against the current standard voluntary SFEMG in normal controls and myasthenic patients. Another ongoing study was the comparison of jitter values in surface stimulation versus voluntary SFEMG. A pilot study to test the android application developed for augmented communication in patients with speech impairment in motor neuron disease in collaboration with CDAC awaited IEC clearance. The study was conducted by Dr Ajay Asranna under the supervision of Dr M D Nair. Dr Deepak Menon, PDF completed two studies on the "Profile of mitochondrial myopathies" and "Case series of dorsal herniation of spinal cord". Two non-funded retrospective projects were ongoing in the Division – "Clinical and electrical profile of Charcot-Marie-Tooth disease" and "Clinical profile of acquired CNS demyelinating disorders".

The Division collaborated with the Biomedical Technology Wing (Principal Investigator: Dr Jayasree) to develop an optical probe for nerve stimulation studies.

PAEDIATRIC NEUROLOGY SECTION

Activities

The Section caters to the broad specialty of neurological problems in children with special focus on neurodevelopmental and metabolic disorders. The Autism Clinic functioned on the first and third Saturdays of every month, and registered 74 new cases during the year. Children with neurodevelopmental disorders such as autism spectrum disorders, attention-deficit/hyperactivity disorders, learning disability, intellectual disability and social communication disorders were managed with multi-disciplinary care in the Autism Clinic. Patient management conference for complicated cases were organised twice a month, involving the paediatric neurologist, physical, occupational and speech therapists and psychologist. Paediatric neurology meetings, involving senior consultants and residents were also conducted weekly. There were 281 paediatric neurology admissions for evaluation and management. They consisted of static encephalopathy, paediatric epilepsy, autism spectrum disorders and childhood movement disorders. Seventy-four new cases and 49 review cases were examined in the Autism Clinic and the distribution of cases is given in the Table below:

Diagnosis	New	Review
Intellectual disability	30	19
Autism spectrum disorder	20	11
Cerebral palsy	17	12
ADHD	4	2
Speech and sound disorder	2	5
Specific learning disability	1	0

New Initiatives

The Institute received a major corporate social responsibility funding of Rs 2.19 Crores from Federal Bank Hormis Memorial Foundation for the five-year project "Comprehensive Care Centre for Neurodevelopmental Disorders" in January 2017. An MoU was executed between Federal Bank Hormis Memorial Foundation and the Institute on 13 January 2017 towards establishing the Centre (Figure 30).

The Institute entered into an MoU with National Institute of Speech and Hearing, Trivandrum, on 5 July 2016 to foster academic and research interests between the Institutes (Figure 31).

Figure 30. Signing of MoU between Director, SCTIMST and Shri Raju Hormis, Head, CSR, Federal Bank to establish "Comprehensive Centre for Cognitive Rehabilitation of Children with Neurodevelopmental Disorders"

Figure 31. Signing of MoU with NISH

R MADHAVAN NAYAR CENTRE FOR COMPREHENSIVE EPILEPSY CARE

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

Activities

The services provided in the RMNC during the year are summarized in the Table below:

Services	Number
Video EEG monitoring	1635
Epilepsy surgery	123
Intraoperative ECoG	108
Intracranial monitoring	12
WADA test	12
Cortical stimulation and mapping	1

In addition to routine clinical activities in the hospital, the Centre also conducted many patient outreach programmes. Twelve epilepsy clinics were conducted at the Primary Health Centre in Changaramkulam in collaboration with the Alamcode Panchayat Committee. A weekly special clinic for women with epilepsy was also conducted at the Women and Children Hospital, Thycaud, Trivandrum. Two epilepsy awareness and diagnostic medical camps were also organized. One post-doctoral fellow, Dr Sai Sathish, completed his training in December 2016.

Events organized by the Department

International Epilepsy Day is observed on the second Monday of February every year, as declared by the International Bureau of Epilepsy (IBE) and International League Against Epilepsy (ILAE). A programme in connection with the International Epilepsy Day was observed in RMNC on 15 February

Figure 32. Shri Viji Thampi speaking at the International Epilepsy Day Programme at the Institute

Figure 33. International Epilepsy Day Programme at the Institute

2017 (Figures 32-34). Shri Viji Thampi, renowned film Director and Cine Artist, was the Chief Guest and Dr M D Nair, Head, Department of Neurology, presided over the function. The meeting was followed by a panel discussion where doctors and therapists discussed various problems faced by epilepsy patients.

Awards and Honours

Dr Manna Jose was awarded best paper award in medical category for the paper titled "Teratogenic effects of carbamazepine in mice" at the 18th Joint Annual Conference of Indian Epilepsy Association & Indian Epilepsy Society, 17-19 February 2017, Patna.

Faculty

Dr Muralidharan Nair, Professor (Senior Grade) and Head of the Department
Dr Sanjeev V Thomas, Professor
Dr Abraham Kuruvilla, Professor
Dr Sylaja P N, Professor
Dr Ashalatha R, Additional Professor
Dr Sajith S, Additional Professor
Dr Syam K, Additional Professor
Dr Ramsekhar N Menon, Associate Professor
Dr Sapna Erat Sreedharan, Associate Professor
Dr Ajith Cherian, Assistant Professor
Dr Sruthi S Nair, Assistant Professor
Dr Soumya Sundaram, Assistant Professor

Technical Staff

Ms Nandini V S, Senior Scientific Assistant
Ms Preetha Govind G, Senior Technical Assistant
Ms Salini K R, Technical Assistant - A
Mr Pradeep M J, Technical Assistant - A
Ms Shana N Nair, Technical Assistant - A
Mr Anees C A, Technical Assistant - A

Medico-social Workers

Dr K Jayachandran, Senior Scientific Officer
Mr Unnikrishnan J P, Junior Social Worker

Therapists

Ms Aley Alexander, Senior Psychologist
Mr Gangadhara Sarma, Psychologist B
Ms Lincy Phillip, Occupational Therapist
Ms Manju Mohan, Speech and Language Pathologist

DEPARTMENT OF NEUROSURGERY

The Department ensures surgical management of cerebrovascular disorders, neuro-oncology, epilepsy, paediatric neurosurgery, movement disorders and spine diseases. The faculty has extensive experience in surgical management of these disorders. It is the only Centre in this part of the country that caters to such wide spectrum of disorders and is a pioneer in the government sector with a structured programme for the treatment of patients with neurosurgical conditions. The Department aims at delivering quality health care using state-of-the-art equipment while keeping in mind the socio-economic factors of the patient population and cost-effectiveness. It also strives to generate a new breed of young neurosurgery talents who will propagate this mission all over the country. The number of observers from various teaching hospitals in the country has doubled.

The residency programme is highly structured, and trains four residents per year to develop specialists who will excel in neurosciences and possess skills required to pursue an academic career or clinical practice. Significant exposure to a range of disorders and bedside discussions on technical problem-solving and decision-making aspects of neurosurgery make them independent in clinical and operative decision-making. Regular teaching rounds, seminars, journal discussions and neuro-radiology sessions contribute to the evolution of better patient management strategies.

Activities

The three major arms of patient care in the Department - outpatient clinics, inpatient wards and ICU care and operating theatre services ensured quality service to patients seeking tertiary neurosurgical care. 1357 surgeries were performed in 2016-17, including complex neurovascular, skull base, endoscopic and functional surgeries.

Awards and Honours

1. Professor Suresh Nair was elected Secretary of World Federation of Skull Base Societies during the 7th International Congress of the World Federation of Skull Base Surgery Congress in June 2016 at Osaka.
2. Professor Suresh Nair was part of the Indian delegation invited by "The Overseas Human Resources and Industry Development Association" of Japan in October 2016. As part of that, he participated in the 75th Annual Meeting of the Japanese Neurosurgical Society at Fukuoka, delivered a guest lecture on facial nerve preservation techniques for giant vestibular schwannomas at the Department of Neurosurgery, Osaka City University School of Medicine, and visited the Department of Neurosurgery at Nara University School of Medicine.
3. Professor Suresh Nair was elected President of the Neurological Society of India (NSI) during the Annual Conference of NSI in December 2016 at Chennai.
4. Dr Jayanand Sudhir, Assistant Professor, attended the 7th India-Japan Neurosurgical Conference in Osaka on 18 June 2016 and participated in the International Indo-Japanese Fellowship at Kyorin University in Tokyo during 20-24 June 2016.
5. Dr Prakash Nair, Assistant Professor, was awarded the Indo-Japanese Microneurosurgery Fellowship to Wakayama Medical University in 2016 and the Minimally Invasive Endoscopic Brain and Skull Base Fellowship at Weil Cornell Medicine, USA, in 2017.

Faculty

Dr Suresh Nair, Professor (Senior Grade) and Head of the Department
Dr Mathew Abraham, Professor
Dr Easwer H V, Professor
Dr Krishnakumar K, Additional Professor
Dr George Vilanilam, Additional Professor
Dr Jayanand Sudhir, Assistant Professor
Dr Prakash Nair, Assistant Professor

DEPARTMENT OF PATHOLOGY

The Department provides round-the-clock laboratory and autopsy services, participating in academic activities and carrying out cutting-edge research to understand the cause and development of cardiovascular and neurological diseases.

Activities

The Department provided surgical and autopsy services, and immunology tests pertaining to cardiovascular, thoracic and neuropathology to the clinical departments. The surgical services were augmented by the introduction of several newer immunohistochemical tests. These helped diagnose and report tumours according to the latest recommendations of WHO 2016 for diagnosis and classification of tumours of the nervous system and lung. The clinical services provided by the Department this year are summarized in the Table below:

Category	Number
Total Surgical Cases	1292
Neurosurgical biopsies	*841*
Cardiothoracic biopsies	*451*
Immunohistochemistry	2726
Immunopathology Tests	4212
Squash Preparations / Frozen sections	313
Cytology	27
Autopsy	3

Nerve biopsy was introduced and, with the receipt of the cryomicrotome, muscle biopsies were re-initiated for Neurology Department.

The faculty were actively involved in inter-departmental teaching programmes for DM and MCh students from clinical departments and MD Transfusion Medicine. The Department also hosted two MD Pathology students from Pushpagiri Medical College, Thiruvalla.

Research Programmes

1. Rheumatic heart disease

Studies on rheumatic disease by Dr Deepa Surendran, PhD scholar, continued under the guidance of Dr S Sandhyamani. The studies showed the presence of degraded proteoglycans and fibrin within fibrinoid material in several excised rheumatic valves. Immunohistochemistry demonstrated the presence of Group A Streptococci also within many such affected valves.

2. Moyamoya disease

Histopathological examination of dural tissue used for improving circulation in cases of Moyamoya disease, showed distinct mucoid arteriosclerotic changes in the blood vessels. These were in the form of diffuse wall thickening with increased deposition of abnormal mucin, degenerative changes in elastic lamina with eccentric partial occlusion of the lumen in some and micro-aneurysms in a few cases. These changes resemble the pathological lesions described in blood vessels to the brain in Moyamoya disease. Such insidious involvement of the external carotid artery branches in the dura is indicative of a systemic vascular disorder whose etiopathogenesis needs to be investigated in detail. The Department continued to provide support to student projects.

Awards and Honours

Dr Rajalakshmi P received the International League Against Epilepsy (ILAE) scholarship to attend the 5th International Summer School for Neuropathology and Epilepsy Surgery (INES) 2016, 6-9 October 2016, Erlangen, Germany

Faculty

Dr S Sandhyamani, Professor and Head of the Department
Dr Deepti A N, Associate Professor
Dr Rajalakshmi P, Assistant Professor (from August 8, 2016)

Technical Staff

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

The Comprehensive Multi-disciplinary Pain Clinic, comprising faculty from Physical Medicine and Rehabilitation, Anaesthesiology, Radiology, Neurosurgery and Neurology, completed 5 years of activity on 31 March 2017. Pain Clinic patient management decisions were taken on a broad multi-disciplinary-based consensus.

Activities

The services provided in the Clinic (Figure 35) included:

1. Transforaminal fluoroscopy-guided injections
2. Trigger point injections
3. Musculoskeletal infiltrations
4. Ultrasound-guided sacro-iliac joint interventions
5. Selective dorsal root ganglia radiofrequency ablation (ultrasound-guided)
6. Facet joint interventions (fluoroscopy-guided)
7. Epidural steroid and anaesthetic injections
8. Radiofrequency ablation in trigeminal neuralgia (fluoroscopy-guided) and CT confirmation of ablator tip
9. Radiofrequency ablation of stellate ganglion in chronic regional pain syndromes (ultrasound-guided)
10. Ultrasound-guided stellate ganglion block
11. Prolotherapy and platelet rich plasma for regenerative therapy
12. Ultrasound-guided nerve blocks and pharmacologic decompression therapy
13. Ozone therapy

Figure 35. Procedures performed in the Pain Clinic

Organization of the Pain Clinic

The multi-disciplinary Pain Team comprises faculty, students and nursing staff from the Departments of Anaesthesiology, Physical Medicine and Rehabilitation, Intervention Radiology, Neurosurgery and Neurology, and a dedicated Pain Nurse.

The referrals to the Clinic included:

1. Persons presenting with chronic non-cancer pain syndromes unresponsive to conventional therapy from specialty units in Kerala and adjoining states
2. Low back and cervical pain syndromes, neck pain, musculoskeletal pain syndromes, facial pain, nerve entrapment syndromes, shoulder girdle and arm pain, painful digits, chronic complex regional pain syndrome, post-herpetic neuralgias, post-operative pain syndromes and, claudication pain syndromes. Patients with poor response and tolerance to medications, patients with poor surgical risk, predictable unfavourable surgical outcome and/or refusal or unwillingness for surgery despite multiple counselling were considered for minimally-invasive procedures.

Though the main focus was on patients suffering from chronic non-malignant pain, the team was also equipped to treat patients with intractable cancer pains.

During the year, 682 patients were catered to in the clinic and intervention suites. Major interventions (under fluoroscopy - trans foraminal, sacro-iliac joint injection, facet joint injection, stellate ganglion block/ radiofrequency ablation, Gasserian ganglion radiofrequency ablation, intra-discal ozone injection) were performed in 18 patients and minor interventions (nerve block, plexus block, musculoskeletal injections/ infiltrations, trigger point injections) were performed in 53 patients, as indicated in the Table below:

Procedure	Number
Review patients	546
Second opinion referrals	60
Minor interventions	53
Major interventions	18
Trigger point injections	10
Musculoskeletal infiltrations	17
Musculoskeletal anaesthetic with steroid injections	11

Awards and Honours

The leading national newspaper 'The Hindu' hailed the Pain Clinic of SCTIMST as a unique service in Trivandrum city in its edition on 29 June 2016 (Figure 36). It was cited as a specialized destination for medical care in the city.


THE HINDU, WEDNESDAY, JUNE 29, 2016

Keyhole Surgeries

Keyhole procedures become the new standard for complex neurological surgeries

The Capital of Care!

The state's capital proves a health care hub with many public and private hospitals offering comprehensive care. High-tech infrastructure and state-of-the-art technologies make them quality health care providers

Figure 36. Feature on Pain Clinic in 'The Hindu'

Faculty

Dr Rupa Sreedhar, Professor, Anaesthesiology
Dr Nandakumaran Nair U, Visiting Professor, Physical Medicine and Rehabilitation
Dr Easwar H V, Professor, Neurosurgery
Dr Subin Sukesan, Associate Professor, Anaesthesiology

DEPARTMENT OF TRANSFUSION MEDICINE

The Department improved its services and academic activities during 2016-17. The Department achieved its goal of 100% voluntary blood donation and had the distinction of becoming the first blood bank to achieve this in the state.

Activities

The Department supported 1268 cardiac surgery, 1380 neurosurgery and 737 paediatric surgery patients for their transfusion needs. 10918 blood components were issued to in-house patients and 6054 units to outside hospitals. Presently, the blood bank is supporting the entire transfusion requirements of the Institute inpatients without asking for replacement donation by patients and relatives, thus alleviating their burden. SCTIMST is the first blood bank to achieve this in the state, and the first hospital-based blood bank to do so in the country.

Research

Platelet components are more sensitive to temperature than the other components. In order to evaluate the quality of components prepared from blood collected from mobile camps, a comparative study of the quality parameters of platelet concentrates prepared from these blood units were done with that of blood collected in-house. It was demonstrated that the quality of these products were comparable.

Another study was done to find the frequency and severity of adverse reactions after blood donations in the mobile camps in comparison with in-house donation.

Training

The Blood Bank is a recognized National AIDS Control Organization, Government of India training centre in the State for Medical Officers, Nurses and Technicians working in the field. Twenty-seven Medical Officers, 25 Nurses and 33 Technicians underwent training in modern blood banking techniques organised by the Kerala State AIDS Control Society.

Postgraduate students from the Department of Pathology, Medical College Trivandrum, underwent one week training in the Department.

New Initiatives

1. The Department increased the number of mobile blood collection camps to meet the increased demand for blood products. The preparation of platelet products were also increased to tackle the in-house needs and support to other hospitals due to outbreaks of dengue.
2. A new donor web portal was launched to increase donor awareness and improve communication with donors and donor organizers.
3. Blood bank started transferring excess plasma to a plasma fractionation centre in exchange for albumin and immunoglobulin as per National Blood Policy.
4. The third version of the Standard Operating Procedure Manual was released.

Events organized by the Department

The Department celebrated the National Blood Donation Day on 1 October 2016. Hon'ble Minister of State for Health and Social Justice, Smt Shylaja Teacher, inaugurated the function. On this occasion, the Hon'ble Minister declared the Blood Bank as 100% voluntary and inaugurated the donor web portal (Figure 37).

Awards and Honours

1. The Department received the State Award for achieving 100% voluntary blood donation (Figure 38).
2. Dr Vinu Rajendran received the best paper award for his presentation "Achieving 100% voluntary blood donation - Experience of a tertiary care centre" at the ISBTI Kerala Chapter, 26 February 2017, IMA Kollam.

Figure 37. Hon'ble Minister of State for Health and Social Justice, Smt Shylaja Teacher inaugurating the National Blood Donation Day on 1 October 2016

Figure 38. Dr Jaisy Mathai receiving the State Award for achieving 100% voluntary blood donation

Faculty

Dr Jaisy Mathai, Scientist G (Senior Grade) and Head of the Department
Dr P V Sulochana, Scientist G
Dr Debasish Gupta, Professor
Dr Sathyabhama, Scientist G

Technical

Ms Sheeladevi S, Scientific Officer
Ms Sindhu P N, Junior Scientific Officer

BIOMEDICAL TECHNOLOGY WING

DEPARTMENT OF APPLIED BIOLOGY

The Department comprises the Divisions:
1. Experimental Pathology
2. Laboratory Animal Science
3. Microbial Technology
4. Molecular Medicine
5. Sleep Research
6. Tissue Culture
7. Tissue Engineering and Regenerative Technologies
8. Thrombosis Research
9. Toxicology

The Department plays a major role in providing biological testing support for product development activities of the Institute. A large number of tests performed by the different Divisions are accredited by the *COFRAC* and are availed by external customers from Indian and international industry and academia. Additionally, the Divisions are engaged in research on various aspects of applied biology, as detailed in the reports of the individual Divisions.

DIVISION OF EXPERIMENTAL PATHOLOGY

The laboratory is unique as a histopathology laboratory having facilities to undertake routine as well as a wide range of specialized techniques for evaluation of biocompatibility of various materials as per international standards and pre-clinical evaluation of medical devices as per approved protocols.

Product Development

The Division has developed an innovative, no-detergent/enzymatic method for preparing biomaterial-grade scaffolds from porcine cholecyst (gall bladder) (Figure 1), which can be used as wound healing matrix in different types of wounds.

Research Programmes

1. Biological evaluation of laser rapid manufactured Ti-porous structures

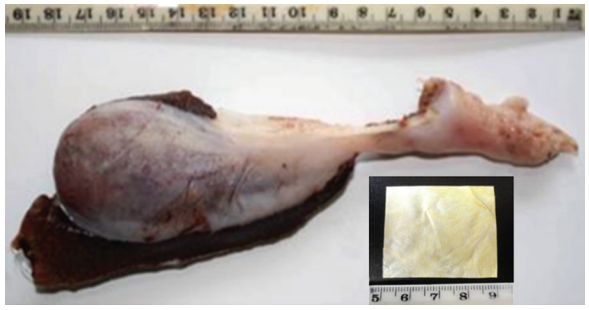


Figure 1. No-detergent/enzymatic method for preparing biomaterial grade scaffolds from porcine cholecyst

The work was mainly on the biocompatibility of Laser Rapid Manufacturing (LRM) technique of titanium (Ti) implants. It also included surface modification using anodization technique. The Ti porous structures developed by LRM method (Figure 2) were found to be cytocompatible and non-haemolytic. As the second phase, the osteogenic induction potential of LRM Ti structures was evaluated using rat bone marrow mesenchymal stem cells (MSCs). Real-time PCR analysis showed induction of a few osteogenic specific genes towards osteogenic lineage. These results revealed that the Ti porous structure has the potential to support or enhance osteogenesis in rat bone marrow MSCs. Similar osteogenic property was obtained with human osteosarcoma cell lines (HOS). The in vivo biocompatibility evaluation in rabbit models was done by implanting the sample rods in one femur, which was compared with normal titanium rod controls implanted in the other femur.

2. Biphasic hydroxyapatite-based keratoprosthesis evaluation in a rabbit model

Keratoprosthesis was designed and manufactured at the in-house facility. The animal model was created and the implantation of the prosthesis

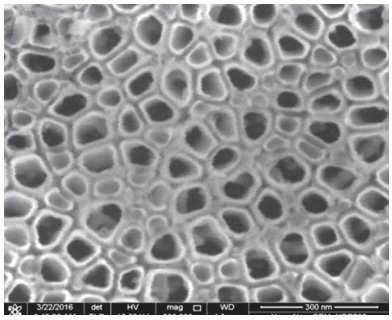


Figure 2. ESEM image of TiO2 nanotubular structures

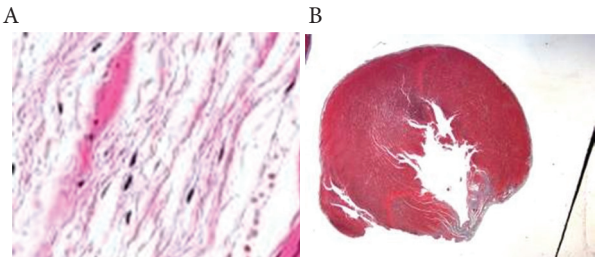


Figure 3. (A) Foreign body giant cell with phagocytosed foreign body in the cytoplasm; (B) Rat heart with fibrosed wall (myocardial infarct model)

was carried out in 5 animals. The surgical procedure was performed in two stages separated by a minimum of 3 months. Histological analysis of keratoprosthesis is ongoing in 2 animals that survived the multi-stage surgical procedure.

Testing and Evaluation

A total of 405 tissue specimens were received which included muscle, subcutaneous tissue with implant and bone with implant for biocompatibility evaluation as per ISO 10993-6 and pre-clinical evaluation specimens such as tissue-engineered scaffolds, vascular grafts, aortic patch, rat pups from teratology study, dental sockets, rabbit knee joint tissues and wound healing studies (Figure 3). Twenty eight test reports, which included accredited and non-accredited reports, were issued in 2016. *COFRAC* external audit was completed successfully in November 2016. The laboratory has maintained the quality system for the past 12 years and retained *COFRAC* accreditation successfully for intramuscular, subcutaneous and bone implantation tests, and mucosal irritation tests. The Division also performed autopsy as part of sentinel health monitoring programme for the Division of Laboratory Animal Science.

DIVISION OF LABORATORY ANIMAL SCIENCE

The Division facilitates research and testing using small laboratory animals by ensuring 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 DLAS is to breed, stock and supply good quality small laboratory animals for testing and research. The Division is under surveillance of *COFRAC* for the quality system. The Division is CPCSEA registered and has to its credit many work procedures maintained as per international guidelines applicable to the field. DLAS had set up a state-of-the-art experimental animal facility with Individually Ventilated Cages (IVC) System and changing stations. The Division also has several animal models that are used for biomedical research by investigators.

During this period, DLAS conducted 3 IAEC (Institutional Animal Ethics Committee) meetings on 02/01/2016, 28/11/2016, and 24/03/2017 and 2 ACAE (Advisory Committee for Animal Experiments) meetings on 01/10/2016 and 04/02/2017.

Research Programmes

The Division participated in the following projects by providing experimental support:

1. Alginate scaffold with recombinant growth factors for enhanced wound healing

2. Efficacy evaluation of insulin-loaded microneedles in diabetic animals
3. An optical peripheral nerve stimulator
4. Evaluation of lineage-committed progenitor cells upon transplantation in rat spinal cord injury and Parkinson's disease models
5. Bio-engineered skin graft for chronic wounds using 3-D hybrid scaffold made up of silk fibroin, fibrin and amnion
6. Pre-clinical evaluation of wound dressings in diabetic model
7. Role of nitrate/nitrite/nitric oxide pathway in the modulation of autophagy in diabetic heart
8. Effect of exercise training on mitochondrial metabolism and function in diabetic heart
9. Pre-clinical evaluation and commercialization of anti-snake venom (IgY), anti- hemotoxins and anti-neurotoxins
10. Studying the effects of HIF-1α stabilization on development and aging of murine neuronal and hematopoietic stem cells
11. Anti-hyperglycaemic activity of Aglaia extract in Swiss Albino mice

Testing and Evaluation

Technical assistance to support research includes simple procedures like blood collection and oral gavage and complex procedures like timed pregnancy and interventional animal models.

Animals bred and supplied from the Division for testing and research during 2016-17:

Rabbits NZW: Sctb - 125; Rats Wi:Sctb/SD:Sctb/SHR - 394; Mice BALB/c /SA:Sctb -582; and Guinea Pigs (HA:Sctb) - 195.

Training

The Division also carried out bi-annual training sessions for researchers in small laboratory animal handling, ethics and small laboratory animal welfare assessments. During the year, 2 sessions were conducted with 28 participants (MSc students and PhD scholars) from all over the country.

DIVISION OF MICROBIAL TECHNOLOGY

The Division specialises in microbiological evaluations of medical devices and biomaterials, works on quality platform and is accredited by *COFRAC* of France as per ISO 17025. The Division continued its focus on understanding medical device-related infections and supported medical device development.

Product Development

1. ***Rapidogram***

   The rapid UTI diagnostic kit (Figure 4) was in the technology transfer phase. During the year, the problems arising during shelf-life evaluations were addressed and resolved. This involved finalising the components of the vials for better stability and longer shelf- life.

Figure 4. Rapidogram, the rapid UTI diagnostic kit

2. ***Antibiotic from Bacillus active against Methicillin-resistant Staphylococcus aureus (MRSA)***

   The Bacillus strain was identified as Bacillus pumilis and the antibiotic was found to be extracellularly secreted. Currently, the factors influencing production of the antibiotic are being optimized.

Research Programmes

1. Immunomodulation by Pseudomonas biofilms

Biofilms are a complex aggregate of bacteria surrounded by a self-produced extracellular shell containing polysaccharide, protein and DNA.

It was observed that, irrespective of the class of antibiotic used, sub-inhibitory concentrations augmented biofilm formation. Analyses of gene expression patterns revealed that, upon administration of an aminoglycoside antibiotic at sub-inhibitory concentrations, the gene involved in quorum sensing (Las A and related effector molecule Tox A) get up-regulated. An alternative quorum sensing system regulated by RhlR was found to be down-regulated in the presence of gentamicin. Simultaneously, the minimal inhibitory concentrations and higher concentrations showed a reduction in the expression of the effector molecule of Las A quorum sensing system (Tox A). Further, delineating the role of Pseudomonas in ventilator-associated pneumonia, its interactions with endotracheal tubes were studied. Studies on triangular interactions between host cells and biofilms on endotracheal tubes showed that there was oxidative stress and up-regulation of reactive oxygen species (ROS) production at early time points.

2. ***Pulmonary fibrosis – role of nanoparticles***

   Nanoparticles are omnipresent in our day-to-day life and exposure to airborne particles induce chronic inflammation and epithelial injury in the lungs, and could promote pulmonary fibrosis. Diesel exhaust particle (DEP) and carbon black, common components of environmental pollution and well-known health hazards, were selected for the study. The material size characteristics were analysed using TEM, DLS (dynamic light scattering) and their cytotoxic potential was studied with MTT and ROS assay. The responses of alveolar epithelial layer to particles are important. A heterotypic in vitro model system is being developed to understand the multiple cell interactions using alveolar epithelial, fibroblast and immune cells.

3. ***Ventilator-associated pneumonia and role of endotracheal tubes***

   Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in the intensive care unit, leading to prolonged hospitalization, increased health care costs, and high attributable mortality. Acinetobacter baumanii is an emerging multidrug resistant pathogen in VAP. It is an opportunistic Gram-negative bacterium capable of surviving in adverse conditions such as desiccation, nutrient starvation and antimicrobial treatments. Ability of A. baumanii to form biofilm on endotracheal tubes is critical in this disease. Modulation of pathogenic genes like pili assembly and production of the Bap surface-adhesion protein play a role in biofilm initiation and maturation after initial attachment to abiotic surfaces. The toll-like receptors in the host cell help in pattern recognition and are responsible for mounting an immune response. The role of A. baumannii adhesion and biofilm formation was under investigation using in vitro systems.

Testing and Evaluation

The Division of Microbial Technology functions on the quality platform and is accredited as per ISO 17025. Evaluation of medical devices at various stages of development starting from facility monitoring upto experimental animal health monitoring was done by the Division. 57 test requests were handled this year in which 126 samples were tested. The tests conducted were as follows (with the number of samples in brackets), Sterility Test (18), In vitro Genotoxicity assay (2), Microbiological monitoring of air (40), Water Analysis (33), Spore Viability (1), Anti-microbial activity testing - Agar diffusion method (2), Growth Promotion Study in Media Validation (18), Antimicrobial activity testing - Dynamic contact method (4), and PCR (8).

DIVISION OF MOLECULAR MEDICINE

The Division focuses on neuronal connectome to understand how it functionally alters in neurological diseases. To elucidate the pathways, the model organism used is Caenorhabditis elegans. This organism has a simple nervous system consisting of 305 neurons that are mapped in fine detail. The connectomes are altered using various genetic mutations as well as by altering the expression profile of synaptic proteins. Besides, the study also involves training the organism for both short-term and long-term learning and memory to understand the neuronal connections and the molecular pathways involved in these basic functions of brain.

Product Development

1. ***Development of point-of-care molecular diagnostic kit for infectious diseases***
   Loop-mediated Isothermal Amplification (LAMP)-based molecular diagnosis kit for rapid screening of tuberculosis was initiated in collaboration with the Intermediate Reference Laboratory, Kerala State Tuberculosis Diagnosis Nodal Agency. The first stage of development was completed. The second stage focused on developing a device platform to perform the reaction. Conventional and microfluidics-based heating devices were considered and a discussion with IIT Kharagpur was initiated for collaborative development.

2. ***Development of recombinant growth factors for wound healing application***
   Recombinant growth factors, TGF-ß and VEGF, were found to have a critical role in wound healing. These human genes were cloned and the proteins were expressed to test their efficacy in the healing process. The results indicated a significant improvement in wound healing in the presence of these growth factors. A scaffold to release these growth factors in a controlled manner is being developed to further enhance the healing process.

Research Programmes

C. elegans connectome gives an excellent opportunity to study the role of connectome in functions like learning and memory as well as development of neurological diseases. A simple connectome of 305 neurons in this organism facilitates the study of functional alterations in synapses and in biochemical signatures. Tools like genetic mutations and chemical antagonists were used in this study to understand how the neurons communicate to store short-term and long-term memories. The focus was on NMDA, AMPA, serotonin and dopamine neurotransmitters and their connectomes to elucidate the pathways (Figure 5). Results suggested that short-term memory circuits overlap with long-term memory, but for the latter a large set of interneurons are required for storage. This information is critical because similar circuit variations have been documented in human brain as well. The results also suggested a central role for insulin in deciding the memory pathway. Besides, for storage of imprinted memories, the same neuronal circuits were shared. This indicated that each memory pathway induced different biochemical signatures within the same set of neurons, and a subset of neurons is critical in information storage in the nervous system.

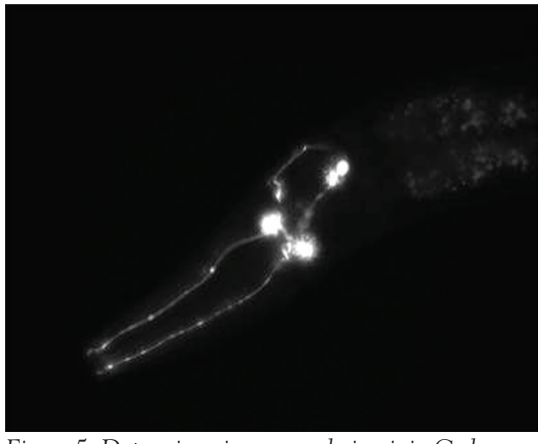


Figure 5. Dopaminergic neuronal circuit in C.elegans

DIVISION OF SLEEP RESEARCH

The Division aims at exploring the neural mechanisms involved in sleep regulation and conducting translational research in the emerging aspects of sleep medicine. 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 involving multiplexer system. Further, the role of pre-natal sleep in modulating cognitive behavior in offspring was examined. Sleep was monitored electrophysiologically by means of stereotaxically-implanted EEG and EMG electrodes. Active principles of medicinal plants were tested for regulation of sleep. The Division also provided extensive training to students in techniques to study sleep and cognition in free-moving animals.

Research Programmes

The Division of Sleep Research conducts extensive studies to explore the role of sleep in developmental programming for cognition. Insomnia and sleep disorders are frequent in all age groups. As sleep disturbance during pregnancy is an unequivocal concern, the current research programme focused on the effects of sleep loss during pregnancy and post-partum for cognitive development of babies. Sleep-wakefulness recordings, especially during pregnancy and infancy, are very challenging in human and animal models. We recorded sleep in albino rats during pregnancy, post-partum and after weaning, and also examined the associated changes in their anxiety levels. The novel research findings provided insight into the dynamic changes in sleep patterns during pre- and post-partum periods. This report provided crucial information on the diurnal and nocturnal variations in sleep-wakefulness and delta power along with adaptive changes in anxiety during pregnancy-postpartum continuum (Figure 6). The delta power, which is an indicator of homeostatic sleep drive, was increased during late pregnancy and after parturition suggesting the need for sleep amidst fragmented sleep. Post-partum sleep and anxiety were reduced in contrast to ante-partum levels. This study also provided an animal model for sleep disorders and drug trials during peri-partum window.

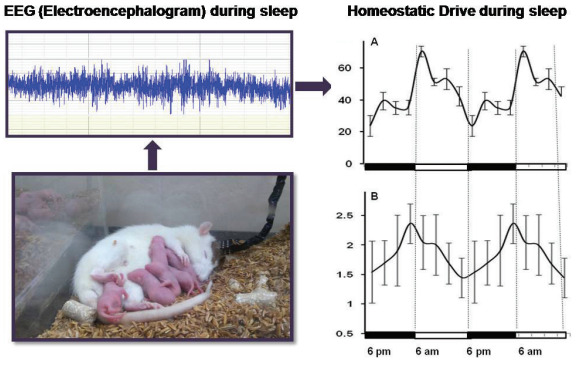


Figure 6. Changes in NREM sleep (A) and Delta power (B) during day and night in rat

The management of sleep loss and anxiety during pregnancy is a challenge as various anxiolytic and hypnotic medicines increase the risk to foetal development. The Division evaluated the hypnotic potential of alpha-asarone, an active principle of herb Acorus calamus, as a relatively safe substitute drug for insomnia.

DIVISION OF TISSUE CULTURE

Tissue Culture Division offers cell culture tests and studies to internal and external customers under the quality platform. The Division provides technical support for product development, participates in research and development activities and other academic programmes of the Institute. Research areas include cell-material interaction, stem cells and tissue engineering, 3-D tissue constructs and in vitro tissue models.

A new project with TRC funding was initiated on 3-D bioprinting of liver tissue constructs for in vitro hepatotoxicity testing. This is a collaborative work and Dr Anil Kumar PR was deputed to the Wake Forest Institute for Regenerative Medicine, North Carolina, USA, for 2 years for training in 3-D bioprinting.

Product Development

A polymeric cell culture substrate was developed for in vitro 3-D organotypic cultures. This soft culture substrate was fabricated in multi-well format for easy handling and culturing. It is optically clear, durable, flexible and non-fluorescing with the required mechanical properties, and will be useful for toxicity screening of chemicals and biomaterials.

A new design of a miniature bioreactor was designed and fabricated using 3-D prototyping for in vitro hepatotoxicity analysis (Figure 7).

The design provides the necessary fluid flow that mimics in vivo liver lobule. It could be used in the early stages of drug development, patient-specific drug screening and disease modelling.

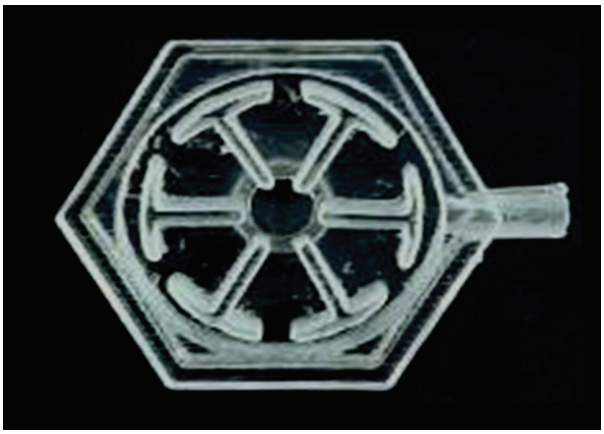


Figure 7. The bioreactor module prototype. Microfluidic channel mimics the fluid flow of liver lobule.

A novel polymeric formulation as a bio-ink was developed for cell encapsulation, tissue engineering and 3-D bioprinting. The multi-component extrudable hydrogel system contains a functionalized biopolymer, a photo-initiator and a cocktail of free radical scavengers.

Research Programmes

1. ***Bio-functionalized electrospun mat for wound management***

   In this study, porous polycaprolactone (PCL) mats were fabricated (Figure 8) and functionalized with thrombin to use as haemostatic agent to prevent excess blood loss from large area bleeding skin wounds. Bio-functionalization efficiency was analyzed. Fibrin clot formation and in vitro cytocompatibility assays confirmed biocompatibility.

2. ***Tissue- engineered myocardial patch by cell sheet engineering technology***

   Myocardial patch was developed on the in-house developed thermo-responsive polymer using differentiated mesenchymal stem cells from human umbilical cord (UCMSCs). The differentiation of UCMSCs and rat mesenchymal stem cells into cardiac lineage was achieved using the cytidine analogue, 5-azacytidine. The characterisation of the cells using cardiac markers was done using flow cytometric analysis. The retrieval of the differentiated cell sheet was standardised and its SEM analysis was performed.

   The rat myocardial infarction (MI) model for the pilot in vivo experiments on the transplantation of the differentiated cell sheet was developed by ligating the descending left coronary artery in Sprague Dawley rats. The model was confirmed by histological evaluation.

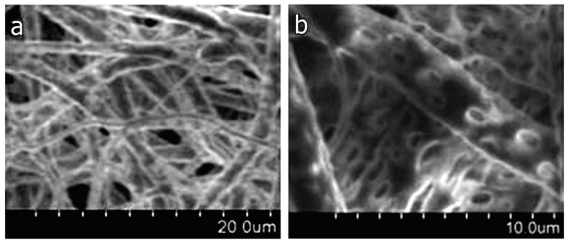


Figure 8. (a) SEM images of PCL Electrospun mat (b) Image showing porosity in fibers

3. ***Development of thick myocardial construct in "Slab Culture"***

   Thick myocardial construct was developed using "Slab Culture Technique" from differentiated mesenchymal stem cells on the in-house-designed thermo-responsive polymer-coated EVA well plate. The parameters and volume for the spin

coating of the culture dishes with NGMA (poly N-Isopropylacrylamide co- glycidylmethacrylate) were optimised. The thermo-responsiveness and efficiency of the spin coating were assessed using L929 cell retrieval. The water contact angle drop on lowering the temperature was assessed. The design of the EVA plates was laid down in-house and the plates were generated with a 1 mm thick rectangular well in the middle for cell seeding. Density of cell seeding and culture of the cells on the in-house designed EVA plates were standardised. The viability of the thick construct obtained was assessed by FDA-PI.

4. ***Alternate adult stem cells for ocular surface regeneration***

Adult stem cells residing in somatic tissues are an attractive source for tissue engineering because of their unique biological properties. In case of bilateral limbal deficiency, requirement of alternate cell source is more significant. Capacity of different mesenchymal stem cells such as bone marrow mesenchymal stem cells, adipose derived mesenchymal stem cells, hair follicular stem cells, oral mucosal progenitor cells and circulating blood progenitor cells to differentiate into corneal lineage was assessed. The cells obtained were characterized by morphology using phase contrast microscopy, and expression of characteristic protein markers evaluated by flow cytometry and immunostaining. The stemness of these cells was examined by their ability to differentiate into adipogenic and osteogenic lineages. The progenitor cells so obtained were directed to differentiate into corneal lineage using conditioned medium. The cells after induction for different time periods of 7, 14 and 21 days with the conditioned medium were under evaluation by flow cytometry, immunohistochemistry, western blot and QPCR.

5. ***Trans-differentiated Adipose-derived Mesenchymal Stem Cell (ASC) sheets for corneal surface reconstruction***

Adipose-derived MSCs were differentiated into corneal epithelial lineage and were then engineered to a sheet format for ease of transplantation. Corneal epithelial differentiation of MSCs was achieved by culturing MSCs for 14 days in limbal explant condition medium. Differentiation was confirmed by a terminal differentiation marker CK 3/12. Later, these populations were transferred to a NGMA dish for engineering the cells as a sheet structure (Figure 9).

Alternatively, these cells could also be cultured on NGMA to achieve corneal epithelial differentiation. These trans-differentiated MSC

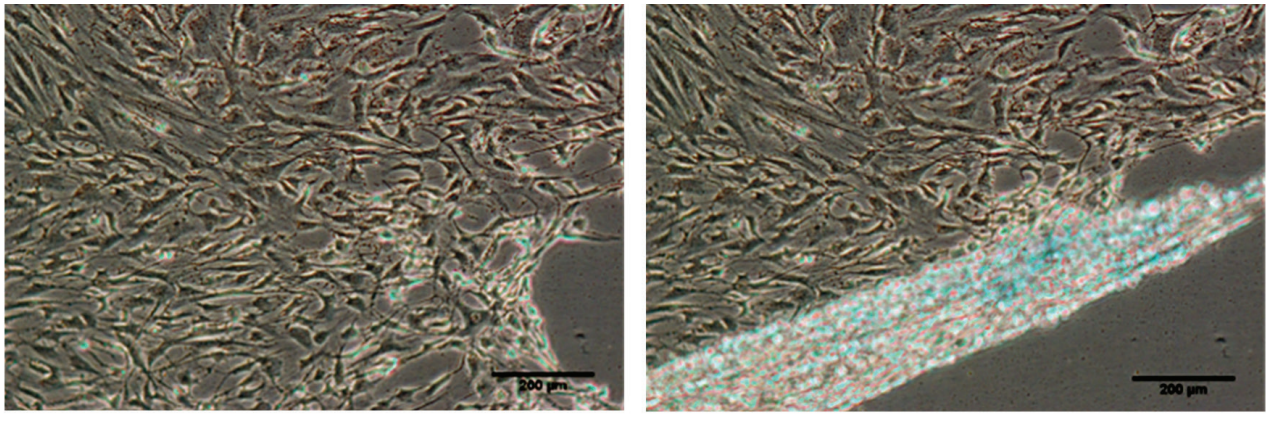


Figure 9. Retrieval of Mesenchymal Cell Sheet

sheets can be used for corneal epithelial damage therapies as an alternate cell source for limbal stem cells. Engineered sheets will ensure maximum donor cell presence in the damaged area.

6. ***Peripheral blood mononuclear cells (PBMNCs)***

PBMNCs were isolated from rabbit blood using density gradient centrifugation. Fibroblast-like colonies were observed within 10 days of in vitro culture. Proliferative and colony forming efficiencies were confirmed by population doubling experiment and colony forming unit assay. The stemness of these cells was confirmed by their ability to differentiate into osteogenic lineage as demonstrated by positive staining for Alizarin red and von Kossa. Positive staining for Oil red O confirmed the differentiation of these cells into adipogenic lineage.

7. ***Bio-functionalized thermo-responsive culture substrate for multipotent corneal stromal stem cells***

Thermo-responsive substrate was modified by conjugating amniotic membrane (AM)-derived proteins to NGMA. The cell sheet retrieval efficiency of AM-conjugated NGMA was also evaluated.

Amniotic membrane-derived proteins are conjugated to NGMA and, when run on an SDS PAGE, the conjugated proteins do not run down and are blocked due to their bulky size. In PNIPAAm, the proteins running down the gel is a direct evidence to say the GMA group has formed a bond with AM-derived proteins via the epoxy ring. The observations were confirmed using western blot analysis for AM-derived proteins, decorin, mimican and lumican (Figure 10). Decorin and mimican showed low expression of proteins which run down the lane through the gel, confirming that these proteins get conjugated and are bonded with the polymer. Lumican, being a large molecular weight protein, was not effectively conjugated. This protein-conjugated NGMA polymer was also validated with human corneal stromal stem cells for carrier-free cell

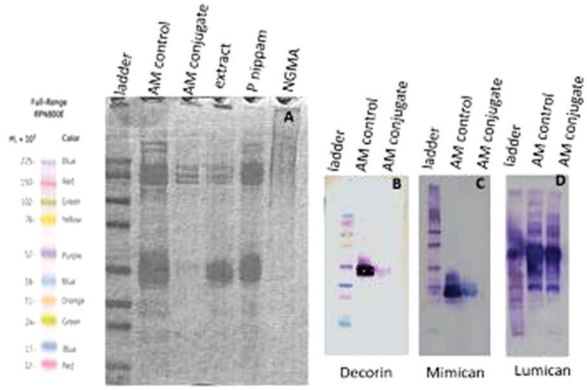


Figure 10. (A) SDS page analysis for AM protein alone (lane 2), AM NGMA conjugate (Lane 3), PNIPAAm conjugated Protein (lane 5) NGMA (lane 6) (B,C,D) Western blot analysis of (B) Decorin (C) Mimican and (D) Lumican of the NGMA conjugated AM and AM protein.

sheet after retrieval from the bio-functionalized NGMA (NGMA-AM pro). Corneal stromal stem cells (CSSC) were also grown on NGMA-AM pro and were cultured to confluence. At confluence, cells were retrieved as a sheet utilizing the thermo-responsive property of NGMA. 10% gelatin was used as the transfer agent.

8. ***Differentiation of dental pulp and periodontal ligament using modified calcium formulations***

The study involves development of cost-effective biomaterial towards regeneration of dental pulp and periodontal ligament. Apical papilla cells were evaluated as a suitable cell source for cell material interaction studies with modified bioactive calcium salts. They were isolated, cultured and their osteogenic potential was evaluated. Osteogenic potential of BioCaS cement using periodontal ligament cells (hPDLCell) was also evaluated. hPDLCell viability, adhesion and differentiation on calcium phosphates, calcium sulfates, BioCaS cements and sintered hydroxyapatite discs are ongoing. Cytotoxicity evaluation and cell adhesion tests were completed.

Testing and Evaluation

Accredited tests of in vitro cytotoxicity for biomaterials and medical devices based on international standards were carried out. Cytocompatibiltiy studies were also done for both internal and external customers. This year, more than 120 samples were evaluated in test mode and 4 in study mode, namely, in vitro evaluation of silk-based biomaterials, specific cytocompatibility and osteogenic evaluation of dental materials, osteogenic evaluation of biomaterial, and osteogenic and cytocompatibility evaluation of biomaterial.

A new in vitro test method was developed to study cell affinity towards biomaterials. In the evaluation of cytocompatibility, the cells are expected to show specific response towards a material. In the evaluation of wound dressing materials, conventional methods provide information on whether the cells adhere or not to the biomaterial. To understand the cell affinity towards a biomaterial, the new proposed method uses a combination of cell adherent and non-adherent surfaces together with the test material. This in vitro model will help understand cell adhesion affinity towards materials.

DIVISION OF TISSUE ENGINEERING AND REGENERATIVE TECHNOLOGIES

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

New Initiatives

1. A study to identify an injectable hydrogel for repair of cartilage injury and growth plate defects as a project with TRC funding
2. Developing a lint-free absorbent dressing for surgical and highly exudating chronic wounds as a project with TRC funding
3. A new design for osteochondral tissue engineering

Product Development

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

The treatment of articular cartilage injury is a challenge for orthopaedic surgeons because of the difficulty in achieving the actual regeneration of hyaline cartilage. The corrective surgeries for growth plate defects are highly invasive with limited effectiveness. Methods to induce cartilage regeneration and prevent undesirable bony repair through biological means are needed. An injectable hydrogel which will act as a delivery vehicle for chondrocytes for repairing growth plate defects was developed to serve this need. This hydrogel is an ideal and cost-effective solution that would not only help retain the clot and enable weight bearing, but also provide stability against compressive and shear forces. The dual property of the gel to retain the clot and to assist the delivery of autologous chondrocytes to the injury site will improve clinical effectiveness. An applicator system was also designed and patented for delivering the gel system (Figure 11).

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

This is the proof-of-concept phase in the designing of a medical dressing that is expandable, biocompatible, lint-free and soft, with fast wicking and high liquid holding capacity (Figure 12).

It has controlled pore size uniformly distributed throughout its volume. The uniqueness of this product compared to the other wound dressing

materials is that it would present a more pliable and foldable dressing as gauze roll.

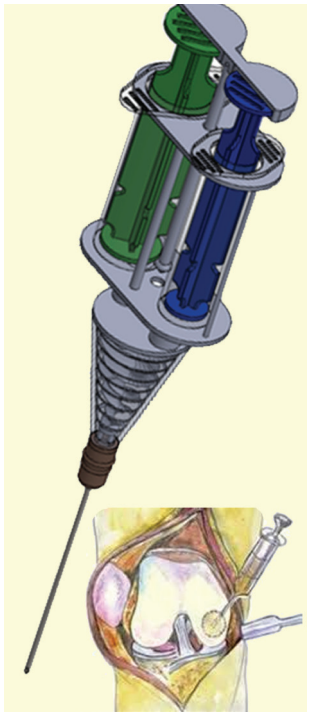


Figure 11. An applicator system for delivering the gel system

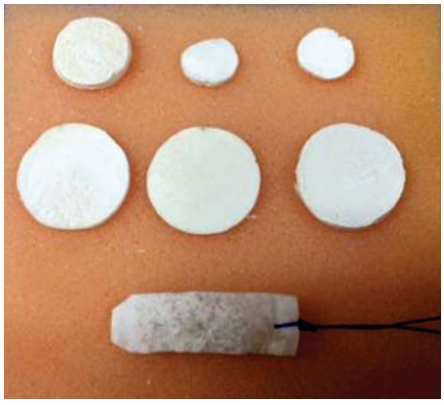


Figure 12. Lint-free, soft, absorbent dressing

Research Programmes

1. ***Highly porous 3-D electrospun scaffold for islet tissue engineering***

The physiological effect of tissue-engineered islet construct to reverse hyperglycemia in diabetic rat model was evaluated. The islet-like clusters (ILC) differentiated from rat adipose mesenchymal stem cells seeded on nanofibrous scaffolds were encapsulated in sodium alginate and implanted in the omental pouch of the diabetic rat. The diabetic animals without implant were used as controls. Rats implanted with differentiated ILCs had significantly lower glycemic level compared to diabetic controls (Figure 13).

Insulin, quantified in the blood serum of rats by ELISA, showed higher level of insulin expression in rats implanted with tissue-engineered constructs compared to diabetic control. The tissue-engineered constructs retrieved from the rats 60 days after implantation showed viable islet clusters, blood capillaries (Figure 14) and insulin expression.

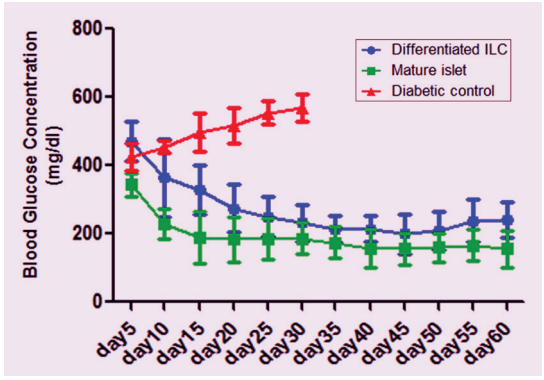


Figure 13. Fasting blood glucose levels of rats showed decrease in hyperglycemia in rats implanted with tissue-engineered construct

2. ***Synthesis of photoluminescent semi conductor ternary nanocrystals for biomarking and targeting***

A one-pot solvothermal synthetic method was adopted for synthesizing gram scale amount of ternary nanocrystals with photoluminescent characteristics. The synthesized crystals have nano-sized dimensions (hydrodynamic size)

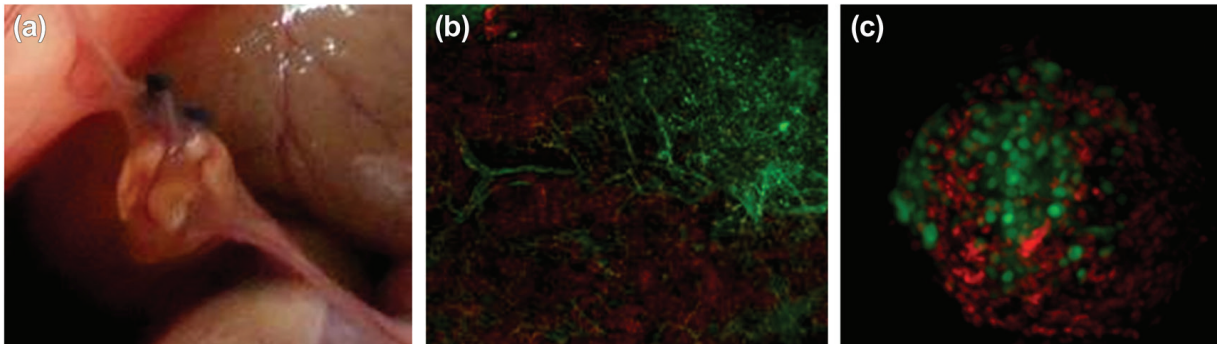


Figure 14. a) shows the retrieved implant, b) viable capillaries in the retrieved implant, c) viability of ILC in retrieved implant

with predominant fluorescent intensity. The synthesized crystals had very good stability at room temperature. They were phase-transferred into water for biomarking and targeting applications.

3. Silica-based nanocarrier system

An inorganic silica-based nanocarrier system was developed as carrier for short chain interference RNA (siRNA). A cationic polymer was synthesized and coated on the surface of the silica particles to deliver the genes into the cell cytoplasm. Fluorescent- tagged siRNA was used to deliver the genes inside the cells.

4. Tracheal tissue engineering

An electrospun fibrous tracheal tube was fabricated and its mechanical characteristics – tensile strength, suture retention and burst strength – were characterized. To improve cell penetration in the electrospun scaffold, rabbit chondrocytes were seeded while electrospinning. Live and dead staining showed that the new method did not compromise cell viability. IVIS imaging and histology showed the cells to be well-distributed in the 3-D matrix.

5. Controlled delivery of biological molecules using biodegradable microneedles

Non-invasive delivery of protein and peptide therapeutics has been a long-standing objective in pharmaceutical development. Microneedle (MN) arrays are minimally invasive devices that can be used to bypass the stratum corneum barrier and thus achieve enhanced transdermal drug delivery. PVA-based microneedles insulin were developed for the purpose and characterized for their mechanical stability. The MNs were found to be sturdy enough to penetrate the dermis of rabbit skin without fracture. Histopathological analysis showed that MNs could easily penetrate through the rabbit dermis (Figure 15).

As an additional application, they could be used as tools for creating micropits to house HFSC to develop a full thickness tissue-engineered skin graft (Figure 16). A patent application was filed on this concept.

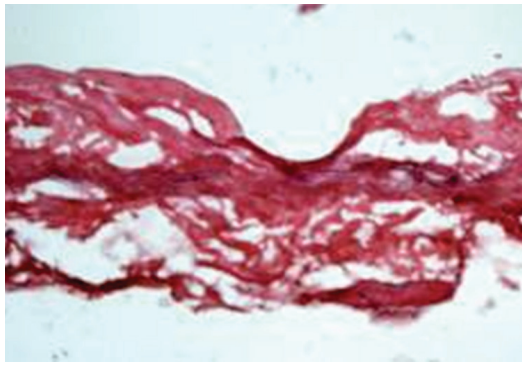


Figure 15. Histology of rabbit skin after insertion of the microneedle patch

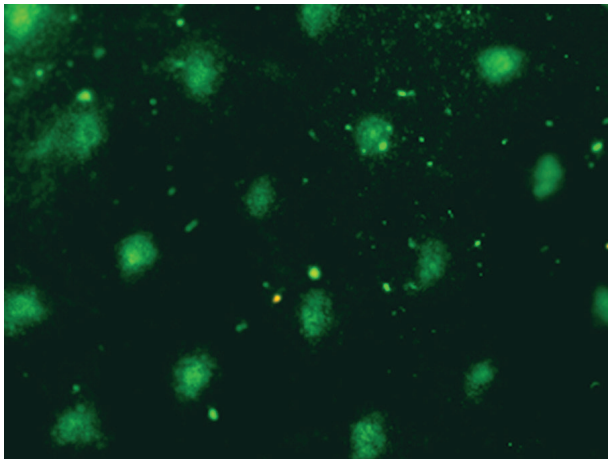


Figure 16. Fluorescent-tagged cells trapped in the micropits

6. ***Tissue- engineered small diameter small vascular graft***

   Tissue-engineered small diameter (5mm ID) vascular graft was fabricated from mesenchymal stem cell-derived smooth muscle cells and co-electro spun biomaterial (gelatin-vinyl acetate and poly caprolactone) and in vivo evaluation of patency and endothelization was done. Mesenchymal stem cells were isolated from ovine abdominal adipose tissue and differentiated into vascular smooth muscle cells on the tubular graft. The seeded and bare scaffolds were implanted as interposition carotid artery graft bilaterally in ovine model for a period of 3 months. 66.6% patency of the graft at both positions was obtained and confirmed after terminal angiogram of animals. The histological morphometry is in progress.

7. ***Development of layered skin construct using electrospun protein-PEG methacrylate blend***

   A single construct with distinct layers was designed in such a manner that skin-specific cells (fibroblasts, hair follicle stem cells and keratinocytes) could be seeded one over the other sequentially, thereby avoiding the hassle of the sandwich model in which the cell-seeded membranes are placed one layer over the other. The project also looked at the development of a method for placing hair follicle stem cells in microneedle- embossed three dimensional pits for the fabrication of a full thickness tissue-engineered skin construct.

DIVISION OF THROMBOSIS RESEARCH

The Division made significant progress in product development and research and contributed to testing services. Focus was on translation of the previous several years' research into clinical application. The technical staff were trained to maintain Class 100 clean room for processing plasma under aseptic conditions and were competent to work under Good Manufacturing Practice (GMP) conditions. A new project was initiated in collaboration with the Department of Biomedical Devices Engineering to develop a point-of-care instrument for measurement of prothrombin time (PT/INR) to monitor effectiveness of anti-thrombotic drugs. The stem cell research with potential future applications in regenerative medicine through cell/drug delivery and tissue engineering also made considerable progress.

During the year, the Division initiated three collaborative programmes. An MoU was signed with IIT Guwahati (IITG) to develop tissue-engineered skin substitute. A hybrid scaffold was designed using silk fibroin developed at IITG and fibrin developed at this Division as the major components. The scaffold is under evaluation using in vitro adipose-derived mesenchymal stem cell culture (ADMSC) system. Another MoU was signed with the Department of Biotechnology, Cochin University of Science and Technology (CUSAT), to carry out autologous stem cell transplantation in animal models for neural regeneration and a collaborative project was initiated. As part of product commercialization, an MoU was signed with an industry, New Medicon India, Pvt. Ltd., Chennai, to carry out systematic pre-clinical evaluation of anti-snake venom antibodies, to be used as therapeutic antibodies and based on the results, for further limited clinical trial.

Product Development

The Technology Proving Facility (TPF) for small scale manufacture, established by the Division, was inspected by the Drug Controller General of India (DCGI) office to verify if the Class 100 GMP facility was in accordance with the regulatory requirement. Based on their recommendation, test licenses were obtained for 3 products: Fibrin sealant, Albumin and Factor VIII. Fibrin sealant technology was ready for transfer to an industry. Based on CDSCO requirement, processing steps were standardized and 3 batches of fibrinogen concentrate were produced from 20L of pooled plasma. All 3 batches consistently yielded more than 300 vials of fibrinogen concentrate. Ion exchange chromatography was also scaled up and 2L of cryoplasma were processed to yield more than 300 vials of thrombin in each batch. Shelf-life studies were initiated with all 3 batches after normal proposed storage condition of 2-8 °C and accelerated storage condition of 20-22 °C. The product met essential regulatory requirements (IP/EP/WHO). Preliminary product design was made with clinician brochure, kit insert, printed box for packing etc. Methods for purification of Factor VIII from cryoprecipitate and albumin from cryo-poor plasma by employing chromatographic principles are being standardized.

An industry-linked project proposal was sanctioned by DPRP programme of Department of Science and Technology, Government of India, for pre-clinical evaluation of anti-snake venom. Preliminary planning was done with in-house collaborators for safety and efficacy evaluation and clinical investigators for limited clinical trial after the pre-clinical testing was found successful. The project terms were finalized and industry assured commercialization of the product if successful pre-clinical and clinical tests were completed.

The development of an assay platform for the measur -ement of prothrombin time (PT) with international normalised ratio (INR) is a novel programme initiated in collaboration with the Department of Medical Devices Engineering (DMDE) of the Institute. The investigators from the DMDE made a prototype with reaction channels, clotting time detection device based on image processing and a programme to compute the acquired data. The investigator from our Division completed a significant part of reagent standardization and initiated validation against the conventional measurement systems. A patent was filed.

Research Programmes

Platelet proteomic profiling from 20 control and 20 diabetic subjects was completed. Data analysis revealed the over-expression of a group of reactive oxygen-producing proteins and cardiovascular disease-related proteins and down-regulation of fibrinolysis, glycolysis and nitric oxide pathway proteins. The final report of the project was submitted to the funding agency, and the project is being extended for six months.

The student research programmes were all based on adipose tissue-derived mesenchymal stem cells (ADMSC). Major objective of the project was to standardize stem cell isolation and expansion procedure from adipose tissue; to standardize an isolation protocol for yielding sufficient number of MSCs; to estimate the proliferation potential of isolated MSCs; to characterize the culture-expanded MSCs using surface markers and to establish tri-lineage differentiation potential of expanded cells. Ongoing experiments are: (i) to lineage-commit ADMSC to different types of skin cells (dermal and epidermal), (ii) to lineage-commit ADMSC to different blood vessel cells such as endothelial cells and smooth muscle cells, (iii) to lineage-commit ADMSCs to different central nervous system cells such as neural progenitors and oligodendrocyte progenitors, (iv) to lineage-commit ADMSC to heart tissue cells such as cardiomyocyte progenitors and cardiac fibroblasts, (v) to lineage-commit ADMSCs to liver tissue cells such as hepatocytes; (vi) to lineage-commit ADMSC to chondrocytes; and (vii) to over-express vascular endothelial cell growth factor by genetic engineering of MSCs.

Testing and Evaluation

The Division has made a commitment to the testing and evaluation of biomedical devices that are being developed. New personnel were recruited for the purpose and training was completed. Several materials and devices such as stent and heart valve were evaluated as per the guideline in ISO 10993-part 4 for in vitro blood compatibility testing and

reports were issued. Inter-laboratory comparison (ILC) of parameters accredited by *COFRAC* was completed. The use of ILC data for assurance test quality was appreciated by the *COFRAC* assessor.

DIVISION OF TOXICOLOGY

The Division focuses on biomaterial toxicology and is accredited by *COFRAC* France as per ISO 17025. Full-fledged facility exists here for pre-clinical 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. The toxicity studies carried out during 2016-17 were closed patch test for delayed hypersensitivity (4), maximization test for delayed hypersensitivity (10), intracutaneous test (17), acute systemic toxicity test (12), implantation in muscle (1), pyrogen test (1), bone implantation (2), animal skin irritation test (3) and penile irritation test (1). Five reports were generated on the physico-chemical analysis of potable water for internal samples.

Product Development

The proof-of-concept for the development of an in vitro pyrogen test kit for the evaluation of pyrogenicity using human whole blood was completed. The validation process under different environmental conditions was initiated. This is an ELISA method for pyrogenicity assessment, suitable for a wide spectrum of applications to measure the undetected non-endotoxin pyrogens, such as pyrogens of chemical or biological nature.

Research Programmes

1. ***Interfacing of nanographene with mouse bone marrow mesenchymal stem cells and its allied molecular toxicity using in vitro and in vivo methods***
   This is an ongoing, ICMR-supported project which studies the immunotoxicity, biodistribution and toxicokinetics of nanographene.

2. ***Integration of nanographene with rat neonate cerebellar granule neurons and associated toxicity: an in vitro and in vivo approach***
   Characterization of granule neurons, feto-placental transmission of nanoparticles, bio-distribution, and toxicokinetics were studied in this project.

3. ***Interaction of brain astrocytes with zinc oxide nanoparticles and related inflammatory, immuno- and neurotoxicological response using rat model***
   In this UGC-supported project, the standardization and characterization of ZnO nanoparticles and astrocytes were completed. Target organ studies of ZnO, elemental analysis is underway.

Faculty

Dr Prabha D Nair, Scientist G, (Senior Grade), Head of the Department
Dr T V Kumary, Scientist G
Dr Lissy K Krishnan, Scientist G
Dr A Maya Nandkumar, Scientist G
Dr Mohanan P V, Scientist G
Dr Anoopkumar Thekkuveetil, Scientist F
Dr T V Anilkumar, Scientist F
Dr A Sabareeswaran, Scientist E
Dr Kamalesh K Gulia, Scientist E
Dr Anil Kumar P R, Scientist E
Dr Anugya Bhatt, Scientist E
Dr V S Harikrishnan, Scientist D
Dr Lynda V Thomas, Scientist D
Dr Remya N S, Scientist C

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Ms Usha Vasudev, Scientific Officer
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Dr Geetha C S, Junior Scientific Officer

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Ms Deepa K Raj, Technical Assistant
Ms Sreeja K R, Technical Assistant
Mr Joseph Sebastian, Technical Assistant
Mr Ranjith S, Technical Assistant
Mr Sarath Kumar R S, Technical Assistant
Mr Vinod D, Technical Assistant
Ms Nimi N, Technical Assistant

DEPARTMENT OF BIOMATERIALS SCIENCE AND TECHNOLOGY

The Department focuses mainly on the development of novel biomaterials and the translation of these technologies as viable, affordable products to industry. It consists of the Divisions of:

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

DIVISION OF DENTAL PRODUCTS

Two externally-funded and one internally-funded projects are currently ongoing in the Division. Technology transfer activities of four indigenously developed products were initiated. Radiopaque and bioactive composites were developed as part of ongoing collaborative DRDO project titled "Development of dental restorative based on inorganic-organic hybrid resin for barodontalgia". As part of the collaboration with DRDO, an MoU was signed to execute in vivo toxicological evaluation and pre-clinical studies initiated by DRDO using samples developed and supplied by our laboratory.

3-D bioprinting programme was initiated involving scientists and engineers from various departments. Clinically relevant models of prosthesis were also 3-D printed using poly lactic acid. A major focus was the development of bioink formulation for 3-D bioprinting of a liver tissue construct. Many polymers were screened to finally arrive at a suitable candidate for a bioink. After evaluation of various hydrogel formulations, a bioink formulation based on modified gelatine was zeroed in. Gelatine was modified by an improved buffer method and characterized for degree of substitution, gelling time, viscosity and cell viability. The printability of these hydrogels was also demonstrated and various complicated shapes were printed with them (Figure 17).

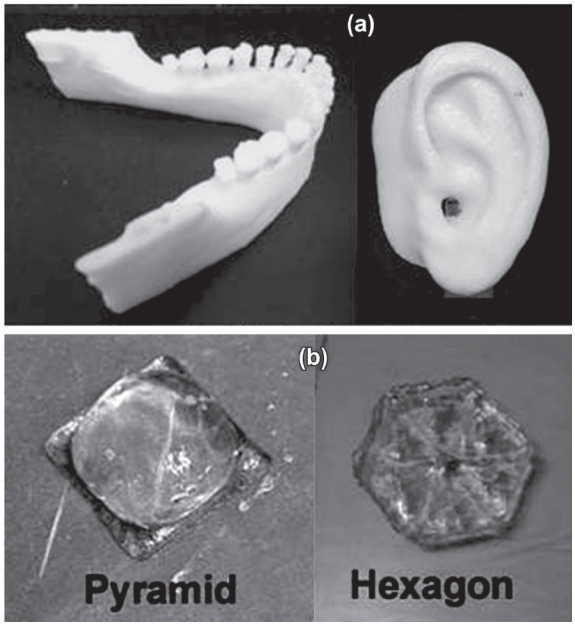

Figure 17. Demonstration of 3D printing (a) clinically relevant models (b) shapes with bioink gels

Industry collaboration continued with HLL Lifecare and Anabond Stedman Pvt. Ltd., to whom technologies were previously transferred.

Product Development

Bioactive radiopaque composite based on novel inorganic-organic hybrid resin was developed. These novel composites possess good mechanical properties with excellent bioactivity. In order to induce radiopacity to the composite radiopaque, glass filler was incorporated along with quartz. The linear polymerisation shrinkage was found low compared to Bis-GMA based composite. The cytocompatibility studies including in vitro cytotoxicity, cell viability and cell adhesion of the new composite showed that it is non-toxic in nature. In vivo toxicological evaluation of the new material was carried out in small animal

models. No abnormalities or loss in body weight was observed in mice during acute systemic toxicity evaluation. Injecting the extract of the powdered sample in rabbit did not elicit any skin irritation. No erythema or oedema was observed in guinea pig with intradermal or topical introduction of the sample. Short-term implantation studies are in progress.

The intrauterine device `EMILY' jointly developed by the Division and HLL Lifecare Ltd., created another milestone with the product being exported to African and Latin American countries.

Research Programmes

1. Development of new bioinks for bioprinting

During the year, novel bioinks were developed for 3-D bioprinting in the lab for liver construct development as part of TRC programme. Liver tissue constructs were developed using HepG2 cell lines and liver function tests are ongoing (Figure 18).

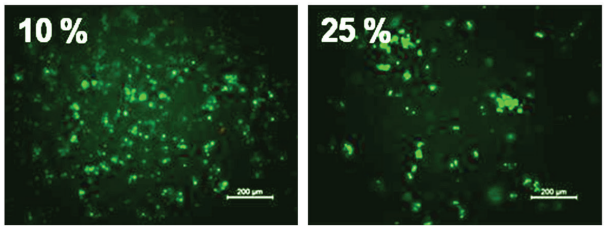

Figure 18. HepG2 encapsulation and viability in GeIMA

Testing and Evaluation

An amount of Rs 2,01,250/- was generated through internal and external testing of biomaterials by the Division during the year. Micro CT, particle size analysis and FT-Raman spectrometer were mainly used for testing of biomaterials.

DIVISION OF BIOPHOTONICS AND IMAGING

The Division is working mainly on the development of materials and devices for biophotonics applications in the field of sensing, imaging, diagnosis and therapy. Recently, nanosensors capable of sensing multianalytes simultaneously were developed. Sensors were designed to have different optical activity in the presence of different analytes. Using a novel 'zinc detector' developed under the collaborative project with CSIR-NIIST funded by DBT, the dynamics and translocation of zinc ions in epileptic conditions were successfully imaged. Currently, ongoing projects include development of nanoprobes for drug delivery and imaging of brain by attributing barrier crossing potential to the nanoprobe. Development of nanocarrier-incorporated stem cell delivery is also underway in the Division. The development of an optical peripheral nerve stimulator is also in progress under the TRC-funded programme. A multi-institutional project "Gold nanorod based targeted nanoprobe for cancer theranostics: Diagnosis by SERS and fluorescence imaging and therapy by PDT and PTT" in collaboration with CSIR-NIIST, funded by DBT, was initiated.

Product Development

The feasibility study of optical neural stimulation, which is expected to significantly contribute to the development of an optical peripheral nerve stimulator, is underway. This study is funded by TRC. The various stimulation parameters for peripheral nerve stimulation, effectiveness of the optical methods for nerve stimulation, reproducibility of the technique and the safety aspects are being evaluated.

Research Programmes

1. Study of mechanistic action of Vanadia nanoparticles on breast cancer cell line with emphasis on elucidating various cell death mechanisms is ongoing.
2. Small-sized gold nanoclusters were synthesised using a small capping agent. These were utilised

for sensing the neurotransmitter, dopamine. Anisotropic gold nanosystems with multiple sharp arms were successfully synthesised.

3. The dynamics of zinc ions in hippocampus in neurodegenerative diseases like epilepsy were studied in vitro and in vivo using a ratiometric fluorescent molecular probe, developed under a DBT-funded project.
4. Gold clusters were synthesised for gene regulation-based cancer therapy. Gold nanorod-based targeted nanoprobe, developed in collaboration with CSIR-NIIST, was found to be biocompatible and non-toxic.
5. A multifunctional theranostic probe based on gold-carbon nanocomposites was developed. Gold nanoparticles of different shapes were developed to facilitate photothermal chemotherapy, CT imaging and surface-enhanced Raman scattering by utilizing its surface plasmon absorption in NIR region. This gold-carbon system was further conjugated with an anti-cancer drug and a highly fluorescent photosensitizer to accommodate chemotherapy, PDT and fluorescent imaging modalities.

DIVISION OF BIOCERAMICS

The Division is engaged in developing bioceramics-based tissue repair materials for orthopaedics and dentistry. The most significant achievement of the Division during the period was the transfer of the know-how of the new bioactive calcium sulphate cement 'BioCaS' to M/s G Surgiwear Ltd. This is a cost-effective, self-setting bone filler cement useful for orthopaedic and dental applications. Personnel from the company were given training in the production of the material.

This year, the Division initiated two projects under Technical Research Centre. One is the "Development of drug-eluting ceramic platforms" aimed at making osteoconductive porous graft shapes for the treatment of bone diseases. The other is the design of "Bioactive inter-vertebral spacers for lumbar fusion", which is useful for vertebral fusion procedure to eliminate lumbar pain. A new project funded by DBT "Scaffolds based on self-assembling peptide dendrimers and resorbable calcium phosphates for endodontic tissue regeneration" was initiated. In this project, scaffold materials will be developed for the regeneration of tooth pulp and dentine to manage open-apex tooth.

Product Development

Bioactive beads of multi-modal porosity were designed for drug delivery in bone infections. The beads were made up of bioactive, osteoconductive and resorbable materials with micro and nano porosities. Drugs in liquid form could be loaded in them and implanted in the infected site. The drug elution would control the infection and the beads would eventually integrate with the host bone, leading to healing. Green bodies in the shape of beads were prepared by creating spherical drops of material slurry in a specially designed soft bed of hydrophobic powders. High temperature sintering step produced the final porous beads possessing multi-modal porosity. This innovative technique of bead preparation was automated using a pneumatic controlled auto-dispenser system so that beads of uniform sizes could be obtained (Figure 19).
Candidate antibiotics were loaded in liquid form into the beads of 3 mm and 6 mm diameters by syringe-suction and the elution characteristics were studied.

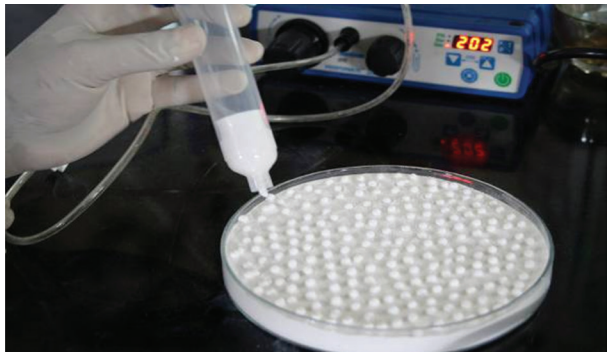

Figure 19. Pneumatic controlled auto-dispenser system to make beads

The in vitro drug elution lasted for a period of 20 days.

Spinal fusion is a common procedure done in the elderly to mitigate back pain arising from degenerative disc disease. Vertebral bodies, mainly in the lumbar region, are fused with autologous bone, placing specially shaped metallic devices known as spacers, to maintain the space. The design development of the interbody fusion devices was taken up with bioactive ceramic coating to achieve faster and stable fusion. Lumbar fusion device inserted through transforaminal route is more useful and hence this specific design was followed. A delivery tool was also designed which could steer the device into the disc space during surgery. Apart from this conventional device, an innovative design with articulating pin mechanism was designed to better anchor the device in the bone.

Research Programmes

1. ***Fast resorbing porous hydroxyapatite grafts by hydrothermal synthesis***

   Bioceramic bone graft materials synthesized through conventional high temperature sintering are slow resorbing in vivo. Faster resorption could be induced by making the material through hydrothermal ion exchange process. Tricalcium phosphate synthesized through wet chemical reaction was used as the precursor. The precipitate was dried and calcined, and subsequently pore formers were added and pressed into 'green' shapes using cold isostatic press. These were processed in 1M ammonium phosphate solution inside the hydrothermal reactor at 150 °C and for 8 h, at 6 bars pressure. The obtained material was characterized and identified to be phase-pure hydroxyapatite. The porosities, assessed through micro CT technique were in the range 60-125 microns. Bioactivity was ensured through in vitro cytotoxicity assay and immersion studies in simulated body fluid (SBF). The in vitro degradation study was conducted in phosphate buffered saline. The material showed faster resorption than conventional bioceramic, along with excellent bioactivity.

2. ***A composite gel of collagen and hyaluronic acid derivative***

   A biomaterial used as tissue engineering scaffold should be able to maintain cell shape, phenotype and promote extra cellular matrix (ECM) synthesis. Matrices based on collagen is popular, however, the cells grown on them appears flat, elongated and have spindle, dendritic or stellate morphology. Composite gels using collagen and hyaluronic acid dialdehyde (HDA, a derivative of hyaluronic acid) were developed for cartilage tissue engineering. The influence of matrix composition and its micro-architecture in regulating cell-shape were explored in cell culture in vitro. Cells in collagen-HDA hydrogels were spherical without any protrusions, similar to that in the native tissue (Figure 20).

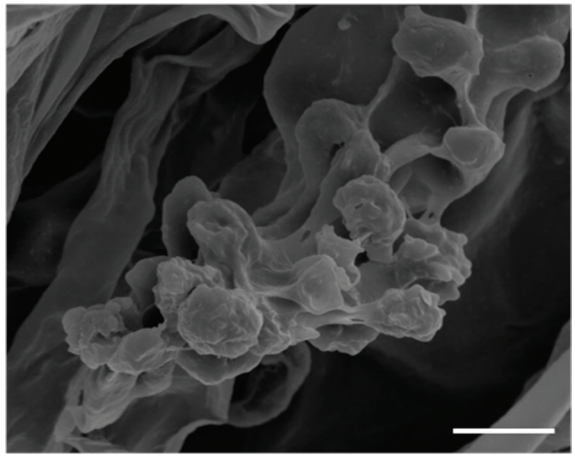

Figure 20. Chondrocytes grown over collagen-hyaluronic acid dialdehyde scaffold surface. The scale bar corresponds to 10 microns.

3. ***Synthesis of low dimensional bioactive monetite by solvent exchange method***

   A method was optimised to synthesize high purity low-dimensional monetite (CaHPO4, dicalcium phosphate anhydrous) for biomedical applications by solvent exchange in a polar aprotic medium. A stoichiometric aqueous solution containing calcium nitrate and phosphoric acid was prepared and the solvent was exchanged with acetone when fine particles of monetite were precipitated.

The particles were identified to be phase pure monetite having 10-20 microns size across with burr-like nano surface growth features (Figure 21). The material obtained was found bioactive in immersion test using simulated body fluid. Cell adhesion studies using L929 cell lines showed it to be highly cell compatible. The material is ideal for the use in bioceramics and bone cements. The monetite particles obtained possess large surface area per unit volume which makes them useful in designing bioactive cements intended for local drug delivery in the case of bone diseases.

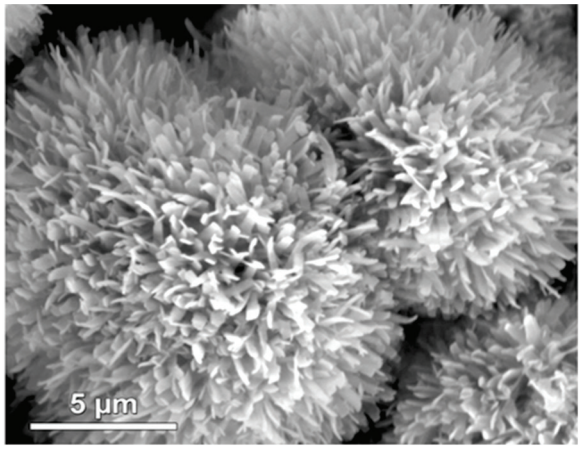

Figure 21. Monetite particles prepared through solvent exchange process having burr-like nanofeatures

Testing and Evaluation

The laboratory offered various tests for internal and external customers, including:

1. X-Ray Powder Diffraction
2. Scanning electron microscopy, Environmental scanning electron microscopy and EDS analysis
3. Atomic Emission Spectroscopy with Inductively-Coupled Plasma (AES ICP) for elemental analysis

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. These biomaterials are being developed using natural polysaccharides such as alginate, chitosan, and pullulan.

Chitosan is considered as one of the most valuable polymers for biomedical and pharmaceutical applications due to its biodegradability, biocompatibility, non-toxicity and antimicrobial properties. However, non-availability of medical grade chitosan is a limiting factor. Hence, attempts were made to develop purified chitosan for biomedical applications. This chitosan was derivatized using various molecules and the modified chitosan was used to develop sponges for wound dressing. The feasibility of in situ drug loading was evaluated and established using various antimicrobial drugs.

Polymeric non-viral vectors were developed for anticancer gene delivery applications. These vectors were found to be non-toxic or less toxic with good hemocompatibility. These cationic vectors for anticancer gene delivery were developed using pullulan and dextran and showed promising results under in vitro conditions

Product Development

Two derivatives of chitosan were prepared with succinic acid and caffeic acid. A range of succinate derivatives were prepared and from this, one formulation was chosen for further studies. In the case of caffeic acid conjugates, two derivatives were prepared and both were taken ahead for further studies. These derivatives were then developed into sponge type wound dressing materials.

Both the chitosan derivatives exhibited good swelling characteristics which is essential for drug loading

applications in this product. Chitosan succinate sponges showed up to 1800 times swelling (Figure 22). The antioxidant properties of chitosan caffeic acid conjugates were evaluated. The ability of these polymers to scavenge free radicals such as DPPH, ABTS cation radical and superoxide anion was established. The drug loading and release characteristics of these sponges were evaluated using antimicrobial drugs.

Figure 22. Chitosan succinate sponge

Research Programmes

1.Pullulan-based non-viral vectors were developed for anticancer gene delivery

Two major approaches were evaluated towards this goal. One was by developing cationized pullulan-based thiomers and the other by grafting molecules that improve blood compatibility without compromising the transfection efficiency resulting in varying degrees of success. The therapeutic gene used was p53.

(i) Thiomers for simultaneous gene delivery and Pgp inhibition

The study focused on disulphide-modified pullulan-based cationic polymer to evaluate gene delivery efficacy as well as efflux pump inhibiting property of the polymer. Redox- sensitive cationized pullulan was synthesized by conjugating pullulan with PEI and mercaptosuccinic acid (MSA), which with further oxidation of thiol group formed PPMSS. The polymer, upon interaction with the negatively charged DNA, formed nano-sized complexes with particle size in the range 100-150 nm. The nanoplex was stable in the extracellular milieu whereas intracellularly it releases DNA, which was mimicked by increase in the particle size following exposure with DTT (>300 nm) and subsequent release of DNA in agarose gel electrophoresis. The endo-osmolytic property of the polymer was also found to be superior compared with PEI, ensuring intracellular release of DNA. In vitro studies of polymers in C6 cell lines, apart from showing low cytotoxicity in both C6 and L929 cell lines (>80% cell viability), showed improved uptake and transfection efficiency. Endocytosis inhibitor studies revealed that the polymer takes multiple pathways to get access into the cells. Studies carried out with TRITC-tagged polymer revealed that the unpacking of the polyplex takes place in the cytosol and the DNA is transported to nucleus. Furthermore, the ability of the polymer to inhibit efflux pump in cancer cells have also been elucidated in terms of Pgp inhibition studies and drug retention kinetics using the anticancer drug, DOX. Immunostaining methods were adopted to show the particle ability to inhibit Pgp. Unlike the control groups where the Pgp expression was prominent, only a limited expression of Pgp was noted in the particle pre-treated group even after exposure to the anticancer drug, DOX, showing a strong interaction between the particle and membrane Pgp expression. This has been further reinforced with the finding of significant retention of DOX in the particle-treated group compared with the untreated control one. A relation was also observed between the presence of glutathione and Pgp inhibition. Above all, the synergetic effect of the polymer in performing both as a gene delivery vehicle (p53 gene) and efflux pump inhibitor served as a potential means to combat cancer by enhancing the sensitivity of cancer cells to cancer treatment.

(ii) Monomer-grafted PEI for gene delivery

Non-viral polymeric gene delivery vectors were developed by grafting PEI with 4 different vinyl monomers namely vinyl imidazole (VI), 2-(diethyl amino) ethyl methacrylate (DEAEM), ethylene glycol dimethacrylate (EGDMA) and 2-[(acryloyl oxy) ethyl] trimethyl ammonium chloride (AETMAC). These vinyl monomers grafted to PEI at the weight

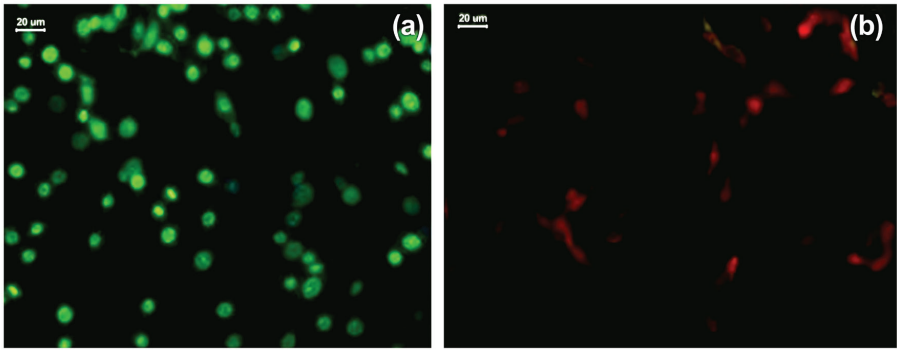

Figure 23. (A) Cellular uptake of PI nanoplex with YOYO tagged ctDNA (green fluorescence) at the weight ratio 3:1 (polymer to ctDNA). Nucleus stained with Hoecsht (blue fluorescence). (B) Live dead assay in C6 cells transfected with PI nanoplexes containing p53 plasmid. Red fluorescence (EtBr) depicts dead cells.

ratio 1:0.1 either by free radical addition reaction using CAN as initiator (VI) or by Michael addition reaction (DEAEM, EGDMA, AETMAC) to form PI, PD, PE, and PA respectively. Size and zeta potential, the two major parameters that determine the fate of the nanoplex during blood circulation and the cellular internalisation were determined using Malvern Zetasizer after complexing with ctDNA at 6 different weight ratios (0.5:1, 1:1, 2:1, 3:1, 4:1, 5:1). The optimum weight ratio was selected based on the values of size and zeta potential which was 3:1 for PD, PE and PI and 5:1 for PA. Smaller sized particles formed with PI followed by PD, PA and PE in that order, while zeta potential was in the order PD > PI > PA > PE. Polymeric vectors intended for gene delivery should possess buffering capacity near acidic pH in order to resist the drop in pH that is experienced in endosomal compartment once the nanoplex gets internalised. In this study, all the PEI derivatives exhibited good buffering capacity in the pH range 7-5 and was in the order PI < PA < PD < PE. MTT assay was carried out in C6 cells in order to elucidate the percentage cell viability in the presence of polymer. PA exhibited about 95% cell viability even at a high concentration which was greater compared to all other PEI derivatives. This was followed by PD which shows about 75% cell viability at higher concentration (100μg/ml) while the other two derivatives (PI and PE) become toxic at this concentration. Cellular internalisation was studied by tagging ctDNA with fluorescent dye YOYO while transfection efficiency was studied by analysing the expression of p53 in C6 cell (Figure 23). All the PEI derivatives except PA exhibited good cellular uptake and transfection efficiency. PA exhibited poor transfection efficiency irrespective of their excellent cellular internalisation. This could be related to the reduced vector unpacking that ultimately results in poor p53 gene expression.

Faculty

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DEPARTMENT OF MEDICAL DEVICE ENGINEERING

The Department is dedicated to the research and development of medical devices, from design to pre-clinical evaluation, including computer-aided design, in-silico evaluation, fabrication, prototyping, and functional evaluation at various stages. The Department consists of the Divisions of:

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

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

During the year, technologies of second-generation cardiovascular products, tilting disc heart valve and gel-coated vascular graft, were transferred to M/s TTK Healthcare Ltd., Trivandrum. Eight new projects were initiated under the Technical Research Centre for Biomedical Devices.

DIVISION OF ARTIFICIAL INTERNAL ORGANS

Development of two second-generation cardiovascular devices was completed and the technologies transferred to industry. Two projects under the TRC scheme were flagged off for development of aortic stent graft and atrial septal defect occluder. Two Technology Development Fund (TDF) projects, viz., annuloplasty ring for mitral valve correction and flow diverter stent for treating intracranial aneurysms, made substantial progress. A project for making voice prosthesis, in collaboration with Regional Cancer Centre, Trivandrum, was approved by KSCSTE for funding.

Two MoUs were executed with CSIR-NAL for development of NiTi shape memory alloy-based medical devices and with M/s TTK Healthcare Ltd. for development of annuloplasty ring.

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

Product Development

1. ***Aortic Stent Graft***
   Stent designs were developed that are being validated in-silico for crimpability, radial strength and migration resistance. Suturing techniques for stent to graft were developed and a stent crown was prototyped by CSIR-NAL as per SCTIMST design. Three design concepts for the delivery system were developed and prototyped.

2. ***Atrial Septal Defect Occluder***
   Various designs of the ASD occluder were braided and delivery system features identified. FEM modelling of designs are in progress.

3. ***Annuloplasty Ring for Mitral Valve Correction***
   Design and prototype for the annuloplasty ring were developed and evaluated in-silico. Fixtures developed for wire bending, polishing, mechanical testing and biocompatibility testing of the metal wire were completed.

4. ***Flow Diverter Stent for treating intracranial aneurysms***

   A parametric study to optimize the stent design was initiated using CFD and CAD models (Figure 24). A braiding machine was developed with automated step-height control.

5. ***Leukocyte depletion filter***

   The second phase of the testing of a candidate material for leukocyte depletion filter for South India Textile Research Association (SITRA), Coimbatore, was completed. In the first phase, preliminary evaluation including cytotoxicty, hemolysis and SEM evaluation was performed for screening. One of the 3 materials tested in the first phase was selected for detailed evaluation including, material characterization, cytocompatibility, toxicity and haemocompatibility.

DIVISION OF EXTRACORPOREAL DEVICES

The major activities of the Division are focused on medical devices for supporting the human cardiopulmonary system. The ongoing activities in the Division include developing membrane oxygenators for neonatal and paediatric application, paracorporeal left ventricular assist device, centrifugal blood pump including drive unit and magnetic flow meters, transcutaneous energy transfer system, infrared energy- based technologies for blood warmers, infant warmers and vein viewers. The Division also supported various TRC projects of the Institute. Two major facilities were installed during the year; rapid prototyping system (Figure 25) and particle image velocimetry system.

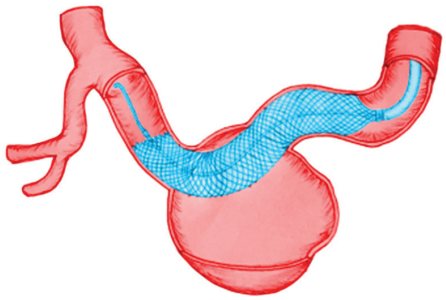


Figure 24. Flow diverter stent

Figure 25. Rapid prototyping machine

The activities undertaken by the Division in 2016-17 included the following.

1. Industry-sponsored project for development of paediatric and neonatal membrane oxygenators has reached proof-of-concept phase
2. Two projects sanctioned under the Technology Research Centre for development of paracorporeal left ventricular assist device and centrifugal blood pump along with drive unit and flow meter were started and significant progress was made.
3. One TDF project for development of detection system for CT contrast agent extravasation was started in collaboration with other departments of the institute.

Product Development

1. ***Paediatric and neonatal membrane oxygenators for extracorporeal cardiopulmonary bypass surgeries***

   This industry-sponsored project is aimed at the development of membrane oxygenators that replace the gas exchange function of the lungs during extracorporeal cardiopulmonary bypass surgery procedure. Two devices, one for paediatric applications and the second for

neonatal applications reached proof-of-concept level. The devices have two components, namely, the Heat Exchanger and a Mass/Gas Exchanger. Evaluations at different stages, from in silico analysis to evaluation in in vitro environment using blood and blood analogous fluids were completed for both the components (Figure 26).

Figure 26. In vitro evaluation of pediatric oxygenator

2. Centrifugal blood pump along with drive unit and flow meter

Centrifugal blood pump supports heart function during extracorporeal cardiopulmonary bypass surgery procedure. There are three major sub-systems for the device: the pump, drive unit including motor and controller, and a flow meter (Figure 27). In the project, computational fluid

Figure 27. Prototype of blood pump, drive unit and flow meter

dynamics (CFD) and finite element analysis (FEA) techniques for validation of the design with various improvements are ongoing. Prototypes were fabricated with rapid prototyping and machined components for further validation of the results. The motor for driving the pump was developed using brushless DC motor technique, flow meter using electromagnetic induction for measuring the blood flow and a controller for accurately controlling the rotational speed of the motor. In vitro evaluation for the assessment of the device performance was initiated.

3.Paracorporeal left ventricular assist device (pLVAD)

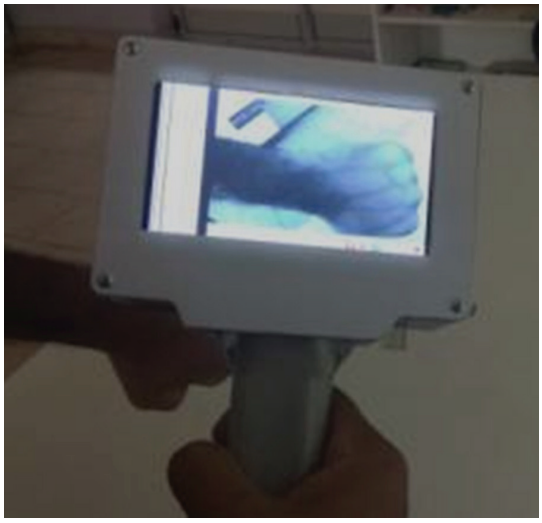
A continuous flow ventricular assist device intended for supporting the failing heart paracorporeally is being developed. There are three major components for the device: pump, motor and the controller (Figure 28). Preliminary

Figure 28. pLVAD with portable controller

designs of the components were prepared based on the basic physics of blood flow as well as electromagnetism. Preliminary prototypes of the magnetically-levitated centrifugal blood pump, brushless DC motor for driving the pump and controller employing feedback from motor sensors were made and evaluation is ongoing.

4. Detection system for CT contrast agent extravasation

Specification of the system was finalized, initial design was completed and prototypes that could detect the vein using IR illumination were fabricated. The system consists of hardware for illumination, image capture and image processing software to detect the vein of the patient. Further, effort to identify extravasation of contrast agent is currently ongoing. (Figure 29).



Figures 29. Vein viewer prototype

5. *Blood Warmer*

An infrared-based warming system capable of warming the stored blood to normal body temperature was developed (Figure 30). Multiple prototypes were fabricated and evaluations were carried out for assessment of performance.

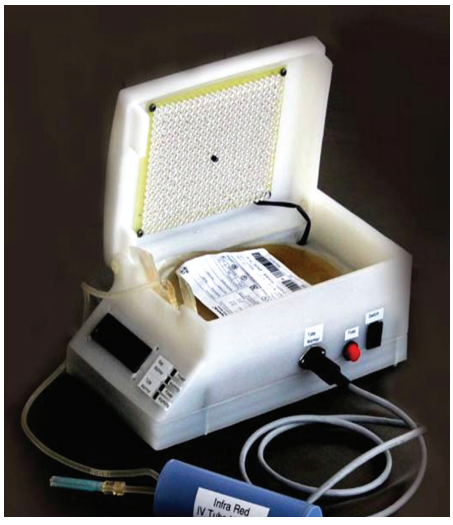


Figure 30. Blood warmer prototype

6. *Baby Warmer*

A portable baby warmer based on infrared technique was designed and developed. Multiple prototypes were made (Figures 31) and testing of prototypes according to IEC 60601 and IEC 80601 is in progress.

Figure 31. Prototype of Baby warmer - wrapper model and bassinet model

Research Programmes

Effort to develop transcutaneous energy transmission system suitable for powering implantable electronic devices like left ventricular assist devices is ongoing. Prototype fabrication using rapid prototyping system for other Divisions of the institute was pursued (Figure 32).

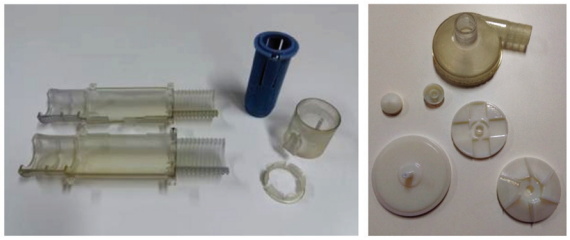


Figure 32. Fabrications in Rapid Prototyping system

DIVISION OF IN VIVO MODELS AND TESTING

The primary responsibility of the Division is to conduct proof-of-concept and pre-clinical evaluation of medical devices or biomaterials in animal models. To sustain this activity, the Division, through its CPCSEA-registered animal house, provides healthy experimental animals such as pigs and sheep.

To promote Ankamali pig as an animal model for biomedical research, the Division is collecting and documenting baseline reference data of in-house bred Ankamali swine for physiological, hematological, biochemical, phenotypic and genotypic characteristics.

The ongoing research in the Division on processed bovine, buffalo and porcine pericardium such as decellularised or glutaraldehyde cross-linked pericardium with heparin cross-linking for various cardiovascular applications resulted in one technology transfer, a patent application and a publication.
A process for 'glutaraldehyde treatment of pericardium with anti-mineralization treatment' was transferred to M/s G Surgiwear Ltd., Shajahanpur, UP.

Product Development

Proof-of-concept studies on pulmonary valve conduit made from processed pericardium are ongoing. Studies on glutaraldehyde process with anti-mineralization treatment of xeno-pericardium such as bovine, buffalo and porcine pericardium are also ongoing.

Research Programmes

Research on anti-mineralization treatment of processed pericardium is ongoing. A method to immobilize magnesium onto processed pericardium was developed (Figure 33) to control in vivo calcification. An application for Indian patent was made to protect this know-how.

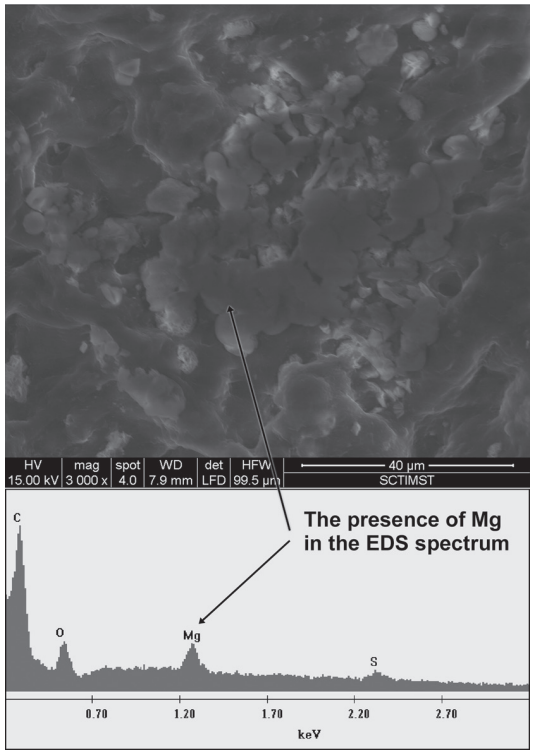


Figure 33. ESEM picture demonstrating presence of magnesium on the surface of processed pericardium

Testing and Evaluation

The animal evaluation conducted during the year included:

1. Evaluation of hydrothermally-derived and fibrous HAP for its ability to prevent ridge resorption in rabbit molar extraction model
2. Evaluation of TE small diameter vascular graft in rabbit and sheep
3. Evaluation of encapsulated islet in diabetic pig
4. Evaluation of processed pericardium in pig and rat

DIVISION OF MEDICAL INSTRUMENTATION

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

The Division is collaborating with Bhabha Atomic Research Centre (BARC) in the development of sophisticated medical devices like DBS for movement disorders and depth electrodes. An MoU was signed in this regard with BARC on 11 August 2016 (Figure 34).

Product Development

1. ***Deep Brain Stimulator System***

   Deep brain stimulation involves implanting electrodes within certain areas of brain (Figure 35). The stimulation is controlled by a pacemaker-like device placed under the skin in upper chest. A wire that travels under the skin connects this device to the electrodes in the brain.

2. ***Intracranial electrodes for use in acute and chronic electrocorticography***

   Measurement of electrical signals from brain using subdural electrodes implanted on the surface of the brain (electrocorticography, ECoG) is employed during surgical treatment of drug-resistant epilepsy. Implanted electrodes are usually required in order to identify the seizure onset zone. A project for the development of such electrodes was initiated.

DIVISION OF POLYMERIC MEDICAL DEVICES

The Division focuses on the development of polymeric medical devices. Thrust is also on new research initiatives through PhD programmes. The Division offers mechanical testing services to internal and external customers.

A new project to develop radiopaque liquid embolic devices for the treatment of arteriovenous malformation in brain under TRC funding was initiated.

Figure 34. Signing of MoU with BARC, Mumbai, for the development of Deep Brain Stimulator

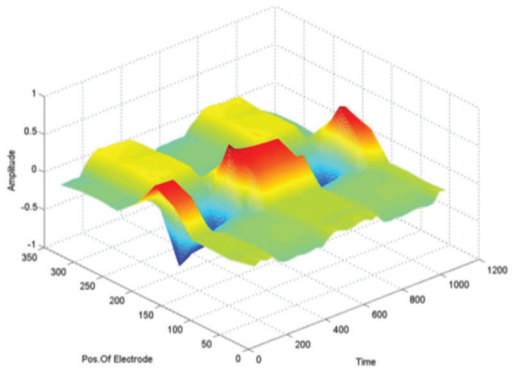


Figure 35. Charge distribution studies on a physiological phantom employed for simulating the brain tissues

Product Development

1. The second-generation, coated vascular graft project was completed and the technology was transferred to the industry.

2. A prototype of lead-free lightweight X-ray shielding thyroid collar was developed by incorporating radiopaque polyurethane and X-ray attenuating inorganic compounds. This project is funded by the Institute of Nuclear Medicine and Allied Sciences, Defence Research and Development Organization.

Research Programmes

1. ***Graphene-based modifications of electrospun polyurethane for biomedical applications***
   Graphene oxide was coated onto the electrospun fibroporous polycarbonate urethane membrane by a simple method of electrospraying. Graphene oxide thin films transferred over polycarbonate urethane exhibited a differential adhesion behaviour by reducing adhesion of bacteria and platelet, while allowing adhesion of L929 fibroblast cells.

2. ***Smart nanoplatforms for theranostic applications***
   This programme aimed to develop dual purpose nano-platforms that can do targeted drug delivery and optical imaging simultaneously. Optical imaging in the near-infrared (NIR) region is used for visualizing morphological details in tissues. The work is progressing towards the development of a smart theranostic nanoplatform based on neodymium doped hydroxyapatite (HAN). The presence of neodymium endows the HAN nanoplatforms with NIR fluorescence capability.

3. ***Non-steroidal anti-inflammatory drug therapies for the treatment of arthritis and cancer***
   In this work, a 'prodrug micelle-based approach', a model hydrophobic non-steroidal anti-inflammatory drug (NSAID), was tethered to amphiphilic methoxy polyethylene glycol polypropylene fumarate (mPEG-PPF) diblock copolymer. The polymer-drug conjugate (mPEG-PPF-Ibu) demonstrated high drug conjugation efficiency (90%) and self-assembled to form micellar nanostructures in aqueous medium. The work has potential for NSAID-based therapies in the treatment of arthritis and cancer.

4. ***Development of a magneto-fluorescent nanogel for theranostic applications***
   The work mainly focused on the development of a magneto-fluorescent nanogel based on photoluminescent comacromer (PEG-maleic acid-glycine), N, N-dimethyl amino ethyl methacrylate (DMEMA) and citrate capped superparamagnetic iron oxide nanoparticles (C-SPION). The cellular uptake of the nanogel on cervical cancer cell line HeLa, evaluated through Prussian blue staining and fluorescence microscopy, revealed good cancer cell imaging capability. Magnetic hyperthermia experiments showed that the synthesized nanogel caused lysis of cancer cells. The fluorescence bioimaging capability of the nanogel in mice model showed good NIR imaging capability. These results suggested that the synthesized magneto-fluorescent nanogel stands as a promising candidate for theranostic applications. A schematic representation of the synthesis of magneto-fluorescent nanogels for theranostic applications is shown below (Figure 36).

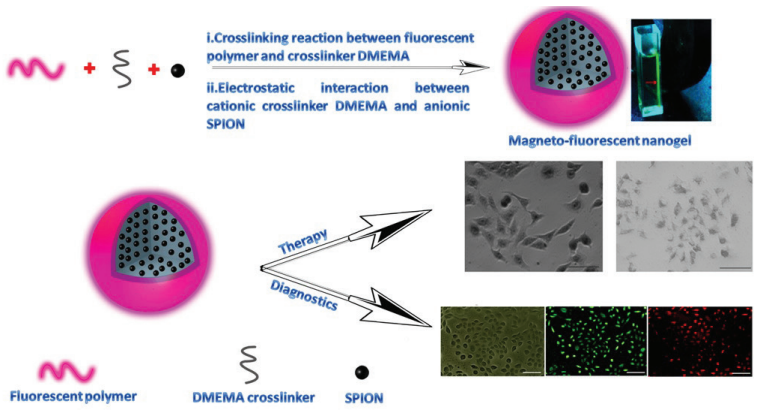


Figure 36. Schematic representation of synthesis of magneto-fluorescent nanogels

5. Development of a targeted nanogel for theranostic application

A fluorescent nanogel was synthesized using a photoluminescent comacromer (polyethylene glycol-maleic acid-4 aminobenzoic acid), diethylene glycol dimethacrylate and octreotide. The nanogel could load up to 78% of anticancer drug (doxorubicin) and release it over a period of 5 days in a sustained manner. The studies showed good cellular uptake of the nanogel. Fluorescence bioimaging of the nanogel in mice demonstrated NIR imaging capability. The biodistribution studies of the nanogel in mice showed longer in vivo circulation lifetime.

DIVISION OF PRECISION FABRICATION

The Division facilitates the technical service support activities in making prototypes, designing, fabricating and machining of jigs, fixtures, moulds and test setups required for the various ongoing projects of the Institute, utilising the CNC machines and conventional machines, to deliver quality precision work. From this Division, 57 major work orders and 29 miscellaneous work orders were executed during the year for different projects and for other departmental research and developmental activities (Figure 37).

Faculty

Mr Muraleedharan C V, Scientist G and Head of the Department
Mr D S Nagesh, Scientist G
Mr V Ramesh Babu, Engineer G
Dr Roy Joseph, Scientist G
Dr P Ramesh, Scientist G
Dr P R Umashankar, Scientist F (Veterinary)
Dr Sachin J Shenoy, Scientist E (Veterinary)
Mr Sujesh Sreedharan, Engineer E
Mr Vinodkumar V, Engineer E
Mr Ranjith G, Engineer D
Mr Sarath S Nair, Engineer D
Mr Anoop Gopinathan, Engineer C
Mr Jithin Krishnan, Scientist B
Mr Subhash N N, Chitra High Value Fellow C
Dr Shivaram Selvam, DST-INSPIRE Faculty
Dr Sunita Prem Victor, Innovative Young Biotechnologist Award Fellow

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Mr Prem Mohan M, Technical Assistant - B
Ms Smitha P, Technical Assistant - B
Mr Subhash Kumar M S, Technical Assistant - A
Ms Sreedevi V S, Technical Assistant - A
Mr Biju B, Technical Assistant - A
Mr Reji Kumar S, Technical Assistant - A
Mr Prathyush M, Technical Assistant - A
Mr Biju V, Laboratory Animal Care Taker - A

Figure 37. Typical prototyping/fabrication outputs

1. Oxygenator heat exchanger tubes in aluminum, 2. Annuloplasty ring fabrication fixtures, 3. LVAD components in titanium, 4. Bloom strength test set up, 5. Blood pump components, 6. Pellet pressing die, 7. Wire coating fixture assembly, 8. DBS charge mapping setup fixture, 9. Fixture for wire polishing, 10. Braiding fixture component, 11. Blood Bag Warmer components, 12. Intra vertebral spacer components and application tool.

DEPARTMENT OF TECHNOLOGY AND QUALITY MANAGEMENT

The Department is responsible for diverse activities like interfacing the Institute and industries for technology transfer and collaborative research activities, implementation and management of accreditation/ certification of various quality management systems, intellectual property management, upkeep of the Central Analytical Facility and calibration activities, scale up of production under technology proving facility, providing engineering support including local area networking and providing customer service as a single point of contact for all testing services.

CALIBRATION CELL

Calibration Cell co-ordinates the calibration and traceability requirements of the BMT Wing campus. The Cell carries out these activities using its in-house capabilities and, wherever required, co-ordinates with external agencies to meet the requirements. Reference materials are maintained by the Cell for ensuring traceability of measurement with national / international standards.

Mechanical and thermal calibrations being carried out by Calibration Cell are accredited by NABL, India. Mechanical calibration includes calibration of volumetric glassware, micropipettes, electronic balances, mass sets and rotational speed. Calibration of relative humidity (RH) monitors, thermometers and temperature chambers like incubators are included in thermal calibrations. In 2016-17, 256 internal and 87 external calibrations and measurements were performed.

The NABL audit (surveillance) was completed by March 2017 in mechanical and thermal calibrations. Calibration Cell participated in Inter Laboratory Comparisons (ILC) for relative humidity parameter with FCRI, Palakkad. A study project on system validation used in medical diagnosis was also completed for a research and development organization.

CENTRAL ANALYTICAL FACILITY

The primary objective of the Facility is to provide test services, strictly adhering to the quality management policy of the Institute. Advanced facilities for the characterisation of materials are in place and were extended for internal as well as external customers, and analysed over 800 samples. These included analysis by high performance liquid chromatography, gel permeation chromatography, texture analysis, thermal analysis, fluorescent image analysis, confocal Raman spectra and chemical mapping.

A new project was initiated in collaboration with Public Health England (PHE), UK, for the development of delayed-release formulation of a specific antibody. The polyclonal antibody was developed by PHE for the treatment of Clostridium difficile infection. This antibody needs to be delivered directly at the infection site in the colon via oral route. The development work on the delayed-release formulation was completed and its characterisation is ongoing.

Customer Service Cell

The Cell is the single-point contact for the evaluation of medical devices and biomaterials.

The summary of the testing services is as in the Table below:

Description	External			Internal		
	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
No. of work orders	632	684	578	416	294	313
No. of test materials	2175	1857	1355	1211	865	941
Income (Rs)	46,89,000	34,650,58	37,32,527	12,23,000	5,12,375	19,95,175

Online system for testing services

A web-based system was developed by the Computer Division of the Hospital Wing for testing services. The system takes care of activities right from raising the request till issue of test reports. The system was implemented for internal requests and shall be opened to external customers soon.

DIVISION OF ENGINEERING SERVICES

Functions of the Division included providing technical support for general maintenance of equipments and environment at various facilities, network management, management of utility supply like power, water, and maintenance of waste incinerator and sewage systems of the campus. Electrical service maintains the 11 KV supply system and diesel generator for power backup.

QUALITY CELL

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

Following were the major activities of the Cell during the year:

1. *COFRAC* surveillance assessment was conducted on 8-9 February 2017. No non-conformities were identified and previous 3 non-conformities were closed.
2. NABL desktop surveillance audit report for Thermal and Mechanical Calibrations was completed in March 2017.
3. Management reviews: Management Review Committee meeting was held on 7 March 2017. Two Technical Management Committee meetings were held on 17 June 2016 and 1 December 2016.
4. Two internal audits were carried out during 17-26 May 2016 and 16-28 November 2016.
5. Documents initiated/revised - 139 system procedures and work procedures, 68 laboratory notebooks were issued, 76 registers and logbooks were prepared and issued to various laboratories/ sections, and 16 corrective actions were generated in different laboratories.

Training Programmes

ISO 13485:2016 Awareness and Internal Auditor Training was conducted from 3-5 October 2016. Awareness training was a 1-day programme on 3 October attended by 49 personnel (Figure 38). The internal auditor training was held on 4-5 October 2016 and was successfully completed by 34 personnel (Figure 39).

Figure 38. ISO 13485:2016 awareness training 3 October 3 2016

Figure 39. ISO 13485:2016 internal auditor training 4-5 October 2016

TECHNOLOGY BUSINESS DIVISION

The Division focuses on the following activities of the Institute:

1. Co-ordinating institute-industry interactions related to technology transfer and research project collaborations
2. Co-ordinating all the activities of Intellectual Property Rights like patent, design and trademark registration of the Institute
3. Co-ordinating testing services and specific protocol-based study requests from the industry and academia for medical devices and biomaterials
4. Co-ordinating the internal research project funding of the Institute comprising the Technology Development Fund Scheme and the Overhead Fund Scheme
5. Preparing reports on the activities of Institute for submission to external agencies such as DST, DSIR and ICMR

The following were the major activities executed during the year:

1. Three technology transfer agreements were signed on 19 November 2016 with M/s Surgiwear Ltd., Shajehanpur, UP which were: (i) Calcium sulfate cement, (ii) Process for gluteraldehyde-treated bovine pericardium, and (iii) Poly Vinyl Alcohol sponge.
2. A Non-Disclosure Agreement was signed with M/s New Medicon Pharma Lab Pvt. Ltd. for collaboration in relation to the snake anti-venom project.
3. The standing internal technology transfer committee meetings were held on 21 April 2016, 29 June 2016, 2 November 2016, 25 January 2017 and 10 March 2017.

Industry visits and discussions

The Division co-ordinated with the following industries for the purpose of exploration of technology transfer and also for project or R&D collaborations: M/s Surgiwear Ltd., M/s HLL Lifecare Ltd., M/s Sahajan and Technologies, M/s Shree Pacetronix, M/s Optimus Lifesciences, M/s Prime Dental, M/s Prevest Denpro, M/s Basic Healthcare, M/s Anabond Stedmann, M/s Jayon Implants, M/s Sri Tissue Engineering, M/s Zum Helein, M/s Ibis Medical, M/s Agappe Diagnostics; M/s Vins Bio and M/s Mundra Group.

Exhibitions and industrial meets

Title and theme of the event	Date and venue	Organizers/Co-organizers
Participation of SCTIMST at IITF, 2016	14-27 November 2016, New Delhi	'Team ITPO' & Asian Trade Promotion Forum (ATPF), India Convention Promotion Bureau (ICPB), BRICS Trade Promotion Group based on the BRICS Contact Group on Economic and Trade Issues (CGETI)
Participation of SCTIMST at 104th Indian Science Congress	3-7 January 2017, Sri Venkateswara University Campus at Tirupati, Andhra Pradesh	Pride of India Expo was organized as part of ISC 104. The DST pavilion, where SCTIMST was also a participant won the award for the most interactive exhibition pavilion in the expo.
Report of participation in Indian Medical Devices and Plastics Conference 2017	17-18 March 2017	Medisource (Asia) for Indian Medical Devices and Plastics Disposables/Implants Industry

Figure 40. Internal training programme on regulatory mechanism for medical device development

Figure 41. Internal training programme on regulatory mechanism for medical device development

Training

An internal training programme on regulatory mechanism for medical device development in EU and India provided by M/s Regulatory-1, Bangalore, was conducted during 2-3 September 2016 (Figures 40 & 41).

Faculty

Mr D S Nagesh, Scientist G and Head of the Department
Mr S Balram, Engineer G, CEO, TIMed
Dr Roy Joseph, Scientist G
Dr Ramesh P, Scientist G
Mr D Ranjit, Engineer F
Ms Leena Joseph, Scientist E
Dr Anugya Bhatt, Scientist E
Dr Arun Anirudhan V, Scientist D
Mr Sajithlal M K, Scientist D
Ms Sandhya C G, Scientist D
Mr Rajkrishna Rajan, Scientist D
Mr K Rajan, Junior Engineer
Mr Asok Kumar K R, Junior Engineer
Mr Sabu K S, Junior Engineer
Mr Binu C P, Junior Engineer

Technical

Mr Willi Paul, Scientific Officer
Mr P R Hari, Scientific Officer
Dr C Radhakumary, Scientific Officer
Mr Arumugham V, Senior Scientific Assistant
Mr Rajesh R P, Scientific Assistant
Mr Sreekanth S L, Scientific Assistant
Mr Premnath D, Senior Technical Assistant
Mr Raju A S, Technical Assistant - B
Ms Asha Rani V, Technical Assistant - A
Mr Biju V, Laboratory Animal Care Taker - A
Mr Saju S, Junior Technical Assistant

SCTIMST-TIMed
Technology Business Incubator for Medical Devices and Biomaterials

TIMed is the Technology Business Incubator (TBI) of SCTIMST for promoting start-ups and entrepreneurship in medical devices, biomaterials and healthcare technologies. It is located in the 5th floor of MS Valiathan Medical Devices Engineering Block in the Biomedical Technology Wing campus. TIMed was launched on 16 May 2015 and is funded by NSTEDB, Department of Science and Technology, Government of India, and Kerala State Industrial Development Corporation (KSIDC).

The following six companies are incubating their projects with the support of TIMed:

1. Mobilexion Technologies Pvt. Ltd. - Development of Ubiqmedique acute care Telemedicine Cart for use in ICUs in rural and district hospitals
2. Ellipsor Health Pvt. Ltd. - Wearable device for monitoring of vitals in neonates
3. SRH Nutrition LLP - Nutraceutical development for diarrhoea and malnutrition by functional screening of active compounds from medicinal plants to improve rehydration
4. Zum Heilen Healthcare Pvt. Ltd. - Creating unique wound healing products, both for application on wounds and for outer cover
5. Evelabs Technologies Pvt. Ltd. - Affordable solutions for intravenous therapy starting with infusion monitoring device
6. Indriyam Biologics Pvt. Ltd. - Biosensor for identification of snake species in case of snake bite

Of the above, M/s Evelabs and M/s Indriyam were admitted during the year. Sweptron Healthcare Pvt. Ltd. ended its incubation activity at TIMed during the year due to financial difficulties faced by the founder.

The facility of SRH Nutritions at TIMed was inaugurated by Director, SCTIMST and Managing Director, KSIDC, on 18 August 2016.

Talks under the series Talk@TIMED were initiated in January with the following speakers:

1. Shri C Balagopal- Founder and former managing Director, Terumo Penpol Ltd. – Building world class with local resources
2. Shri Jayasankar Prasad, CEO, Kerala Start-up Mission – All you wanted to know about start-ups
3. Shri Rajesh Nair, Director, EY India and President, TiE Kerala – Key essentials of a Business Plan
4. Dr Easwer H V, Professor of Neurosurgery – Translational Research from a surgeon's perspective
5. Dr Gopakumaran Nair, Patent Attorney on recent changes in IPR Act

An MoU was signed between TIMed and The Indus Entrepreneurs (TiE), Kerala Chapter, on 23 January 2017 to facilitate mentoring of TIMed incubatees by the members of TiE (Figure 42). A global not-for-profit organization, TiE, focused on promoting entrepreneurship and its members are successful and experienced entrepreneurs, venture capital firms and angel investors.

TIMed was one of the five incubators empanelled by Kerala Technological University to offer a Minor in Entrepreneurship to its students.

TIMed submitted its proposal to BIRAC under the SPARSH scheme to become a Social Innovation Immersion Partner and offer TIMed Fellowships. The proposal was short-listed and final approval is awaited. TIMed also submitted an application for NIDHI Seed Support Scheme of NSTEDB, DST.

Figure 42. Signing of MoU between TIMed and TiE, Kerala Chapter

PATENTS

In the previous year, 8 Indian patent applications were filed of which two were granted. One design registration was also filed in India for the same period.

Events Organized

1. Division of Experimental Pathology organised a modular course in Regulatory Toxicologic Pathology: Module I: General Pathology for Toxicologic Pathologists and Toxicologic Pathology of Nervous, Cardiovascular and Urinary Systems from 8-11 February 2017, at the BMT Wing (Figure 43). The conference was organized by Drs T V Anilkumar and A Sabareeswaran. Figure 43. Inauguration and proceedings of the modular course in Regulatory Toxicologic Pathology (high resolution picture in original needed)
2. The Division of Laboratory Animal Sciences conducted the 19th and 20th Animal Handling training programmes from 25-30 July 2016 and 26-31 December 2016, respectively at the BMT Wing.
3. Dr Kamalesh K Gulia organized the programme 'Sleep and Cognition: Brain at Stake!' at the XIIIV Annual meeting of Indian Academy of Neurosciences, 19-21 October 2016 at National Brain Research Centre, Manesar, under the aegis of Indian Academy of Neurosciences and National Brain Research Centre, Manesar.
4. Dr Jayasree R S was the convenor of Annual Technical Meetings of Materials Research Society of India (MRSI) held on 2 April 2016 at the Indian Institute of Space Sciences and Technology, Valiamala, Trivandrum, and on 27 January 2017 at the University of Kerala.

Awards and Honours

1. Dr T V Anilkumar was elected President of the Indian College of Veterinary Pathologists, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, for a three-year term starting from January 2017.
2. Dr T V Anilkumar continued as President of the Asian Society of Veterinary Pathology, Bangkok, for the second year of the two-year term starting from November 2015.
3. Dr Kamalesh K Gulia was elected Member of National Academy of Medical Sciences (India).
4. Dr T V Kumary visited the University of Nottingham, UK, as part of DST UKIERI project in August 2016.
5. Dr Anilkumar P R proceeded to Wake Forest Institute of Regenerative Medicine, North Carolina, USA, to undergo a 2-year training programme from August 2016.
6. Dr Lizymol P P received the National Award for Technology Innovation - 2017 for the "Development of organically modified ceramic

resin for dental restorative application".

7. Ms Vibha C received the Best Poster Award in 29th Kerala Science Congress-2017 for the paper titled "Development of bioactive radiopaque composites for biomedical applications".
8. Dr Francis Fernandez, Research Associate, Bioceramics Division, was selected for the Academia Industry Training (AIT) jointly organized and funded by the Department of Science and Technology (DST), Swissnex India, and Society for Innovation and Entrepreneurship (SINE, IIT Bombay). Top 10 Indian candidates were supported via this programme for transforming their applied research ideas into commercial applications and discovering their entrepreneurial potential. As a part of the programme, Dr Francis attended a session in Switzerland from 27 November 2016 onwards, for a week.
9. Dr Manoj Komath received the Inventor Memento for developing 'Bioactive Calcium Sulfate' product in the Technology Conclave 2016 organised by SCTIMST at Hotel Dimora, Trivandrum, on 19 November 2016.
10. Dr Jayasree R S was elected Fellow of Royal Society of Chemistry (London).
11. Dr Jayasree R S was awarded the Materials Research Society of India (MRSI) Medal Award for 2017.
12. Dr Jayasree R S was a special invitee at the DBT Nanobiotechnology Task Force meeting held during 23-25 February 2017 at IISER, Trivandrum.
13. Dr Rekha M R received the Developing Country Scholarship Award for her paper "Pullulan-PEI-Histidine towards gene delivery: Vector unpacking with respect to molecular weight and cytoplasmic histones" at the World Biomaterials Congress in Montreal, Canada, in May 2016
14. Mr Vineeth V M received the 'Best Oral Presentation Award' for his paper, 'Self-fluorescent polymeric nanogels for theranostic applications', presented at the National Conference on Recent trends in chemical Sciences held at the University College, Thiruvananthapuram.

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

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

Activities

MPH and PhD programmes were the two important training programmes. In addition to these programmes, we also had a few Diploma in Public Health students. Fourteen MPH and 2 PhD students successfully completed their programme during the year. Seventeen MPH students continued into their second year, and another 13 MPH and 2 DPH students joined in 2017. In addition to the MPH training programme of the Centre, the MPH program offered through the National Institute of Epidemiology (NIE), Chennai, Christian Medical College (CMC), Vellore, and Indian Institute of Public Health, Delhi, continued to train students. From the NIE, Chennai, 19 MPH students succesfully completed their programme, 19 continued into their second year and another 17 students joined during the year. From CMC, Vellore, 2 students continued into their second year and another five students joined during the year. From the Indian Institute of Public Health, Delhi, the recently-affiliated Institute, 46 students joined during the year. Fifteen PhD students, 7 full-time and 8 part-time continued their training programme. An additional 4 PhD students joined in January 2016. Two PhD students at NIE, Chennai, and 3 PhD students at CMC, Vellore, continued their programme.

We also had several externally-funded research projects and a few internally-funded research projects, which are included in the respective sections of this report.

Research Programmes

1. ***The Kerala Diabetes Prevention Program***

   The Kerala Diabetes Prevention Program is a research project supported by the National Health and Medical Research Council (NHMRC) of Australia through the Melbourne University. The objective of the project is to see whether the incidence of type 2 Diabetes can be reduced through life style modification, focusing on healthy diet and physical activity. This is a cluster randomized controlled trial for which the baseline, 12 and 24 months data collection was completed. There were three published papers from this project, with the fourth one under review by Lancet Diabetes and Endocrinology. In addition, another proposal to look at the outcomes after 6 years was submitted to NHMRC.

2. ***Controlling Hypertension In Rural India (CHIRI): Overcoming barriers to diagnosis and effective treatment***

   This project, supported by the Global Alliance for Chronic Diseases and the NHMRC, looks at the prevalence of hypertension and barriers for its control. It was implemented at three sites in India: West Godavari and Rishi Valley in Andhra Pradesh, and Kerala representing three levels of epidemiological and demographic transition. The protocol paper was published in BMJ open journal and the study findings were presented at national and international conferences. Presently, we are working towards dissemination of the findings of this project.

3. ***Kerala Diabetes Prevention Program with Kudumbashree Mission***

   The Kerala Diabetes Prevention Program (KDPP) is a community-based program implemented jointly by the SCTIMST and Kerala Kudumbashree State Mission (KSM) that promotes positive behavior

changes in individuals to prevent/delay diabetes in Kollam, Ernakulum and Kannur districts of Kerala. From each district, 5000 peer leaders will be trained by the experts from SCTIMST and Kudumbashree State Mission. Each peer leader will then provide 12-educational/training sessions to about 25 of their neighborhood group members. The programme is expected to reach about 375,000 people who will be trained in reducing the major risk factors of diabetes, such as unhealthy diet, physical inactivity, excessive intake of alcohol and tobacco use. The training of peer leaders (40 from each district), printing and distribution of flip charts and other booklets for the 15000 peer leaders were completed. In addition, baseline survey of a sub-sample of 2400 randomly selected individuals from the neighborhood groups and detailed information, including fasting blood sugar measurements for 300 of them, were completed during the year.

4. ***Prevention and Control of Non-communicable Diseases in Kerala***

Prevention and Control of Non-communicable Diseases (NCDs) in Kerala is a project supported by the Government of Kerala. The major objectives of this project are: (1) to conduct a World Health Organization (WHO) STEPS survey in a representative sample of the Kerala population in the age group of 15-69 years and assess the NCD risk factors such as tobacco use, alcohol consumption, unhealthy diet, physical inactivity, and find out the proportion of people with obesity, hypertension and diabetes, (2) propose a structure and function for the health protection agency of Government of Kerala based on a qualitative study, (3) implement NCD risk reduction activities in 20% of Government and aided schools, and (4) implement NCD risk reduction strategies in 20% of village Panchayats. Data collection for objectives 1 and 2 were completed, and objectives 3 and 4 were implemented. The Government of Kerala has extended this project for another year.

5. ***Research Initiative on factors influencing women's reproductive choices***

The project is supported by the Ford Foundation and consists of three inter-related activities:

Activity 1: A multi-centred prospective research study on factors influencing postpartum reproductive choices in Jharkhand and Kerala. Data collection was completed and data analysis is ongoing.

Activity 2: A smaller-scale study on sexual and reproductive rights and reproductive choices among married and unmarried young women in Kerala. The data collection and analysis were completed.

Activity 3: Mapping and critical review of research on sexual and reproductive health and rights in India during 2000-2013. Three volumes of annotated bibliographies were produced as e-publications, and three critical-review papers were commissioned in February 2017 and are expected to be ready by July 2017.

6. ***Closing the Gap: Health Equity Research Initiative in India***

Springer India accepted a book proposal for publication, with nine chapters, entitled "Health Inequities in India: A Synthesis of Recent Evidence". The manuscript was submitted on 31 March 2017. The results of evidence synthesis carried out as part of the project were presented at the Evidence to Policy Conference (EPHP) of the Institute of Public Health in Bengaluru on 9 July 2016. Shri Manoj Jhalani, Joint Secretary Health, Dr Neeru Singh, Director, Tribal Health Research Centre, ICMR, Jabalpur and Ms T K Rajalakshmi, The Hindu, Delhi, came on board as steering group members of the project since January 2017.

We completed the data collection process of a collaborative research project on "Health equity and tribal health" with three partners in four sites - The Action North-East Trust (Assam), Public Health Resources Network (Chhattisgarh and Jharkhand) and Health Action by People

(Kerala). Data analysis is currently ongoing. One faculty grant was made to Dr Biju Soman, Additional Professor, AMCHSS, SCTIMST, for carrying out research in Kerala on "Geospatial mapping of health inequity among tribal population in Noolpuzha Grama Panchayat in Wayanad district, Kerala" and field study grants were awarded to 2 MPH students. Four persons were selected as research advisors and MoUs were signed to provide research support to the 3 institutions and a faculty project. Three capacity-building Workshops on "Cutting Edge Research on Health Equity: Concepts and Methods" and Workshop to discuss research results were conducted.

Professor Simone Diniz, Head, Maternal and Child Health Unit, University of Sao Paulo in Brazil, visited the AMCHSS during 21 November to 2 December 2016. She presented a series of five lectures for students and one public seminar.

The health inequities web portal (www.healthinequities.com) had more than 360 members. Latest publications on health equity and other relevant resources were regularly posted on the portal. Four original courses uploaded as video or audio-lectures complete with reading lists and power point presentations were available to members. Newsletters announcing new additions to the portal were sent bi-weekly to the members.

In addition, a Workshop on the social media strategy for the web portal was conducted on 30 March 2017 and MPH students started a series of webinars on equity issues.

Completed projects

Advances in Research on Globally Accessible Medicine (AROGYAM)

This grant funded a research network whose original objectives were to stimulate new ways of considering social scientific issues in public health and to offer insights, particularly into how to understand and improve public health in India and amongst populations of Indian origin living in Europe. Our original proposal envisaged work in four areas: non-communicable diseases, communicable diseases (especially HIV/AIDS, malaria and tuberculosis), biomedical technologies, and the globalization of knowledge, technology, and people. Based on our opening Workshop, we developed working groups that took forward these concerns around specific themes. The most significant of these were: (1) Global governance in public health, with focus on the effects of commercialization, (2) Globalizing mental health, (3) Medical 'tourism', better understood as patient flows across borders, (4) Gender, health and reproductive rights in the context of debates over intersectionality, (5) Reproductive loss and bereavement, (6) Issues of quality management and enhancement, and (7) the marketing of 'traditional' medicines from Asia and the increasing 'Europeanization' of traditional Asian medical systems.

We achieved our original goals in large part although some work continues. The project led to: (1) teaching packs available online, (2) edited collections that are currently with publishers or are at the submission stage, (3) special panels at international conferences, (4) enhancement of skills of doctoral students through their participation in 3 special Workshops, and (5) associated research grants along with likely submissions for further research that resulted from the personal relationships established or strengthened through AROGYAM.

We expect the findings of this network to be carried forward, particularly within training programmes in public health schools in India, the UK and Germany, as well as in the field of medical humanities.

Others

An external evaluation of the programnes of AMCHSS was conducted by Professor Rajesh Kumar, Head of the School of Public Health, Post Graduate Institute of Medical Education and Research, Chandigarh, and Professor CAK Yesudian, former Head of School of Health Systems, Tata Institute of Social Sciences, Mumbai.

The faculty members of AMCHSS were reviewers and editorial board members of several national and international journals.

New Initiatives

1. An MoU was signed between our Institute and the Department of Health and Family Welfare, Government of Kerala, for the conduct of the Kerala Health Surveillance project. AMCHSS will provide technical expertise for this project.
2. The Government of Kerala accorded sanction for a no-cost extension of the project on prevention and control of non-communicable diseases in Kerala until March 31 2018.
3. An MoU was signed between our Institute and the National Centre for Disease Informatics and Research (NCDIR), Bangalore, for the implementation of high quality survey and data collection for monitoring the National Non-communicable Diseases (NCDs) targets during the year 2017. We will be responsible for the survey in Kerala and Karnataka states.
4. An MoU was signed between our Institute and the Mission Director, National Health Mission for a comprehensive evaluation of the activities of the mission in Kerala.

Events organized by the Department

1. Professor Mala Ramanathan organized a Workshop on 'Research Ethics and Public Health' on 25-28 April 2016 at Centre for Bioethics and Culture, Sindh Institute of Urology and Transplantation, Karachi, Pakistan.
2. Dr Cherian Varghese, Coordinator, Management of NCDs, WHO Geneva, delivered the AMC seminar on 'Prioritizing interventions for NCD prevention and control' on 4 August 2016 at Seminar Hall, AMCHSS.
3. Professor Mala Ramanathan organized a Workshop on 'The New Regulations on Drug Trials in India' for researchers and policy makers in the region on 6 August 2016 at Seminar Hall, AMCHSS.
4. Professor Mala Ramanathan organized a Workshop on 'Good Clinical Practice and New Indian Regulations for Clinical Trials' for Institute Ethics Committee and Technical Advisory Committee members on 7 August 2016 at Seminar Hall, AMCHSS (Figure 1).
5. The Centre organized a training program for the district project managers of the non-communicable diseases project on 8-9 and 22-23 August 2016 at AMCHSS.
6. Professor Mala Ramanathan and Institute Ethics Committee jointly conducted a course on 'Ethics in Health Research' on 8-12 August 2016 at Seminar Hall, AMCHSS.
7. Professor K R Thankappan conducted a webinar on 'Effectiveness of lifestyle intervention on incidence of type 2 diabetes in a high-risk population selected using a diabetes risk score in India: a cluster randomized controlled trial' for the Excellence in Non-Communicable disease Research (ENCORE) trainees and faculty members on 17 August 2016.
8. The function to launch the 'Kerala Diabetes Prevention Program' by Hon'ble Minister for Local Self Government and Kudumbashree Dr K T Jaleel was jointly organized by AMCHSS, Kudumbashree Mission and Kollam district panchayat on 18 August 2016 at Souparnika Auditorium, Kottarakara, Kollam (Figures 2 & 3).
9. Professor Mala Ramanathan conducted a Workshop on 'Qualitative Methods for Health Research' on 23-29 August 2016 at Centre for Bioethics, Yenepova University, Mangalore.
10. The function to launch the project on 'Prevention and Control of Non-Communicable Diseases' by the Hon'ble Chief Minister of Kerala, Shri Pinarayi Vijayan was jointly organized by AMCHSS and Department of Health, Government of Kerala, on 30 August 2016 at AMCHSS auditorium (Figure 4).

11. The training of school teachers for the prevention and control of non-communicable diseases in Kerala was jointly organized by AMCHSS and Department of Education, Government of Kerala, on 23 September 2016 at AMCHSS auditorium.
12. The training of peer leaders of Kerala Diabetes Prevention Program in Kollam district was jointly organized by AMCHSS and Kudumbashree Mission on 27-28 September 2016 at Kollam Corporation Hall, Kollam.
13. Professor Raman Kutty conducted a Workshop on 'Analysing Medical and Health Data Using R' on September 30 - October 1 2016 at AMCHSS (Figure 5).
14. The orientation for Panchayat Presidents and Standing Committee Chairpersons on prevention and control of non-communicable diseases in Kerala was jointly organized by AMCHSS and Kerala Institute of Local Administration (KILA), Thrissur on 17 October 2016 at KILA, Thrissur.
15. The training of peer leaders of Kerala Diabetes Prevention Program in Ernakulum district was jointly organized by AMCHSS, Ernakulum District Panchayat and Kudumbashree Mission on 18-19 October 2016 at District Panchayat Office, Kakkanad, Ernakulam.
16. Dr Simone G Diniz, Associate Professor and Head of the Department of Maternal and Child Health, School of Public Health, University of São Paulo, Brazil, delivered the AMC seminar on 'Movement for Humanistic Childbirth in Brazil - the global and national context in which it emerged and the shapes it has taken in Brazil and elsewhere currently' on 25 November 2016 at Seminar Hall, AMCHSS (Figure 6).
17. The Centre conducted a Workshop on 'Health Equity' in collaboration with Azim Premji University and Public Health Foundation of India on 12-16 December 2016 at Bengaluru.
18. The second annual national conference of AMCHSS, AMCCON 2017, on 'Recent Trends in Public Health Research and Practice' was held on 6-7 January 2017 at AMCHSS auditorium (Figure 7).
19. The AROGYAM peri-doctoral Workshop was jointly conducted by AMCHSS and Jawaharlal Nehru University, New Delhi, on 20-22 March 2017 at Seminar Hall, AMCHSS.

Awards and Honors

Professor K R Thankappan was awarded the Fellowship of the National Academy of Medical Sciences (FAMS) at the convocation organized as part the 56th Annual Conference of the National Academy of Medical Sciences, India on 22 October 2016.

Faculty

Dr K R Thankappan, Professor (Senior Grade) and Head of the Department
Dr V Raman Kutty, Professor
Dr T K Sundari Ravindran, Professor
Dr P Sankara Sarma, Professor
Dr Mala Ramanathan, Professor
Dr Biju Soman, Additional Professor
Dr K Srinivasan, Additional Professor
Dr Ravi Prasad Varma, Associate Professor
Dr Manju R Nair, Scientist C
Mrs V T Jissa, Scientist B

Support Staff

Ms Jayasree Neelakantan, Upper Division Clerk

Figure 1. Participants of the training programme for Institute Ethics Committee and Technical Advisory Committee members on Good Clinical Practice and New Indian Regulations for Clinical Trials on 7 August 2016

Figure 2. Dr K T Jaleel, Hon'ble. Minister for Local Administration, inaugurated the Kerala Diabetes Prevention Program implemented jointly by SCTIMST and the Kerala Kudumbashree Mission at Kottarakara on 18 August 2016

Figure 3. Kudumbashree peer leaders and members who attended the inaugural function of the Kerala Diabetes Prevention Program at Kottarakara on 18 August 2016

Figure 4. Shri Pinarayi Vijayan, Hon'ble Chief Minister of Kerala, inaugurated the project "Prevention and control of non-communicable diseases in Kerala" on 30 August 2016. Dr B Ekbal, member Kerala State Planning Board, Dr Asha Kishore, Director, SCTIMST, Shri K M Chandrasekhar, President, SCTIMST, Shri Rajeev Sadanandan, Additional Chief Secretary Health and Family Welfare, Government of Kerala and Dr R Ramesh, Director of Health Services are also seen.

Figure 5. Participants of the Workshop on "Analyzing Medical and Health Data Using R"

Figure 6. AMC seminar by Dr Simone Diniz, Faculty and Head of Maternal and Child Health, School of Public Health, University of Sao Paulo, Brazil, on "Movement for Humanistic Child Birth in Brazil", on 25 November 2016

Figure 7. Valedictory function of the AMCCON 2017

DIVISION OF ACADEMIC AFFAIRS

The Institute continued to be a much sought-after destination for DM /MCh/ Post- Doctoral Fellowship programmes in Cardiac and Neurosciences, attracting top performers. Similar trends were also observed in the PhD entrance examination. The Achutha Menon Centre for Health Science Studies that has carved a niche for itself as a Centre of Excellence in teaching and research in the area of public health continued to attract students for Master's and Doctoral programmes.

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 Neurosurgery (after M.S)
9. MCh Vascular Surgery
10. MCh Neurosurgery 5-year course (after MBBS and 1 year Senior house surgency / 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 Cardiovascular Imaging and Vascular Interventional Radiology
14. Post-doctoral certificate course in Diagnostic Neuroradiology
15. Post-doctoral certificate course in Vascular Surgery
16. Post-doctoral fellowship (Post DM/ MCh/DNB)

PhD / Masters

17. MD in Transfusion Medicine
18. Master of Public Health (MPH)
19. M Phil (Biomedical Technology)
20. PhD

Diplomas

21. Diploma in Public Health
22. Diploma in Cardiovascular and Thoracic Nursing
23. Diploma in Neuro Nursing
24. Diploma in Operation Theatre Technology
25. Diploma in Advanced Medical Imaging Technology

PG Diploma

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

Advanced Certificate

31. Advanced Certificate Programmes in Physiotherapy

Other Programmes

Joint Programmes

1. M Tech (Clinical Engineering)
2. PhD (Biomedical Devices and Technology)

Affiliated Programmes with other Centres

A. National Institute of Epidemiology, Chennai

1. Master of Public Health (Epidemiology and Health Systems)
2. PhD in Public Health

B. Christian Medical College, Vellore

1. MS Bioengineering
2. PhD in Bioengineering/ Public Health/ Biological Sciences

3. Master of Public Health (MPH)

C. IIITMK, Trivandrum
PhD (For Engineering Graduates)

D. IIPH, New Delhi
Master of Public Health

Admission Process

Admission to various programmes of study is regulated by policy and procedures approved by the Academic Committee of the Institute from time to time.

Number of students enrolled during the year

The students enrolled in various courses offered by the Institute are indicated below:

Course	Number
DM/MCh and Post-doctoral Certificate Courses	46
PhD	19
MPhil Programme	10
Master of Public Health	13
MD Transfusion Medicine	1
Diploma / PG Diploma Programmes	38

Based on the performance of the candidates in the entrance examination and the merit list prepared in accordance with the provisions of the Institute's admission policy, 138 candidates were offered admission to various programmes, of which 127 candidates joined. The candidates admitted to various programmes passed their qualifying examinations from 48 Indian Universities/Institutions/Boards.

Student strength

The total strength of students on the rolls of the Institute (excluding the joint programs and affiliated programs) as on 31 March 2017 was 311.

The scholarships and awards received by our students were a source of pride. Among post-doctoral students, 27 were awarded the best paper and poster awards during the year. Several publications from the Institute stemmed from the hard work of our DM/MCh and PhD students. The publishing profile of our students improved in 2016-2017.

Degree / Certificates Awarded

Name of Programme	Numbers	Remarks
DM	21	
MCh	10	
PDF	7	
PDCC	6	
PhD	15	
MPhil	5	
MPH	15	
MPH	18	CMC Vellore
MPH	9	NIE Chennai
MS - Bioengineering	2	CMC Vellore
DPH	1	
Diploma in Cardiovascular and Thoracic Nursing	9	
Diploma in Neuro Nursing	8	
Diploma in Cardiac Laboratory Technology	3	
Diploma in Neuro Technology	4	
Diploma in Clinical Perfusion	3	
Diploma in Advanced Medical Imaging Technology	3	
Diploma in Medical Records Science	2	
Diploma in Operation Theatre Technology	2	
Diploma in Blood Banking Technology	2	

Short -Term Training/Observership

Candidates sponsored by Government/Autonomus 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 departments/ disciplines. Observers from various institutions all over the country spent 1 week to 3 months in different departments of the Institute.

Annual Convocation

The Annual Convocation of the 32nd batch of graduates was held on 27 May 2016. The convocation address was delivered by Dr Aravind Panagariya, Hon'ble Vice- chairman, NITI Aayog, Government of India. Guest of Honour was Dr P Balram, Former Director, Indian Institute of Science, Bangalore. The Institute President, Shri K M Chandrasekhar presided and delivered the presidential address. Prof Asha Kishore, Director of the Institute, welcomed the gathering and presented the academic report. The Dean, Dr V Kalliyana Krishnan proposed the Vote of Thanks. 146 graduates received their degrees during the ceremony.

G Parthasarathy Oration

The Annual G Parthasarathy Memorial Oration was held in the Institute on 17 February 2017. Shri Subramanian Ramadorai, Former Vice-chairman, Tata Consultancy Services, delivered the Oration. Mr Balgopal, Former CMD, Terumo Penpol Ltd., introduced the Guest of Honour. The Institute President, Shri K M Chandrasekhar, presided over the function and delivered the presidential address. Director, Prof Asha Kishore, welcomed the gathering and Dr Harikrishna Varma, Head, BMT Wing, proposed the Vote of Thanks.

National Science Day 2017 Celebrations

The National Science Day 2017 was celebrated on 27 February 2017 at the Central Institute on Mental Retardation, Thiruvananthapuram (Figure 1). The theme of the National Science Day 2017 was "Science & Technology for Specially Abled Persons". A team of scientists, clinicians and engineers visited the Institute and interacted with the staff and students (Figure 2). The students presented various cultural programmes and demonstrated their day-to-day activities.

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 also participated in the Town Official Language Implementation Committee meetings.

Staff

Dr Asha Kishore, Director and Chairperson
Dr V Kalliyana Krishnan, Dean of Academic Affairs
Dr T V Kumary, Associate Dean (PhD Programme)
Dr Shivakumar K, Associate Dean (Research & Publications)
Dr Shrinivas V G, Associate Dean (Student & Faculty Affairs)
Dr Sundari Ravindran T K, Associate Dean (Health Science Studies)
Dr Thomas Koshy, Associate Dean (Examination and Curriculum Development)
Dr A V George, Registrar
Dr Sundar Jaysingh, Deputy Registrar (until 30-11-2016)
Dr B Santhosh Kumar, Deputy Registrar (Acting) (From 1-12-2016)
Mr V S Shiju, Assistant Administrative Officer (Academic) - A
Mr H Ramprasad, UDC - A
Ms K H Jeeva, Executive Assistant - A
Mr Manoj Kumar K V, UDC - A (Hostel Caretaker)

Figure 1. National Science Day 2017 celebration at Central Institute on Mental Retardation

Figure 2. SCTIMST staff interacting with the students at Central Institute on Mental Retardation

DIVISION OF NURSING EDUCATION

Activities

The specialty nursing programmes of the Institute continued to attract registered nurses as evidenced by the number of applicants for the two programmes - Diploma in Cardiovascular and Thoracic Nursing, and Diploma in Neuro Nursing. The number of applicants was more than four times the annual intake. The 28th batch of cardiac specialty nursing students and 24th batch of neuro speciality nursing students graduated in December 2016. Presently, 217 cardiac nurses and 160 neuro nurses are working in many parts of the world. Currently, the list of students undergoing training in these two specialty programmes is provided in the Table below:

	Students		
Programme	**First year**	**Second year**	**Graduated**
Diploma in Cardiovascular and Thoracic Nursing	10	9	9
Diploma in Neuro Nursing	9	10	8
Total	**19**	**19**	**17**

Research Programmes

The effect of CPR training among nurses was assessed using a pre-test/post-test design. Phase I of the study was completed during the year.

Faculty

Dr Saramma P P, Senior Lecturer in Nursing

LIBRARY- HOSPITAL WING

Activities

The Hospital Wing library has a collection of 15560 books and 15750 back volumes of journals. During the current year, the library subscribed to 110 journals. Electronic access to the subscribed journals is available in both the campuses.

Being part of the National Knowledge Resource Consortium (NKRC), the library continued to have access to full-text of selected journals from Elsevier, Wiley, Springer, Oxford University Press, American Chemical Society, Royal Society of Chemistry, Nature Publishing Group, Taylor & Francis, databases of Web of Science and ASTM Standards, as well as the plagiarism checking software, iThenticate. 240 documents, which included journal articles, theses and dissertations, were checked for plagiarism during the year.

The publications from the Institute from 1977 have been listed in the library site.

Staff

Mr S Jayachandradas, Librarian-cum-Information Officer - Gr I

Ms Sudha T, Librarian-cum-Documentation Officer - B

Mr Joy Vithayathil, Senior Librarian-cum-Documentation Assistant

Ms Dimple Gopi, Librarian-cum-Documentation Assistant - A

Ms Seema S, Librarian-cum-Documentation Assistant - A

LIBRARY - BMT WING

Activities

The library of the BMT Wing has 11039 books, 6019 back volumes, and subscribes to 51 journals. The library has been subscribing to ASM Medical Materials Database, a comprehensive, peer-reviewed database providing a single relational resource to summarize scientific and engineering knowledge on implantable medical materials data to support surgical, cardiovascular, orthopaedic and neurological medical device design developed by ASM International. The library has a good collection of standards and patents. The standards essential for the Quality Management System and for the research and development activities of BMT Wing are frequently updated.

The Document Archiving Cell is part of the library with the Librarian-cum-Documentation Officer acting as the Archivist.

Staff

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

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

MEDICAL ILLUSTRATION UNIT

The Unit works towards producing resources for use in patient care, training and research.

Activities

The work covers three areas:

1. Creating medical art and graphic design using traditional and state-of-the-art technology for publication and training purposes
2. Clinical photography for academic activities and routine photography at institutional events
3. Providing audiovisual facility for institutional events

Staff

Mr G Lijikumar, Junior Scientific Officer

Ms Vasanthy S, Senior Artist

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 $ 36000.00	3 years
Deciphering the genetic architecture of the LRRK2 gene in the Indian population	Dr Asha Kishore	Michael J Fox Foundation, USA	US $ 5488.00	3 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
205MS303 – A multicentre, open-label extension study to evaluate the long term safety and efficacy of BIIB019, Daclizumab High Yield Process (DAC HYP), monotherapy in subjects with multiple sclerosis who have completed study 205MS301	Dr Muralidharan Nair	Biogen Idec	25.00	3 years
Quantification of disability in epilepsy: A move towards rehabilitation and empowerment	Dr Sanjeev V Thomas	Centre for Disability Studies, Kerala	07.45	30 months

Growing beyond barriers; Epilepsy care through schools	Dr Sanjeev V Thomas	Social Justice Department, Government of Kerala	30.90	1 year
Analysing the functional connectivity networks in brain in drug-resistant idiopathic generalized epilepsy using EEG-fMRI co-registration	Dr Ashalatha R	SERB	28.70	3 years
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	3 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., Gujarat	1.50	3 years
Pilot study for establishing nationwide network of registries on Management of Acute Coronary Event (MACE Registry)	Dr Harikrishnan S	ICMR	08.08	3 years
A resting state fMRI & task- based fMRI	Dr Kesavadas C	GE Technology Centre, Bengaluru	09.00	3 years
International Stroke Perfusion Imaging Registry (INSPIRE)	Dr Sylaja P N	University of Newcastle, Australia	03.16	3 years
Bio-Repository of DNA - Stroke	Dr Sylaja P N	Imperial College of Science, Technology and Medicine, London	03.95	2 years
Head Position in Stroke Trial (HeadPost)	Dr Sylaja P N	HeadPost International Coordinating Centre, Australia	1.70	1 year

Apolipoprotein B and A1 in ischemic stroke subtypes	Dr Sylaja P N	Emory University, USA	6.16	2 years
Mitochondrial remodeling for prevention of chronic pressure overload induced cardiac remodelling	Dr Renuka Nair	ICMR	21. 20	3 years
Oxidative stress mediated stem cell modification promotes cardiac failure in hypertrophic remodeling	Dr Renuka Nair	BRNS, Government of India	20.00	3 years
Molecular mechanisms in wound healing in the heart: Regulation of the cardiac fibroblast AT1 receptor	Dr Shivakumar K	DBT	37.80	3 years
Mitochondrial metabolism and function in type 2 diabetic heart	Dr Srinivas G	SERB	50.77	3 years
In vitro Beta-amyloid uptake by peripheral blood macrophages: predictor for progression on mild cognitive impairement (MCI) to Alzheimer's disease (Ad)	Dr Srinivas G	ICMR	18.91	3 years
Telehealth and medical education	Dr Jawahar S K	Planning Board, Government of Kerala	23.00	5 years
Mitochondria-specific anti-oxidant: Target for the reversal of metabolic remodeling and prevention of cardiac hypertrophy	Dr Sreeja Purushothaman	KSCSTE	14.00	3 years
Study of carbamazepine embryotoxicity in relation to MDR1 polymorphisms	Dr Manna Jose	DST	25.81	3 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	09.90	5 years
Prospective single arm, multi-center, observational registry to further validate safety and efficacy of Ultimaster DES system in unselected patients representing everyday clinical practice	Dr Bijulal S	Terumo India Ltd.	11.74	18 months
Comprehensive Care Centre for Neurodevelopmental disorders	Dr Soumya Sundaram	Federal Bank Hormis Memorial Foundation	219.00	5 years
Validation of the Malayalam version of Montreal Cognitive Assessment (MoCA) Scale and a prospective evaluation of MCI in Parkinson's Disease using the Malayalam version (MoCA-M)	Dr Syam K	ICMR	3.81	3 years

Biomedical Technology Wing

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)	Duration
Preparation of hydrogel formulations from cholecystic extracellular matrix for biomedical applications	Dr Akhila Rajan	SERB	31.20	3 years
Biological evaluation of laser rapid manufactured Ti-porous structures	Dr A Sabareeswaran	BRNS, Government of India	18.77	3 years
Programme support on translational research on biomaterials for orthopedic and dental applications	Dr A Sabareeswaran	DBT	23.10	5 years
Development of rapid UTI diagnostic kit with antibiotic sensitivity	Dr A Maya Nandkumar	DST	28.00	2 years
To alleviate cognitive deficits in the offspring induced by sleep loss during pregnancy by administering alpha-asarone: A study in an animal model	Dr Kamalesh K Gulia	DST-CSRI	44.08	3 years
Defining the mechanobiology that leads to heterogeneity in muscle stem cells and its implication in regeneration	Dr Praveen K S	SERB	89.00	5 years
Adult stem cells as alternate cell sources for ocular surface regeneration	Dr T V Kumary	DST	48.00	3 years
An innovative tissue-engineered corneal regenerative therapy derived from a thermoresponsive bio-functionalized polymer and multipotent corneal stromal stem cells	T V Kumary and A Hopkinsons Queen's Medical Centre Campus, University of Nottingham, UK	DST-UKIERI	UK £ 39900	2 years
The role of NMDA and dopamine receptors in spinal pain pathways	Dr Pradeep Punnakkal	DBT	100.00	3 years
Differentiation of MSCs into chondrocytes by sustained delivery of miRNAs using chitosan hydrogel	PI: Dr Vrisha Madhuri Co-PI: Dr Prabha D Nair	DST-SERB	76.97	3 years
Musculoskeletal Tissue Engineering	Dr Prabha D Nair	DBT Indo-Danish	719.33	2 years
Role of platelet protein on endothelial cell and smooth muscle proliferation	Dr Anugya Bhatt	KSCSTE	29.00	3 years
Effect of vascular endothelial growth factor-transfected human ADMSCs in promoting angiogenesis for chronic wound healing	Ms Amita Ajit	DST-WoS	25.00	3 years

Development of biomimetic strontium-incorporated nanostructured ceramic coatings on Cp-Titanium for orthopaedic implants	Dr P V Mohanan	DBT	5.23	1 year
Translational research on biomaterials for orthopaedic and dental applications	Dr H K Varma	DBT (Center of Excellence Programme organised by IISc.)	70.73	5 years
Scaffolds based on self-assembling peptide dendrimers and resorbable calcium phosphates for endodontic tissue regeneration	Dr Manoj Komath (co-PI)	DBT (In collaboration with IIT Delhi)	34.92	3 years
Development of bioactive bone cement based on novel inorganic organic hybrid resin	Dr Lizymol P P	KSCSTE	18.44	3 years
Development of dental restorative material based on inorganic organic hybrid resin for barodontalgia	Dr Lizymol P P	DRDO	19.91	2 years
Gold nanorod-based targeted nanoprobe for cancer theranostics: Diagnosis by SERS and fluorescence imaging and therapy by PDT and PTT	Dr R S Jayasree	DBT	27.97	3 years
Blood-brain barrier targeted nanoconstructs for the diagnosis of brain diseases and the delivery of therapeutics into the brain	Dr R S Jayasree	DBT	11.45	3 years
Gold nanorods for targeted photodynamic therapy and fluorescence imaging	Dr R S Jayasree	ICMR	41.00	3 years
Encapsulation of IgG antibody for colon delivery	Dr Roy Joseph	Public Health England, UK	8.00	1 year
Development of cardiopulmonary devices	D S Nagesh	SIDD Lifesciences Pvt. Ltd., Chennai	27.00	3 years
Development of a light weight, lead-free, polymer-based thyroid collar for medical and dental diagnostic radiology	Dr Roy Joseph	Institute of Nuclear Medicine and Allied Sciences, DRDO, Delhi	19.62	2 years
Multifunctional hydroxyapatite/lanthanide core shell nanoparticles for near-infrared theranostic imaging	Dr Sunita Prem Victor	DBT	46.50	3 years
Targeted delivery of proteins using polymeric nanocapsules	Dr Shivaram Selvam	DST	40.00	5 years
Nano calcium phosphate and polymer linked supramolecular architectures for bioimaging and potential therapeutic applications	Dr Sunita Prem Victor	DST	26.00	3 years

Achutha Menon Centre For Health Science Studies

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)	Duration
Kerala Diabetes Prevention Program (KDPP)	Prof K R Thankappan	National Health and Medical Research Council, Australia	AUD 1.03 Million	5 years
Kerala Diabetics Prevention Program (KDPP II)	Prof K R Thankappan	World Diabetics Foundation, Denmark	US $ 250541	3 years
Indian European Research (AROGYAM)	Prof K R Thankappan	ICSSR	34.46	3 years
Control and Prevention of Non-Communicable Disease in Kerala	Prof K R Thankappan	Health and Family Welfare Department, Government of Kerala	495.00	2 years
Closing the gaps: Health Equity Research Initiative in India	Prof T K Sundari Ravindran	International Development Research Centre, Canada	295.00	4 years
Research initiative on factors influencing women's reproductive choices	Prof T K Sundari Ravindran	Ford Foundation, USA	US $ 42115	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 Harikrishnan S & Dr Jeemon Panniyammakal	PHFI	27.12	5 years

Institute - Funded TRC & TDF Projects
(Biomedical Technology Wing)

Title of the Project	Principal Investigator	Total Outlay (Rs in Lakhs)	Duration
Fabrication of a wound healing matrix from porcine cholecystic extracellular matrix	Dr T V Anilkumar	31.40	3 years
Histopathological evaluation in TRC programme	Dr A Sabareeswaran	23.75	5 years
Biphasic hydroxyapatite-based keratoprosthesis evaluation in a rabbit model (TDF)	Dr A Sabareeswaran	2.05	30 months
Microbiological evaluations	Dr A Maya Nandkumar	11.60	3 years
Alginate scaffold with recombinant growth factors for enhanced wound healing	Dr Anoopkumar Thekkuveettil	43.20	2 years
Point-of-care diagnosis for infectious diseases	Dr Anoopkumar Thekkuveettil	3.75	1 year
3-D printing of liver tissue constructs for in vitro hepatotoxicity testing	Dr T V Kumary	340	2 years
An injectable hydrogel for repair of cartilage injury and growth plate defects	Dr Prabha D Nair	54.71	2 years
Lint-free absorbent dressing for surgical and highly exudating chronic wounds	Dr Lynda V Thomas	36.01	2 years
Evaluation of biodegradable PLGC-fibrin hemostatic graft for skin regeneration	Dr Lissy K Krishnan	22	1 year
Development of assay platform and sensing device for PT/INR monitoring	Dr Anugya Bhatt	22	2 years
Standardization of albumin and FVIII production and IVIG purification from 'small pool' human plasma	Dr Lissy K Krishnan	38.14	1 year
Toxicity evaluation of materials/devices	Dr P V Mohanan	45.00	3 years
Bioactive intervertebral spacers for lumbar fusion	Dr Manoj Komath (PI) & Dr H K Varma (Co-PI)	31.24	2 years
Bioactive material platform for drug delivery in bone	Dr H K Varma (PI) & Dr Manoj Komath (Co-PI)	58.55	2 years
Development of a bioactive radiopaque inorganic-organic hybrid resin for dental and orthopaedic applications	Dr Lizymol P P	8.03	2 years
Aortic stent graft	Mr Sujesh S	109.44	2 years
ASD occluder	Mr Sujesh S	41.53	2 years
Annuloplasty ring	Mr Ranjith G	9.40	2 years

Flow diverter stent	Mr Sujesh S	5.49	2 years
Development of centrifugal blood pump along with drive unit and flow meter	Mr Vinodkumar V	63.98	18 months
Development of paracorporeal left ventricular assist device	Mr D S Nagesh	245.26	3 years
Development of detection system for CT contrast agent extravasation	Mr Sarath S Nair	6.50	2 years
Application of decellularised bovine pericardium for fabrication of a novel valved conduit for RVOT reconstruction in sheep model	Dr Umashankar P R	9.90	3 years
Characterization and documentation of baseline reference data of in-house bred Ankamali Swine for application in biomedical research	Dr Sachin J Shenoy	2.50	2 years
Deep Brain Stimulation system for movement disorders	Mr Muraleedharan C V	176	3 years
Development of intracranial electrodes for use in acute and chronic electrocorticography (ECoG)	Mr Jithin Krishnan	29	18 months
Development and evaluation of radiopaque liquid embolization device by chemical grafting of iodinated compounds on to the ethylene vinyl alcohol co-polymer	Dr Roy Joseph	47.15	3 years

Completed Projects during 2016-17

Hospital Wing

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)
Improving the Control of Hypertension In Rural India (CHIRI): Overcoming barriers to diagnosis and effective treatment	Prof K R Thankappan	GACD & the National Health and Medical Research Council, Australia	78.62
The influence of sleep architecture on the severity of memory disruption in amnestic mild cognitive impairment	Dr Ramshekhar N Menon	KSCSTE	08.41
Validation of Memory Functional Magnetic Resonance Imaging (fMRI) paradigms and its utility in pre-surgical evaluation of patients with refractory Temporal Lobe Epilepsy (TLE)	Dr Ramshekhar N Menon	SERB	14.85
Mitochondria-specific anti-oxidant: Target for the reversal of metabolic remodeling and prevention of cardiac hypertrophy	Dr Sreeja Purushothaman	KSCSTE	14.00

Biomedical Technology Wing

Title of the Project	Principal Investigator	Funding agency	Total Outlay (Rs in Lakhs)
Polymeric platform for developing 3-D organotypic culture for in vitro toxicity evaluation	Dr P R Anil Kumar	TDF	1.97
Detection of Zinc in epileptic condition using ratiometric fluorescent molecular probes	Dr R S Jayasree	DBT	85.02
An in vitro skin tissue- engineering approach for evaluating the potential of hair follicle derived stem cells-implication to wound healing	Dr Babitha S	DST	25.00
Polymer inorganic hybrid scaffolds with cell adherent surfaces and enhanced mechanical properties for osteochondral tissue engineering	Dr Bindu P Nair	DST DST- INSPIRE Faculty	83.00
Controlled delivery of biological molecules using biodegradable micro-needles	Dr Shiny Velayudhan	DBT	43.80
In vitro osteoarthritic model to evaluate the regenerative capability of implants or engineered constructs	Dr Neethu Mohan	DST	18.00
Exploring the potential of islet- like cell aggregates generated from mesenchymal stem cells of human placenta for treating type I diabetes in NOD mice by immunoisolation approach	Dr Prabha D Nair	DBT	80.81
Small-scale production of fibrinogen concentrate and thrombin for clinical use	Dr Lissy Krishnan	TDF	9.95
Toxicity of studies of materials	Dr Mohanan P V	ICMR	0.8
Non-viral gene delivery vectors for therapeutic gene and siRNA delivery for glioma targeting: In vitro evaluation of cationized pullulan-based materials	Dr Rekha M R	DBT	36.11
Visible light-induced in situ gelling multifunctional hydrogels as potential wound dressings	Dr C Radhakumary	DBT	32.7
Feasibility study for the system validation of C-DAC DAQ device	Ms Leena Joseph (Study Director)	Industry	0.1

New Research Initiatives for 2017-18

Project title	Principal Investigator	Funding Agency	Total Outlay (Rs in Lakhs)	Duration/ Status
Eletroencephalographic features and seizure risk in 12-18 year-old children of women with antenatal antileptic drug exposure	Dr Sanjeev V Thomas	ICMR	12.67	3 years - to be initiated from April 2017
Survey for monitoring the National Non-communicable Disease Targets	Dr P S Sankara Sarma	ICMR	71.41	1 year - to be initiated by June 2017
Establishment of the Indian Stroke Clinical Trial Network (INSTRuCT)	Dr Sylaja P N	ICMR	15.16	3 years - to be initiated from May 2017
Secondary Prevention by structured Semi-interactive Stroke Prevention Package in India (SPRINT INDIA) study	Dr Sylaja P N	ICMR	1.37	3 years - to be initiated from May 2017
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 - to be initiated from April 2017

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

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Head, Biomedical Technology Wing, SCTIMST

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Acting Head, Biomedical Technology Wing
SCTIMST

Dr P R Harikrisna Varma (wef 30/07/2016)
Head, Biomedical Technology Wing
SCTIMST

Prof K R Thankappan
Head, AMCHSS, SCTIMST

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Prof K P Aravindan
Department of Pathology (Retd.)
Government Medical College, Kozhikode

Prof Sunil Chandy
Director
Christian Medical College, Vellore

Prof Mukesh Doble
Department of Biotechnology
Indian Institute of Technology Madras

Dr Renuka Nair R
Scientist G (Senior Grade)
Division of Cellular & Molecular Cardiology
SCTIMST

Prof Ajitkumar V K
Head, Department of Cardiology
SCTIMST

Dr Muralidharan Nair
Professor (Senior Grade) & Head, Department of Neurology
SCTIMST

Prof V Ramankutty
AMCHSS
SCTIMST

Shri C V Muraleedharan
Scientist G & Associate Head
Biomedical Technology Wing
SCTIMST

FINANCE COMMITTEE

Prof Asha Kishore (Chairperson)
Director , SCTIMST

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

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

Dr P R Harikrishna Varma (from 30/07/2016)
Head, Biomedical Technology Wing
SCTIMST

Shri Girijavallabhan V K (Ex-officio Convener)
Ex. IA & AS, Senior Deputy Director (Administration)
SCTIMST

PRESIDENT'S COMMITTEE

Prof M S Valiathan
National Research Professor
Manipal Academy of Higher Education
Madhav Nagar, Manipal

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

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

Shri C Balagopal
Maryknoll Bungalow, TC 4/246
Taliath Lane, Kuravankonam-Ambalamukku Road
Thiruvananthapuram

Dr A Ajayaghosh
Director
National Institute for Interdisciplinary Science & Technology, Thiruvananthapuram

Shri A V Ramani
Group Advisor (R & D), TTK Group, Bangalore

Dr M Ayyappan (April 2016 to July 2016)
Chairman & Managing Director
HLL Lifecare Limited
Latex Bhavan, Poojappura
Thiruvananthapuram

Shri R P Khandelwal (August 2016)
Chairman & Managing Director
HLL Lifecare Limited
Latex Bhavan, Poojappura, Thiruvananthapuram

RESEARCH COUNCIL

Prof P Balaram (Chairman)
(Former Director, IISc Bangalore)
Molecular Biophysics Unit
Indian Institute of Science, Bangalore

Prof Asha Kishore
Director, SCTIMST

Dr Manohar V Badiger
Senior Principal Scientist
Polymer Science and Engineering Division
CSIR - National Chemical Laboratory
Dr Homi Bhabha Road, Pune

Prof Alok Dhawan
Director
CSIR-Indian Institute of Toxicology Research
Post Box No. 80, Mahatma Gandhi Marg , Lucknow

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

Prof Bikramajit Basu
Professor, Materials Research Centre
Associate Faculty, Centre for Biosystems Science and Engineering
Indian Institute of Science, Bangalore

Dr Jayanthi Sivaswamy
Dean Academic, Professor
International Institute of Information Technology
Gachibowli, Hyderabad

Shri A V Ramani
Group Advisor (R & D), TTK Group , Bangalore

Prof Sabu Thomas
Director, School of Chemical Sciences
Mahatma Gandhi University
Priyadarsini Hills PO, Kottayam

Dr G Sundararajan
Former Director, ARCI, Hyderabad
Professor, Department of Metallurgical and Materials Engineering
Indian Institute of Technology Madras, Chennai

Prof Vikram Jayaram
Chair, Division of Mechanical Sciences
Department of Materials Engineering
Indian Institute of Science, Bangalore

Prof Siddhartha Roy
Former Director, IICB
Senior Professor & Dean of Studies
Bose Institute, P1/12, CIT Scheme VII M
Kolkata

Dr Y S Mayya
Former Director, Electronics & Instrumentation Group, BARC
55 Sreeniketan, Anushaktinagar
Mumbai

Prof Rinti Banerjee
Madhuri Sinha Chair Professor
Head, Department of Biosciences & Bioengineering
Room No. 503, BSBE Building
Indian Institute of Technology Bombay
Powai, Mumbai

INSTITUTIONAL ETHICS COMMITTEE

Shri Justice P S Gopinathan (Chairman)
Former Judge, High Court of Kerala
Pullukatte House, 67/1723, SRM Road , Eranakulam

Dr Meenu Hariharan
Director, Indian Institute of Diabetes, Trivandrum
Abha, 20/1677, No.8, Sasthri Nagar, Karamana
Thiruvananthapuram

Dr Rema M N
Former DME, and Professor and Head of the Department of Pharmacology, "Manjush", Puthupally Lane
Thiruvananthapuram

Dr R V G Menon
No. 22, Haritha, Kesavadev Road, Poojappura
Thiruvananthapuram

Smt Sathi Nair
Retd. Chief Secretary
'Samtripthi' Devapalan Nagar
Peroorkada, Thiruvananthapuram

Dr K R S Krishnan
Retd. Director, Technical & Operation
HLL Life Care Limited, Poojappura
Thiruvananthapuram

Dr Christina George
Head, Department of Psychiatry
Dr Somervell Memorial CSI Medical College and Hospital
Karakonam PO, Thiruvananthapuram

Dr Kala Kesavan P
Professor of Pharmacology
Medical College, Thiruvananthapuram

Dr P Manickam
Scientist D, National Institute of Epidemiology
R 127, 31'd Avenue, TNHB, Ayapakkam
Chennai, Tamil Nadu

Prof Asha Kishore
Director, SCTIMST

Dr P R Harikrishna Varma
Head, Biomedical Technology Wing , SCTIMST

Prof V Raman Kutty
AMCHSS, SCTIMST

Prof Mala Ramanathan
Member Secretary-IEC, AMCHSS, SCTIMST

Ms Sreepriya C S
Co-ordinator -IEC
Executive Secretary to the Director cum Ethics Committee Co-ordinator
SCTIMST

INSTITUTIONAL ANIMAL ETHICS COMMITTEE

Dr Prabha D Nair (Chairperson)
Scientist G (Senior Grade)
Division of Tissue Engineering and Regeneration Technology
Biomedical Technology Wing, SCTIMST

Prof Kavita Raja
Department of Microbiology, SCTIMST

Dr Lissy K Krishnan
Scientist G, Division of Thrombosis Research
Biomedical Technology Wing, SCTIMST

Dr P R Umashankar
Scientist F, Division of In Vivo Models and Testing
Biomedical Technology Wing, SCTIMST

Dr V S Harikrishnan
Scientist D, Scientist-In-Charge of Animal house facility
Division of Laboratory Animal Science
Biomedical Technology Wing, SCTIMST

Dr Robin D Culas, Scientist from outside the Institute

Dr J C Stephenson, CPCSEA Main Nominee

Dr Arun George, CPCSEA Link Nominee

A G Babu, Socially aware nominee

INSTITUTIONAL COMMITTEE FOR STEM CELL RESEARCH

Dr M Radhakrishna Pillai (Chairman)
Director, Rajiv Gandhi Centre for Biotechnology
Thycaud PO, Poojappura, Thiruvananthapuram

Prof R V G Menon
H No. 22, Haritha
Kesavadev Road, Poojappura
Thiruvananthapuram

Dr P G Premila
7C, Kowdiar Manor
Jawahar Nagar, Thiruvananthapuram

Dr Jackson James
Scientist-E1, Neuro-Stem Cell Biology Laboratory
Department of Neurobiology, Rajiv Gandhi Centre for Biotechnology
Thycaud PO, Poojappura
Thiruvananthapuram

Prof Vikram Mathews
Clinical Haematology
Christian Medical College, Vellore
Tamil Nadu

Dr Sheila Balakrishnan
Additional Professor of Gynaecology & Head, Fertility Unit, Government Medical College
Thiruvananthapuram

Shri Jaideep G Nair
Advocate
Anjali, Veera Bhadra Gardens
Thiruvananthapuram

Prof Asha Kishore
Director , SCTIMST

Dr R Renuka Nair
Scientist G (Senior Grade)
Division of Cellular & Molecular Cardiology, SCTIMST

Dr Lissy K Krishnan
Scientist G, Thrombosis Research Unit
Biomedical Technology Wing, SCTIMST

Dr Anoop Kumar T
Scientist F, Molecular Medicine
Biomedical Technology Wing, SCTIMST

Dr Prabha D Nair (Member Secretary)
Scientist G (Senior Grade)
Division of Tissue Engineering and Regeneration Technology
Biomedical Technology Wing, SCTIMST

Ms Sreepriya C S (Co-ordinator - ICSCR)
Executive Secretary to the Director cum Ethics Committee Co-ordinator
SCTIMST

INSTITUTIONAL BIOSAFETY COMMITTEE

Chairman-IBSC

Dr K Madhavan Nampooothiri (DBT Nominee)
Principal Scientist (Biotechnology)
National Institute of Interdisciplinary Science and Technology (NIIST), Trivandrum

Dr A Maya Nandkumar (Member Secretary)
Scientist F, Division of Microbial Technology
BMT Wing, SCTIMST

Dr Moinak Banerjee (External Expert)
Scientist E-II, Human Molecular Genetics Laboratory
Rajiv Gandhi Center for Biotechnology
Trivandrum

Dr S K Jawahar (Biosafety Officer)
Deputy Medical Superintendent, SCTIMST

Dr Renuka Nair (Internal Expert)
Scientist G (Senior Grade),
Division of Cellular & Molecular Cardiology,
SCTIMST

Dr Lissy K Krishnan (Internal Expert)
Scientist G, Division of Thrombosis Research
BMT Wing, SCTIMST

Dr P Ramesh (Internal Expert)
Engineer F, Division of Polymer Processing
BMT Wing, SCTIMST

Dr T V Kumary (Internal Expert)
Scientist G, Division of Tissue Culture
BMT Wing, SCTIMST

TECHNOLOGY DEVELOPMENT COMMITTEE

Prof Asha Kishore (Chairperson)
Director, SCTIMST

Dr P R Harikrishna Varma
Head, Biomedical Technology Wing, SCTIMST

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

Shri C Balagopal
Maryanoll Bungalow, TC 4/246, Thaliyath Lane
Kuravaonkonam, Kowdiar
Thiruvananthapuram

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

Shri A V Ramani
Group Advisor (R & D)
TTK Group, Bangalore

Prof Vrisha Madhuri
Pediatric Orthopedic Surgeon
Christian Medical College, Vellore, Tamil Nadu

Prof Ashok Kumar
Department of Biological Sciences & Engineering
Indian Institute of Technology Kanpur
Uttar Pradesh

Shri C V Muraleedharan
Scientist G & Associate Head
Biomedical Technology Wing, SCTIMST

Prof Ajit Kumar
Head, Department of Cardiology
SCTIMST, Prof Shrinivas V G
Department of Anaesthesiology
SCTIMST

BUILDING COMMITTEE

Prof Asha Kishore (Chairperson)
Director
SCTIMST

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

Shri G Vijayaraghavan
(Former CEO, Technopark & Former Member State Planning Board)
TC 26/719, Kakshmipriya, Chempaka Nagar
Bakery Junction, Thiruvananthapuram

Dr P R Harikrishna Varma (from 30/07/2016)
Head, Biomedical Technology Wing
SCTIMST

Shri K Muraleedharan Nair
Head CMD (retired) VSSC/ISRO
Trivandrum

Shri Girijavallabhan V K (Ex-officio Convener)
Ex. IA & AS, Senior Deputy Director (Administration)
SCTIMST

SENIOR STAFF SELECTION COMMITTEE

Director, SCTIMST
Head, Biomedical Technology Wing, SCTIMST
Nominee of the Secretary, DST
An expert from outside of the Institute
A scientist from among the members of the Institute Body
A senior academic staff of the Institute

JUNIOR STAFF SELECTION COMMITTEE

Medical Superintendent, SCTIMST
Head, Biomedical Technology Wing, SCTIMST
A representative of the Academic Wing
Three members nominated by the President

The Internal Complaints Committee (ICC) for Prevention of Sexual Harassment of Women at Work Place developed Standard Operating Procedures (SOPs) and formats for writing a complaint that were published in the Institution website in April 2016. The ICC also brought out printed brochures in English and Malayalam for distribution among staff of the Institute in November 2016. One of the two complaints received was settled by interaction of the members of the Committee and the concerned individuals and no further inquiry was conducted. For the second complaint, an enquiry was conducted and the report was submitted to the Director. The ICC was reconstituted in January 2017. An awareness programme was conducted for the newly joined students.

STATEMENT OF ACCOUNTS

2016-17

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31st March 2017

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	2016-17	2015-16
		[Rs.]	[Rs.]
CAPITAL FUND	1	2309495729	2415358210
RESERVES & SURPLUS	2	221557820	468881828
EARMARKED ENDOWMENT FUNDS	3	797201599	568504318
SECURED LOANS & BORROWINGS	4	0	0
CURRENT LIABILITIES & PROVISIONS	7	248231143	392115820
TOTAL		**3576486291**	**3844860176**
ASSETS			
FIXED ASSETS	8	1210151684	1688144242
INVESTMENTS FROM EARMARKED ENDOWMENT FUNDS	9	763387543	129333293
INVESTMENTS-OTHERS	10	221557820	468881828
CURRENT ASSETS , LOANS, ADVANCES ETC	11	1381389244	1558500813
MISCELLANEOUS EXPENDITURE (TO THE EXTENT NOT WRITTEN OFF)		0	0
TOTAL		**3576486291**	**3844860176**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES & NOTES ON ACCOUNT	25		
		0.00	0.00
		0.00	0.00

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR 2016-17

	Schedule	2016-17	2015-16
INCOME		**TOTAL**	**TOTAL**
		Rs.	Rs.
Income from Sales / Services	12	1083957483	904119253
Grants Received from Govt of India(Salary & General)	13	1123643000	957813000
Fees/Subscription	14	10344934	8432450
Income from Investments }	15	12525518	26982987
Withdrawal from ERF }		250000000	100000000
Income from Royalty, Publication etc	16	2628988	1091864
Interest earned	17	55228711	50548463
Other Income	18	10591255	11070681
Total		**2548919889**	**2060058698**
EXPENDITURE			
Establishment Expenses	20	1321441541	1144529802
Other Administrative Expenses	21	1147456199	901825681
Bank Charges	23	91172	118506
Depreciation - Current Year		253890992	161168080
Accumulated		423802867	0
Total		**3146682771**	**2207642070**
Balance being Excess Expenditure over Income		597762881	147583372
Add: Transfer to Special Reserve Account		3864670	1796684
BALANCE BEING DEFICIT CARRIED TO CAPITAL FUND		601627551	149380056

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULES

SCHEDULE 1 - CORPUS/CAPITAL FUND		2016-17	2015-16
	PARTICULARS	[Rs.]	[Rs.]
	Balance as at the beginning of the year	4326934180	4126604027
	Less Depreciation up to the end of the previous year	1911575969	1750407890
	Net balance at the beginning of the year	2415358210	2376196137
	Add: Plan Grants received from Government of India for creation of Capital Assets	485692000	202597000
	Add: Grants received under CSR scheme	22490109	0
	Less:Contribution towards Corpus/Capital Fund	0	0
	Deduct: Balance of net expenditure transferred from the Income and Expenditure Account	601627551	149380056
	Less:Value of Assets Written off during the year	12417038	14054871
	DeductTransfer to BMT/Add Transfer from CHO	0	0
			0
	BALANCE AS AT THE YEAR-END	**2309495730**	**2415358210**
SCHEDULE 2-RESERVES AND SURPLUS:		**2016-17**	**2015-16**
	1. Capital Reserve:		
	As per last Account	--	--
	Addition during the year	--	--
	Less:Deduction during the year	--	--
	3. Special Reserves:		
	As per last Account	468881828	567019319
	Addition during the year (Current year transfer-Increase in provision)	2675992	1862509
	Less: Deductions during the year	-250000000	-100000000
	4. General Reserve:		
	As per last Account	--	--
	Addition during the year	--	--
	Less: Deductions during the year	--	--
	TOTAL	**221557820**	**468881828**

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS		2016-17	2015-16
	a) Opening balance of the funds	568504318	211742527
	b) Additions to the funds:		
	i. Donations/grants	1368415822	701271819
	ii. Income from Investments made on account of funds		
	iii. Other additions (Specify nature)		
	TOTAL (a+b)	**1936920139**	**913014345**
	c) Utilisation / Expenditure towards objective of funds		
	i. Capital Expenditure		
	- Fixed Assets	93950754	11722393
	- Others		
	Total (Detailed Schedule Attached)	93950754	11722393
	ii. Revenue Expenditure		
	- Salaries, Wages and allowances etc.	54713472	53623685
	- Rent & Consumables etc.,	563299384	37851054
	- Other Administrative expenses	427754931	241312895
	Total	1045767786	332787635
	TOTAL (c)		
	NET BALANCE AS AT THE YEAR-END (a+b+c)	**797201599**	**568504318**

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS - AS ON 31.03.2017

PROJ#	NAME OF GRANTEE/ PRINCIPAL INVESTIGATOR	FUND-WISE BREAK UP					
		OPENING BALANCE	ADDITIONS TO FUND		TOTAL		
			GRANTS	OTHER RECEIPTS		FIXED ASSETS	
5000	PROJ-MISCELLANEOUS	1054087.50	5068038.00	648742.70	6770868.20	0.00	
5008	GENERAL CONFERENCE,WORKSHOP	10916.00	0.00	0.00	10916.00	0.00	
5033	MPH PROGRAMME	1480.00	0.00	0.00	1480.00	0.00	
5040	DEVELOPING EXPERIMENTAL THERAUPEUTICALS	858136.70	0.00	0.00	858136.70	0.00	
5055	ROCKEFELLER FOUNDATION,USA	686120.00	0.00	0.00	686120.00	0.00	
5078	PROJECT GRANT/DR MALA RAMANATHAN	5810.00	0.00	0.00	5810.00	0.00	
5091	EURO REG. OF EPILEPSY & PREGNANCY	26667.00	0.00	0.00	26667.00	0.00	
5094	KERALA STATE AIDS CONTROL SOCIETY	257171.00	0.00	0.00	257171.00	0.00	
5100	AMC/MAC ARTHUR FOUNDATION/02-70546	46315.05	0.00	0.00	46315.05	0.00	
5108	EVAL.SUB-TYPES DEMENTIA/ DR.MATHURA	15800.50	0.00	0.00	15800.50	0.00	
5110	TOBACCO CESSATION & RESEARCH / DR.THANKAP	1349997.94	0.00	0.00	1349997.94	0.00	
5119	STAKE HOLDER-PERCEPT/ INST.REV BO	104492.73	0.00	0.00	104492.73	0.00	
5130	TELE-HEALTH & MEDICAL EDUCATION/JAWAHAR	134208.00	0.00	100000.00	234208.00	0.00	
5133	WHO FELLOWSHIP TRAINING CBICD	215059.00	0.00	0.00	215059.00	0.00	
5135	A 16-WEEK,DOUBLE BLIND/ ASHA KISHORE	1326306.00	0.00	0.00	1326306.00	0.00	
5139	A 24 WEEK, MULTICENTER/ DR. MATHURANATH	2602046.78	0.00	0.00	2602046.78	0.00	
5140	HARVARD SCHOOL OF PUBLIC HEALTH	91794.32	0.00	0.00	91794.32	0.00	
5142	BANKING FOR BETTER HEALTH-MEDISAVE	153911.36	0.00	0.00	153911.36	0.00	

SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

Amount Rs.

UTILISATION						TOTAL EXPENDITURE	NET BALANCE
CAPITAL EXPENDITURE		REVENUE EXPENDITURE					
OTHERS	TOTAL	SALARIES/ WAGES	RENT/ CONSUM ABLES	OTHER ADMN EXP	TOTAL		
0.00	0.00	0.00	0.00	4372340.00	4372340.00	4372340.00	2398528.20
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10916.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1480.00
0.00	0.00	0.00	0.00	130695.00	130695.00	130695.00	727441.70
0.00	0.00	0.00	0.00	0.00	0.00	0.00	686120.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5810.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26667.00
0.00	0.00	0.00	0.00	97467.00	97467.00	97467.00	159704.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	46315.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15800.50
0.00	0.00	0.00	0.00	183254.92	183254.92	183254.92	1166743.02
0.00	0.00	0.00	0.00	0.00	0.00	0.00	104492.73
0.00	0.00	180000.00	0.00	4577.00	184577.00	184577.00	49631.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	215059.00
0.00	0.00	24480.00	0.00	277249.00	301729.00	301729.00	1024577.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2602046.78
0.00	0.00	0.00	0.00	0.00	0.00	0.00	91794.32
0.00	0.00	0.00	0.00	0.00	0.00	0.00	153911.36

5146	DEVELOPMENT OF SPECTROSCOPIC PROTOCOL	11026.00	0.00	0.00	11026.00	0.00	
5150	PROTOCOL 6002-INT 001	139026.60	0.00	200000.00	339026.60	0.00	
5153	DEV REF. MANUAL FOR PRIMARY	155802.00	0.00	0.00	155802.00	0.00	
5155	COMM BASED DETECTION	209315.00	0.00	0.00	209315.00	0.00	
5159	NCD RISK FACTOR SURVEILLANCE	71123.00	0.00	0.00	71123.00	0.00	
5161	DOSE RANGING STUDY:CGHR	1282948.00	0.00	0.00	1282948.00	0.00	
5168	PROJ/VERMEER STUDY	1073014.00	0.00	0.00	1073014.00	0.00	
5170	SAFETY OF E 2007 IN LEVODOPA	1294322.00	0.00	0.00	1294322.00	0.00	
5174	CHANGES IN SLEEP WAKEFULNESS-Dr.Mohanku.	49317.00	0.00	0.00	49317.00	0.00	
5175	SURGICAL TRIAL IN LOBAR INTRACEREBRAL	39125.27	0.00	0.00	39125.27	0.00	
5176	WOMEN COMPONENT PLAN	59065.25	0.00	0.00	59065.25	0.00	
5180	COMMUNITY BASED INTRVEN-CV DIS	18308.00	0.00	0.00	18308.00	0.00	
5182	KERALA REGISTRY FOR EPILEPSY AND PREGNANCY	6908.00	0.00	0.00	6908.00	0.00	
5183	OXFORD HEALTH SCHEME,LONDON	123124.92	0.00	0.00	123124.92	0.00	
5184	COMP HEALTH CARE PROJECT ST	404775.00	1000000.00	0.00	1404775.00	0.00	
5190	PREVALENCE OF TYPE II DIABETES IN RURAL	42210.00	0.00	0.00	42210.00	0.00	
5191	GENETICS OF PARKINSONS DISEASE	13027.50	0.00	0.00	13027.50	0.00	
5192	TO PROVIDE INFRASTRUCTURE TO AMCHSS	256405.50	0.00	0.00	256405.50	86000.00	
5193	SAFE MOTHERHOOD PROGRAMME	71796.00	0.00	0.00	71796.00	0.00	
5199	CLINICAL APPLICATION CRYOPRESE	849725.00	0.00	0.00	849725.00	0.00	
5201	OPEN LABEL TRIAL IN PARKINSON	3345311.50	0.00	0.00	3345311.50	0.00	
5203	STUDY IN MRI - ISIR	45243.00	0.00	0.00	45243.00	0.00	
5207	BRAIN MRI STUDIES	6692.00	0.00	0.00	6692.00	0.00	
5209	MANAGEMENT - CORONARY EVENT	358290.00	866187.00	0.00	1224477.00	0.00	
5210	EMPOWERMENT OF WOMEN	993896.00	0.00	0.00	993896.00	0.00	
5213	CREATION OF AMC FUND	1502643.00	0.00	11262929.92	12765572.92	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	11026.00
0.00	0.00	0.00	0.00	178850.00	178850.00	178850.00	160176.60
0.00	0.00	0.00	0.00	0.00	0.00	0.00	155802.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	209315.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	71123.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1282948.00
0.00	0.00	0.00	0.00	413970.00	413970.00	413970.00	659044.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1294322.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	49317.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39125.27
0.00	0.00	0.00	0.00	0.00	0.00	0.00	59065.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	18308.00
0.00	0.00	0.00	0.00	4467.00	4467.00	4467.00	2441.00
0.00	0.00	0.00	0.00	123124.92	123124.92	123124.92	0.00
0.00	0.00	0.00	0.00	817303.00	817303.00	817303.00	587472.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	42210.00
0.00	0.00	0.00	0.00	9250.00	9250.00	9250.00	3777.50
0.00	86000.00	0.00	0.00	430.00	430.00	86430.00	169975.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	71796.00
0.00	0.00	450890.00	169879.95	210293.00	831062.95	831062.95	18662.05
0.00	0.00	0.00	0.00	59184.00	59184.00	59184.00	3286127.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45243.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6692.00
0.00	0.00	389651.00	0.00	92251.00	481902.00	481902.00	742575.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	993896.00
0.00	0.00	0.00	0.00	242174.00	242174.00	242174.00	12523398.92

5216	PROTOCOL SP921 A MULTICENTRE	1053692.10	0.00	0.00	1053692.10	0.00	
5217	STUDY ON WORKLOAD ON NURSES	954577.50	0.00	0.00	954577.50	0.00	
5219	HEALTH IMPACT OF TECHNOLOGY	1045488.00	0.00	0.00	1045488.00	0.00	
5220	CAPACITY BUILDING WOMEN HEALTH	650101.00	0.00	0.00	650101.00	0.00	
5221	RESEARCH PROJECT EQUITY ISSUES	244365.00	0.00	0.00	244365.00	0.00	
5226	ISOLATION, CHARACTERIZATION OF GLIOMAS	357092.00	0.00	0.00	357092.00	0.00	
5227	MONOTHERAPY/ ACTIVE CONTROL	805382.00	271437.00	0.00	1076819.00	0.00	
5232	CEREBELLUM AND CORTICAL	161233.00	0.00	0.00	161233.00	0.00	
5234	IMPROVING LOCALIZATION IN LESION NEGATIVE	654.00	0.00	0.00	654.00	2861069.00	
5237	KERALA DIABETES PREVENTION PROGRAM(K-DPP	3673583.50	251400.00	0.00	3924983.50	0.00	
5238	IMPROVING LOCALIZATION IN LESION NEGA...	4884.00	0.00	0.00	4884.00	0.00	
5243	STEROIDS IN CARDIAC SURGERY	265782.00	0.00	0.00	265782.00	0.00	
5245	IMPROVING LOCALIZATION IN LESION N..	184938.00	0.00	0.00	184938.00	0.00	
5246	COMPREHENSIVE HEART FAILURE	100000.00	0.00	0.00	100000.00	0.00	
5247	A PHASE 3, 12-WEEK, DOUBLE BLIND, PLA...	2241270.10	0.00	0.00	2241270.10	12881.25	
5248	A PHASE 3, DOUBLE BLIND, PLACEBO AND A..	2041792.70	0.00	0.00	2041792.70	0.00	
5249	CNRS-INDO-FRENCH PROJECT	594651.00	0.00	0.00	594651.00	110700.00	
5252	INDO-US COLLABERATIVE STROKE	475753.00	0.00	0.00	475753.00	0.00	
5255	PRIVATIZATION OF HEALTHCARE	327241.50	0.00	0.00	327241.50	0.00	
5256	HEALTHY LIFE STYLE	4614663.00	350404.00	0.00	4965067.00	0.00	
5260	INFLUENCE OF SLEEP ARCHITECTUR	199410.00	0.00	0.00	199410.00	0.00	
5263	MITOCHONDRIA SPECIFIC ANTI-OXI	493803.00	0.00	0.00	493803.00	0.00	

0.00	0.00	0.00	0.00	15772.00	15772.00	15772.00	1037920.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	954577.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1045488.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	650101.00
0.00	0.00	198000.00	0.00	8218.00	206218.00	206218.00	38147.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	357092.00
0.00	0.00	295691.00	0.00	106212.00	401903.00	401903.00	674916.00
0.00	0.00	0.00	96900.00	32895.00	129795.00	129795.00	31438.00
0.00	2861069.00	0.00	0.00	0.00	0.00	2861069.00	-2860415.00
0.00	0.00	871118.00	0.00	1700802.03	2571920.03	2571920.03	1353063.47
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4884.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	265782.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	184938.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100000.00
0.00	12881.25	0.00	0.00	53957.00	53957.00	66838.25	2174431.85
0.00	0.00	0.00	0.00	15789.00	15789.00	15789.00	2026003.70
0.00	110700.00	182000.00	0.00	79000.00	261000.00	371700.00	222951.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	475753.00
0.00	0.00	0.00	0.00	327241.50	327241.50	327241.50	0.00
0.00	0.00	0.00	0.00	588.00	588.00	588.00	4964479.00
0.00	0.00	122415.00	43170.00	8985.00	174570.00	174570.00	24840.00
0.00	0.00	275085.00	167165.94	2000.00	444250.94	444250.94	49552.06

5264	FLUORESCENCE OPTICAL BIOPSY	109100.00	0.00	0.00	109100.00	0.00	
5265	DEVELOPING PHYSICIAN EDUCATION	71858.00	0.00	0.00	71858.00	61142.50	
5267	EVALUATION STUDY OF THE ASHA	192834.00	0.00	0.00	192834.00	0.00	
5271	DEVELOPMENT OF A COMPUTER BASED LANGUAGE -	71325.00	0.00	0.00	71325.00	0.00	
5272	PORTABLE OPTICAL BRAIN-COMP	-70914.00	0.00	0.00	-70914.00	0.00	
5273	INTERNATIONAL STROKE	214200.00	0.00	0.00	214200.00	0.00	
5274	IMPROVING THE CONTROL OF HYPERTENSION .	1632540.82	920000.00	0.00	2552540.82	0.00	
5275	ENCODING OF INTERHEMISPHERIC -	2665656.00	0.00	0.00	2665656.00	474601.00	
5276	VALIDATION OF FMRI	234240.00	100000.00	0.00	334240.00	0.00	
5277	VASCULAR CONGNITIVE IMPAIRMENT	151870.00	0.00	0.00	151870.00	0.00	
5279	FAMILY LED REHABILITATION AFTER STROKE..	292550.00	42390.00	0.00	334940.00	0.00	
5280	DEVELOPMENT OF A TECHNICAL GUIDE: INTE.. -	1488027.00	0.00	0.00	1488027.00	0.00	
5281	LDL RECEPTOR ON MACROPHAGES	0.00	948.00	0.00	948.00	0.00	
5282	INDIAN -EUROPEAN RESEARCH	3895.00	300000.00	0.00	303895.00	0.00	
5283	RESEARCH INTIATIVE ON FACTORS	0.00	2232191.00	0.00	2232191.00	0.00	
5284	INTERNATIONAL STUDY FOR COMPARATIVE	222713.00	121011.00	0.00	343724.00	0.00	
5287	STUDY OF CARBAMAZEPINE ...	307441.00	800000.00	0.00	1107441.00	0.00	
5288	BIO-REPOSITORY OF DNA -STROKE	224368.47	260000.00	0.00	484368.47	0.00	
5289	MITOCHONDRIAL METABOLISM...	544795.00	700000.00	0.00	1244795.00	0.00	
5290	CLOSING THE GAP;HEALTH EQUITY	3980606.51	6030990.57	0.00	10011597.08	0.00	
5291	OXIDATIVE STEM MEDIATED STEM..	413667.00	277142.00	0.00	690809.00	0.00	
5292	A RESTING STATE FMRI & TASK ..	193385.00	626000.00	0.00	819385.00	0.00	
5293	DECIPHERING LRRK2 GENE	105771.00	0.00	0.00	105771.00	0.00	
5294	MTP/EC SERVICES OF WOMEN	264272.00	0.00	0.00	264272.00	0.00	

0.00	0.00	0.00	109017.72	0.00	109017.72	109017.72	82.28
0.00	61142.50	0.00	0.00	10098.00	10098.00	71240.50	617.50
0.00	0.00	0.00	0.00	2145.00	2145.00	2145.00	190689.00
0.00	0.00	11613.00	0.00	59712.00	71325.00	71325.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-70914.00
0.00	0.00	0.00	0.00	2208.00	2208.00	2208.00	211992.00
0.00	0.00	747156.00	0.00	1674400.00	2421556.00	2421556.00	130984.82
0.00	474601.00	0.00	0.00	118007.00	118007.00	592608.00	2073048.00
0.00	0.00	98588.00	159396.00	45276.00	303260.00	303260.00	30980.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	151870.00
0.00	0.00	179552.00	0.00	129528.00	309080.00	309080.00	25860.00
0.00	0.00	0.00	0.00	1488027.00	1488027.00	1488027.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	948.00
0.00	0.00	0.00	0.00	73718.00	73718.00	73718.00	230177.00
0.00	0.00		39252.00	565246.00	604498.00	604498.00	1627693.00
0.00	0.00	0.00	0.00	21102.00	21102.00	21102.00	322622.00
0.00	0.00	660000.00	68636.00	139569.00	868205.00	868205.00	239236.00
0.00	0.00	216000.00	0.00	86409.00	302409.00	302409.00	181959.47
0.00	0.00	0.00	0.00	370980.17	370980.17	370980.17	873814.83
0.00	0.00	1411204.00	0.00	4929846.00	6341050.00	6341050.00	3670547.08
0.00	0.00	94600.00	427266.32	9000.00	530866.32	530866.32	159942.68
0.00	0.00	559925.00	72060.00	13420.00	645405.00	645405.00	173980.00
0.00	0.00	57600.00	8816.50	32278.00	98694.50	98694.50	7076.50
0.00	0.00	32580.00	0.00	4639.00	37219.00	37219.00	227053.00

5296	ELECTROENCEPHALO GRAPHYWORKSHOP	25230.00	0.00	0.00	25230.00	0.00	
5297	THE HUMAN BRAIN MAPPING PROJ..	403545.00	600000.00	0.00	1003545.00	0.00	
5298	MOLECULAR MECHANISMS	222635.00	1035172.00	0.00	1257807.00	0.00	
5299	BIOMEDIAL SIGNAL ANALYSER	173800.00	0.00	0.00	173800.00	0.00	
5300	ANALYSING FUNCTIONAL NETWORKS	209791.00	600000.00	0.00	809791.00	0.00	
5301	IN VITRO BETA AMYLOID UPTAKE	475472.00	1903800.00	0.00	2379272.00	0.00	
5302	/DISABILITY STUDIES IN EPILEPSY	173127.00	372900.00	0.00	546027.00	12300.00	
5303	MITOCHONDRIAL REMODELING	151679.00	593483.00	0.00	745162.00	0.00	
5305	A FAMILY BASED RANDOMIZED	185876.00	393446.00	0.00	579322.00	0.00	
5306	3 DAYS TRAINING	29350.00	23692.00	0.00	53042.00	0.00	
5307	A RESTING FMRI	823392.00	0.00	0.00	823392.00	87960.00	
5308	EPILEPSY CARE THROUGH SCHOOLS	1176246.00	1236000.00	0.00	2412246.00	42941.71	
5309	STRENGTHENING ECO-SYSTEM	354241.00	0.00	0.00	354241.00	0.00	
5310	KERALA DIABETES PREVENTION	3955869.00	5218980.00	0.00	9174849.00	0.00	
5312	EVALUATING BARRIERS AND BARR	143349.00	79067.00	0.00	222416.00	0.00	
5313	EQUIPMENT FOR HEART FAILURE	19999521.00	11700000.00	689456.00	32388977.00	22292432.90	
5414	NON COMMUNICABLE DISEASES	49556060.00	0.00	0.00	49556060.00	3786529.25	
5315	PROSPECTIV SINGLE ARM MUL	0.00	135000.00	0.00	135000.00	0.00	
5316	HEAD POSITION IN STROKE TRIA;	0.00	95000.00	0.00	95000.00	0.00	
5317	MERES1 TRIAL A PROSPECTIVE	0.00	56745.00	0.00	56745.00	0.00	
5318	APOLIPOPROTEIN B AND A1	0.00	709645.00	0.00	709645.00	0.00	
5319	ENCORE	0.00	50420.00	0.00	50420.00	0.00	
5320	EFFECT OF YOGA ON MOTOR CORTEX PLAST	0.00	1145000.00	0.00	1145000.00	97666.97	
5321	EFFECT OF YOGA ON NEUROPSYCHOLOGICAL F	0.00	1293200.00	0.00	1293200.00	30300.00	
5322	PREPRONTAL CORTEX	0.00	945806.00	0.00	945806.00	0.00	
5323	CHITRA DHWANI	0.00	35500.00	0.00	35500.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	25230.00
0.00	0.00	510003.00	104420.00	202959.00	817382.00	817382.00	186163.00
0.00	0.00	96000.00	553901.80	56623.00	706524.80	706524.80	551282.20
0.00	0.00	0.00	0.00	173800.00	173800.00	173800.00	0.00
0.00	0.00	220993.00	35860.00	112389.00	369242.00	369242.00	440549.00
0.00	0.00	332931.00	474954.31	106990.00	914875.31	914875.31	1464396.69
0.00	12300.00	132000.00	0.00	49599.00	181599.00	193899.00	352128.00
0.00	0.00	172479.00	58435.00	34210.00	265124.00	265124.00	480038.00
0.00	0.00	511632.00	0.00	19800.00	531432.00	531432.00	47890.00
0.00	0.00	0.00	0.00	4654.00	4654.00	4654.00	48388.00
0.00	87960.00	0.00	0.00	0.00	0.00	87960.00	735432.00
0.00	42941.71	1188216.00	0.00	289039.00	1477255.00	1520196.71	892049.29
0.00	0.00	123334.00	0.00	230907.00	354241.00	354241.00	0.00
0.00	0.00	1195541.00	0.00	4608666.75	5804207.75	5804207.75	3370641.25
0.00	0.00	187800.00	0.00	9200.00	197000.00	197000.00	25416.00
0.00	22292432.90	0.00	0.00	0.00	0.00	22292432.90	10096544.10
0.00	3786529.25	11159843.00	0.00	16398460.70	27558303.70	31344832.95	18211227.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	135000.00
0.00	0.00	80000.00	0.00	10870.00	90870.00	90870.00	4130.00
0.00	0.00	0.00	0.00	25650.00	25650.00	25650.00	31095.00
0.00	0.00	0.00	0.00	11182.00	11182.00	11182.00	698463.00
0.00	0.00	0.00	0.00	323.00	323.00	323.00	50097.00
0.00	97666.97	319354.00	0.00	113354.00	432708.00	530374.97	614625.03
0.00	30300.00	255400.00	0.00	112584.00	367984.00	398284.00	894916.00
0.00	0.00	285645.00	0.00	46115.00	331760.00	331760.00	614046.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	35500.00

5325	DECIPHERING THE GENERIC	0.00	1202003.00	0.00	1202003.00	0.00	
5326	NEURO DEVELOPMENTAL DISORDERS	0.00	9832320.00	15085.00	9847405.00	491523.57	
5327	MOVEMENT DISORDER	0.00	1677000.00	0.00	1677000.00	0.00	
5328	TO PROVIDE 4GE GIRAFFE WARMER	0.00	3347000.00	0.00	3347000.00	3347000.00	
5329	E-DELIVERY FOR HEALTH CARE	0.00	45000000.00	0.00	45000000.00	0.00	
5330	COAGULATION PROFILE	0.00	50000.00	0.00	50000.00	0.00	
5331	MONTREL CONGNITIVE MOCA-M	0.00	381100.00	0.00	381100.00	0.00	
6050	SALARY PROJECT - Hospital	0.00	0.00	2000.00	2000.00	0.00	
6054	PROJ/DR RADHAKRISHNAN NEUROLOGY	-0.46	0.00	0.46	0.00	0.00	
6055	MOVEMENT DISORDER SURGERY	0.00	0.00	0.00	0.00	0.00	
6058	ATHIYANOOR SCT ACTION/ DR.K.R.T	21006.00	0.00	0.00	21006.00	0.00	
6065	COMPREHENSIVE CENTRE FOR SLEEP DIS ORD.	15532.00	0.00	204511.00	220043.00	0.00	
6072	COMPREHENSIVE STROKE CARE	0.00	0.00	4646077.00	4646077.00	0.00	
6077	Technical Advisory committee	0.00	0.00	172800.00	172800.00	0.00	
6080	COMPREHENSIVE PAIN CLINIC	374500.00	0.00	0.00	374500.00	0.00	
6081	VALIDATION OF A CLINICAL PROTO	142710.00	0.00	0.00	142710.00	0.00	
6082	NOSOCOMIAL INFECTION	70321.00	0.00	0.00	70321.00	0.00	
6084	NEURO INTERVENTION CENTRE(NIC)	0.00	0.00	2981282.00	2981282.00	0.00	
6089	THE EFFECTS OF PROPOFOL	26730.00	0.00	0.00	26730.00	0.00	
6090	STUDY ON THE EFFECT OF DEXMEDE	45000.00	0.00	0.00	45000.00	0.00	
6091	PUBLIC HEALTH DOCUMENTATION -	398298.00	0.00	0.00	398298.00	0.00	
6093	EVALUATION OF VASCULAR GRAFT	85960.00	0.00	0.00	85960.00	0.00	
6095	COMPREHENSIVE HEART FAILURE CLINC	207627.00	0.00	860105.00	1067732.00	0.00	
6096	MOLECULAR BIOLOGY OF PEDIATRIC	50000.00	0.00	0.00	50000.00	0.00	
6097	DEVELOPMENT OF E LOG BOOK	46421.00	0.00	0.00	46421.00	0.00	

0.00	0.00	0.00	0.00	1105.00	1105.00	1105.00	1200898.00
0.00	491523.57	39295.00	0.00	901306.00	940601.00	1432124.57	8415280.43
0.00	0.00	26250.00	0.00	0.00	26250.00	26250.00	1650750.00
0.00	3347000.00	0.00	0.00	0.00	0.00	3347000.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45000000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	50000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	381100.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	21006.00
0.00	0.00	220043.00	0.00	0.00	220043.00	220043.00	0.00
0.00	0.00	3448415.00	0.00	1197662.00	4646077.00	4646077.00	0.00
0.00	0.00	172800.00	0.00	0.00	172800.00	172800.00	0.00
0.00	0.00	29250.00	0.00	0.00	29250.00	29250.00	345250.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	142710.00
0.00	0.00	0.00	70151.40	0.00	70151.40	70151.40	169.60
0.00	0.00	2251740.00	0.00	729542.00	2981282.00	2981282.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26730.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45000.00
0.00	0.00	161870.00	0.00	6606.00	168476.00	168476.00	229822.00
0.00	0.00	0.00	72000.00	0.00	72000.00	72000.00	13960.00
0.00	0.00	1067732.00	0.00	0.00	1067732.00	1067732.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	50000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	46421.00

6098	RESEARCH ON MEDICAL TOURISM	46684.00	0.00	0.00	46684.00	0.00	
6099	CLINICO PATHOLOGICAL CORR...	130000.00	0.00	0.00	130000.00	0.00	
6101	EXECUTIVE FUNCTION IN PERSONS	39930.00	0.00	0.00	39930.00	0.00	
6102	SELECTIVE SUB-TEMPORAL SELE	112390.00	0.00	0.00	112390.00	0.00	
6103	DEVELOPMENT OF A FLEXIBLE ARM	25000.00	0.00	0.00	25000.00	0.00	
6104	Health Technology Assessment	750000.00	0.00	0.00	750000.00	0.00	
7101	ADVANCE TO P I	-1975.00	0.00	5401147.00	5399172.00	0.00	
	TOTAL (A)	135812633.16	109930417.57	27184136.08	272927186.81	33795048.15	
	OTHER PROJECTS				0.00		
1014	NEW PENSION SCHEME	11962510.05		96051846.00	108014356.05		
1301	EMPLOYEES PENSION FUND	111397440.65		297489219.00	408886659.65		
1075	PATIENT WELFARE FUND	6335587.35		1626786.22	7962373.57		
					0.00		
1078	DR. RICHARD A CASH & DR K MOHANDAS AWARD	198146.00		79494.00	277640.00		
1080	STAFF BENEVOLENT FUND	4450248.25		3080483.00	7530731.25		
1081	CONTINUUM - SPECIAL CME PUBLICATION FUND - Hospital	51707.00			51707.00		
1096	PEDIATRIC WELFARE FUND	0.00	50000.00		50000.00		
	TOTAL (B)	134395639.30	50000.00	398327828.22	532773467.52	0.00	
5000	PROJECT EXPENSE	502882.00	0.00	20707487.20	21210369.20	0.00	
5057	DYNAMIC ORTHOPAEDIC PVT LTD, HYDROXY	6787.55	0.00	0.00	6787.55	0.00	
5089	DETEC & TREAT OF CANCER BY LASER	3959.00	0.00	0.00	3959.00	0.00	
7000	MISCELLENEOUS PROJECT	30944.09	0.00	0.00	30944.09	0.00	
7001	PRO;SAHAJANAND VASCU;DR.AURTHUR	84759.75	0.00	0.00	84759.75	0.00	
7002	Dr.TOMS LABORATORY, Dr. K.KRISHNAN	13876.00	0.00	0.00	13876.00	0.00	
7003	PROJ:D.S.T. DR.P.V. MOHANAN	2537.40	0.00	0.00	2537.40	0.00	
7004	PROJ:ATMRF:DR LISSY KRISHNAN	551.25	0.00	0.00	551.25	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	46684.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	130000.00
0.00	0.00	0.00	0.00	39930.00	39930.00	39930.00	0.00
0.00	0.00	51975.00	0.00	525.00	52500.00	52500.00	59890.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25000.00
0.00	0.00	238968.00	0.00	6610.00	245578.00	245578.00	504422.00
0.00	0.00	0.00	0.00	5401043.00	5401043.00	5401043.00	-1871.00
0.00	33795048.15	31537657.00	2731282.94	50245651.99	84514591.93	118309640.08	154617546.73
	0.00			102359867.00	102359867.00	102359867.00	5654489.05
	0.00			231163306.00	231163306.00	231163306.00	177723353.65
	0.00			195622.32	195622.32	195622.32	7766751.25
	0.00						
	0.00			40252.00	40252.00	40252.00	237388.00
	0.00			3087380.00	3087380.00	3087380.00	4443351.25
	0.00				0.00	0.00	51707.00
	0.00				0.00	0.00	50000.00
0.00	0.00	0.00	0.00	336846427.32	336846427.32	336846427.32	195927040.20
0.00	0.00	0.00	0.00	18430515.43	18430515.43	18430515.43	2779853.77
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6787.55
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3959.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	30944.09
0.00	0.00	0.00	5610.00	0.00	5610.00	5610.00	79149.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13876.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2537.40
0.00	0.00	0.00	0.00	0.00	0.00	0.00	551.25

7005	PROJECT:DYNAMIC ORTHOPAEDICS	13656.00	0.00	0.00	13656.00	0.00	
7006	PROJ: D.S.T. D.S.NAGESH	181074.00	0.00	0.00	181074.00	0.00	
7008	NMITLI, PROJECT C.S.I.R	0.90	0.00	0.00	0.90	0.00	
7009	CHITOSAN BASED WOUND DRESSING	4761.75	0.00	0.00	4761.75	0.00	
7011	DST-FAB: CLINICALLY/ SIG:SHAPE OF HEVA	213826.00	0.00	0.00	213826.00	0.00	
7014	AUROLAB,ARAVIND EYE HOSPITAL	13674.00	0.00	0.00	13674.00	0.00	
7015	TTK.HEALTHCARE. DEVELOPMENT OF VALV	39424.00	0.00	0.00	39424.00	0.00	
7016	INDO-GERMAN COMMITTEE MEETING-DST	5407.00	0.00	0.00	5407.00	0.00	
7017	HINDUSTAN LATEX. EVALU:BLOOD BAG	569004.50	0.00	0.00	569004.50	0.00	
7018	ALL INDIA COUNCIL FOR TECHNI:EDU:SH	339919.00	0.00	0.00	339919.00	0.00	
7019	DST.NIRANJAN	69847.00	0.00	0.00	69847.00	0.00	
7020	IFCPAR-DR.JAYAKRISHNAN	188.00	0.00	0.00	188.00	0.00	
7022	DST-LBFDPSBC-DR.SHARMA	79385.00	0.00	0.00	79385.00	0.00	
7023	DEV: HYDRO-CEPHALUS-HINDUSTAN LATEX	45510.00	0.00	0.00	45510.00	0.00	
7026	DEV.HEART VALVE-DST. MURALEE	2522.00	0.00	0.00	2522.00	0.00	
7027	STED-DR T V KUMARY-INVITRO	5089.00	0.00	0.00	5089.00	0.00	
7029	DONERG/LIFE SCIENCE BOARD	6876.00	0.00	0.00	6876.00	0.00	
7031	DBT/DR P V MOHAN/DEV INVITROPYRO	79064.00	0.00	0.00	79064.00	0.00	
7032	DST. DR. ANNINE/BONE REGENERATION	29166.00	0.00	0.00	29166.00	0.00	
7033	BIOFUNCTIONAL EVALUATION DR. UMASANKER	72581.00	0.00	0.00	72581.00	0.00	
7034	DST. DR. NIRMALA RACHEL	14664.00	0.00	0.00	14664.00	0.00	
7035	DST-H.K.VARMA	95433.00	0.00	0.00	95433.00	0.00	
7037	INVIVO EVALUATION/ STED/ DR. LISSY	6205.00	0.00	0.00	6205.00	0.00	
7039	JNC/ASR/DR. MOHANAN/ STUDY OF ACCUTE…..	44684.00	0.00	0.00	44684.00	0.00	
7040	BIOMED/ C.V. MURALEEDHARAN	44000.00	0.00	0.00	44000.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	13656.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	181074.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4761.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213826.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13674.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39424.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5407.00
0.00	0.00	0.00	222690.32	0.00	222690.32	222690.32	346314.18
0.00	0.00	0.00	0.00	0.00	0.00	0.00	339919.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	69847.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	188.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79385.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45510.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2522.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5089.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6876.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79064.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	29166.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	72581.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	14664.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	95433.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6205.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	44684.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	44000.00

7041	CSIR-GRANT-ASHA S MATHEW,PHD STUDENT	55973.00	0.00	0.00	55973.00	0.00	
7042	CSIR-GRANT-BERNADETTE K. MADATHIL,PHD	25870.00	0.00	0.00	25870.00	0.00	
7043	CSIR-GRANT-SAILAJA.G.S.SRF	9067.00	0.00	0.00	9067.00	0.00	
7044	LISI NO TRIAL TRIAL MERIND	21672.65	0.00	0.00	21672.65	0.00	
7045	NIRMALA RACHEL, CSIR	14063.00	0.00	0.00	14063.00	0.00	
7047	U.G.C. GRANT- RESEARCH FELLOW	300935.00	0.00	0.00	300935.00	0.00	
7048	CSIR GRANT- JOSENA JOSEPH	47473.00	0.00	0.00	47473.00	0.00	
7049	CSIR GRANT - MARY VARGHESE	35837.00	0.00	0.00	35837.00	0.00	
7050	INTEREST-PROJECT ACCOUNT	1894584.00	16411732.00	0.00	18306316.00	0.00	
7051	CSIR GRANT - MANITHA B NAIR	12062.00	0.00	0.00	12062.00	0.00	
7052	DBT/DR.PRABHA/DEV. OF TEMP - RES - CO-OPLY	-229010.25	0.00	339057.00	110046.75	0.00	
7053	DR.SREENIVASAN/DEVEL.OF TEMP.RES.CO-OPLY	22619.00	0.00	0.00	22619.00	0.00	
7054	DST-DR.ANOOP-DIFF:EXPR:RAT BRAIN.....	44434.00	0.00	0.00	44434.00	0.00	
7055	CSIR-NMITLI SCHEME-C.V.MURALEEDHARAN	756552.00	0.00	0.00	756552.00	0.00	
7056	D.S.T.ROYJOSEPH, BONE GRAFT SUB:SPINAL	110047.00	0.00	0.00	110047.00	0.00	
7057	DST - PROJECT. DR.JAYABALAN	14471.00	0.00	0.00	14471.00	0.00	
7059	DBT-DR. PRABHA D NAIR, ISLET IMMUN.....	67574.00	0.00	0.00	67574.00	0.00	
7060	ICMR PROJECT/ SUDHAKAR MUTHALEE	124392.00	0.00	0.00	124392.00	0.00	
7062	DR. LIZY-SAHAJA:EVA "STENT"INVITRO.....	102361.00	0.00	0.00	102361.00	0.00	
7065	DR.T.V.KUMARI, DBT. BIOGENE	38659.00	0.00	0.00	38659.00	0.00	
7067	DBT. DR.JAYABALAN, DEV:&STUDIES.....	-27459.00	0.00	27459.00	0.00	0.00	
7069	VSSC - PROJECT. D.S. NAGESH	153475.00	0.00	0.00	153475.00	0.00	
7070	CHO PROJECT - 5146 JAYASREE	-872.00	0.00	0.00	-872.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	55973.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25870.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	9067.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	21672.65
0.00	0.00	0.00	0.00	0.00	0.00	0.00	14063.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	300935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	47473.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	35837.00
0.00	0.00	0.00	0.00	18306316.00	18306316.00	18306316.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12062.00
0.00	0.00	0.00	0.00	110047.00	110047.00	110047.00	-0.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22619.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	44434.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	756552.00
0.00	0.00	0.00	0.00	110047.00	110047.00	110047.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	14471.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	67574.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	124392.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	102361.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	38659.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	153475.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-872.00

7071	STEC-PROJECT: DR.MAYA NANDKUMAR	375.00	0.00	0.00	375.00	0.00	
7072	SAHAJANAND MED.TECH. C.V.MURALIDHARAN	76292.00	0.00	0.00	76292.00	0.00	
7073	STUDY PROJECT:DR.P.V.MOHANAN	-95386.00	0.00	0.00	-95386.00	0.00	
7074	STUDY PROJECT: CLRI-DR.MOHAN	289303.00	0.00	0.00	289303.00	0.00	
7075	STUDY PROJECT - BIOSYNC SCI	11935.00	0.00	0.00	11935.00	0.00	
7076	ARROW INTERNATIONAL : DR.UMASHANKAR	399773.00	0.00	0.00	399773.00	0.00	
7080	DBT-DR.MAYA- TISSUE ENGINEERING HYBRID	10518.00	0.00	0.00	10518.00	0.00	
7081	USV LTD. MUMBAI - DR.MOHAN	88349.00	0.00	0.00	88349.00	0.00	
7082	INDO-US JOINT PROJECT	878.00	0.00	0.00	878.00	0.00	
7083	ARROW HAEMO DIALYSIS	30882.00	0.00	0.00	30882.00	0.00	
7085	DR.R.V.THAMPAN - CSIR	26381.00	0.00	0.00	26381.00	0.00	
7086	HORMONE RELEASING INTRA DEVICES	-86027.00	0.00	0.00	-86027.00	0.00	
7087	CSIR - KALADHAR - BST	39103.00	0.00	0.00	39103.00	0.00	
7092	PROJ/7092/SEA FOOD	1993.00	0.00	0.00	1993.00	0.00	
7093	PROJ/7093/CSIR GRANT-LPA	50562.00	0.00	0.00	50562.00	0.00	
7095	PROJ/7095/CSIR GRANT-VIOLA.B.MORRIS	22072.00	0.00	0.00	22072.00	0.00	
7097	PROJ/7097/ACCELERATED AGEING	2119004.00	0.00	8335.00	2127339.00	422664.00	
7099	PROJ/7099/BCL	7011.00	0.00	0.00	7011.00	0.00	
7100	PROJ/7100/ITR PROGRAMME	4079.00	0.00	0.00	4079.00	0.00	
7101	PROJ/7101/CSIR/SONIA.T.A	2650.00	0.00	0.00	2650.00	0.00	
7103	PROJ/7103/CSIR/VIDYARAJ	5682.00	0.00	0.00	5682.00	0.00	
7105	PROJ/7105/CSIR/ARJUN NAMBOODIRI	26821.00	0.00	0.00	26821.00	0.00	
7107	PROJ/7107/CSIR/NEENA & 2 FELLOWS	34082.00	0.00	0.00	34082.00	0.00	
7108	PROJ/7108/CSIR/ FRANCIS.B.FERNANDEZ	2154.00	0.00	0.00	2154.00	0.00	
7110	PROJ/7110/CSIR/DEEPA.R	10919.00	0.00	0.00	10919.00	0.00	
7111	PROJ/7111/CSIR/SHEEJA LIZA EASO	6353.00	0.00	0.00	6353.00	0.00	
7113	PROJ/7113/KSCSTE/ RATHIKALA	-86.00	0.00	0.00	-86.00	0.00	
7200	JOINT PROGRAME/M.TECH	558991.00	0.00	0.00	558991.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	375.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	76292.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-95386.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	289303.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	11935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	399773.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10518.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	88349.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	878.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	30882.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26381.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-86027.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39103.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1993.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	50562.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22072.00
0.00	422664.00	0.00	939462.61	40274.00	979736.61	1402400.61	724938.39
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7011.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4079.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2650.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5682.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26821.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	34082.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2154.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10919.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6353.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-86.00
0.00	0.00	0.00	0.00	28045.00	28045.00	28045.00	530946.00

7210	PROJ/7210/CSIR/SOMA DEY	1641.00	0.00	0.00	1641.00	0.00	
7220	COST OF ANIMAL FEED	3157587.00	0.00	307480.00	3465067.00	0.00	
7230	PROJ/7230/CSIR/MANJU.S	12421.00	0.00	0.00	12421.00	0.00	
7250	PROJ/7250/CSIR/ KIRAN.S.NAIR	15281.00	0.00	0.00	15281.00	0.00	
7260	PROJ/7260/ST0X083Y09/ DR.P.V.MOHANAN	149985.00	0.00	0.00	149985.00	0.00	
7290	PROJ/7290/CSIR/RAKHI.A	24034.00	0.00	0.00	24034.00	0.00	
7300	PROJ/7300/CSIR/ARIYA SARASWATHY	-7.00	0.00	0.00	-7.00	0.00	
7320	90 DAY SUB-CHRONIC TOXICITY -DR.P.V.MOHA	166674.00	0.00	0.00	166674.00	0.00	
7330	Y.M.THASNEEM - UGC GRANT	7195.00	0.00	0.00	7195.00	0.00	
7350	UGC GRANT - LAXMI.R.NAIR - BMT Project	44023.00	0.00	0.00	44023.00	0.00	
7360	MAMMALIAN BONE CHROMOSOME- DR.P.V.MOHANA	266292.00	0.00	0.00	266292.00	0.00	
7370	VALIDATION OF ETO STERILSATION SYSTEM-	285413.00	0.00	13050.00	298463.00	0.00	
7375	ICMR PROJECT- Ms. Renu Ramesh	16333.00	352667.00	0.00	369000.00	0.00	
7385	CSIR GRANT - CAROLINE DIANA SHERLY	83150.00	423200.00	0.00	506350.00	0.00	
7390	TOXICITY STUDY OF MATIRIALS Dr. P V Mohanan	210528.00	370273.00	160595.00	741396.00	0.00	
7395	RAISING ANTIBODIES IN RABBITS - DR V S HARIKRISH	67905.00	0.00	569520.00	637425.00	0.00	
7400	CSIR GRANT :SHAIJU S NAZEER	3333.00	0.00	0.00	3333.00	0.00	
7402	PROOF OF CONCEPT STUDY - DR UMA SHANKAR	100747.00	0.00	0.00	100747.00	0.00	
7403	ICMR GRANT - PARVATHY R S	0.00	851160.00	0.00	851160.00	0.00	
7404	BIOFUNCTIONAL AND HISTILO - DR UMA SHANKAR	761369.00	0.00	0.00	761369.00	0.00	
7405	IN VITRO EVALUATION OF CELL- DR T V KUMAR	182692.00	0.00	311134.00	493826.00	0.00	
7406	CSIR GRANT - R ARATHI	6135.00	0.00	0.00	6135.00	0.00	
7407	TRSF MESENCHYMAL STEM CELL	1686.00	0.00	0.00	1686.00	0.00	
7409	SRUTHI PHD STUDENT UGC	23000.00	0.00	0.00	23000.00	0.00	
7411	DEV POLY ADHESIVE & POTT	1113110.00	0.00	6180.00	1119290.00	0.00	
7412	REMYA K CSIR FELLOW	16764.00	0.00	0.00	16764.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	1641.00
0.00	0.00	0.00	298161.34	0.00	298161.34	298161.34	3166905.66
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12421.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15281.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	149985.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	24034.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	166674.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	7195.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	44023.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	266292.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	298463.00
0.00	0.00	336000.00	0.00	0.00	336000.00	336000.00	33000.00
0.00	0.00	252000.00	204580.13	0.00	456580.13	456580.13	49769.87
0.00	0.00	0.00	59388.00	0.00	59388.00	59388.00	682008.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	637425.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3333.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100747.00
0.00	0.00	760760.00	35312.00	0.00	796072.00	796072.00	55088.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	761369.00
0.00	0.00	0.00	171252.05	0.00	171252.05	171252.05	322573.95
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6135.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1686.00
0.00	0.00	0.00	0.00		0.00	0.00	23000.00
0.00	0.00	109200.00	794893.00	9057.00	913150.00	913150.00	206140.00
0.00	0.00	0.00	13484.00	0.00	13484.00	13484.00	3280.00

7413	"PROJ/7413/ANTIMICROBIAL ACTIVITY"	175316.00	0.00	0.00	175316.00	0.00	
7414	"PROJ/7414/EFFECT OF NANOGRAPHENE MOUSE.."	10000.00	423200.00	0.00	433200.00	0.00	
7415	"PROJ/7415/AXONAL GUIDANCE"	9780.00	380000.00	0.00	389780.00	0.00	
7416	"PROJ/7416/PULMONARY FIBROSIS"	162258.00	0.00	0.00	162258.00	0.00	
7417	"PROJ/7417/INVITRO & INVIVO EVALUATION"	133000.00	0.00	30000.00	163000.00	0.00	
7418	"PROJ/7418/THE NATURE OF FOREIGN BODY ..."	284000.00	0.00	0.00	284000.00	0.00	
7419	PROJ/7419/DETERMINATION OF TOXICITY	0.00	211600.00	0.00	211600.00	0.00	
7421	PROJ/7421/FIBRIN BASED MATRIX	0.00	484355.00	0.00	484355.00	0.00	
7422	PROJ/7422/ HISTOPATHOLOGICAL EVALUATION	0.00	93600.00	0.00	93600.00	0.00	
7423	PROJ/7423/TRACKING CARDIAC STEM	0.00	485197.00	0.00	485197.00	0.00	
7424	PROJ/7424/SYNAPTIC PROTEOME	0.00	667137.00	0.00	667137.00	0.00	
7425	PROJ/7425/BIOENGINEERED SKIN AFT FOR ...	0.00	284000.00	0.00	284000.00	0.00	
8004	PROJ/8004/PROGRAM SUPPORT & TISSUE	-278345.00	0.00	0.00	-278345.00	0.00	
8005	PROJ/8005/PROGRAM SUPPORT & TISSUE	-98722.00	0.00	0.00	-98722.00	0.00	
8006	PROJ/8006/ BIOCONJUGATION NANO MAT.	139019.00	0.00	0.00	139019.00	0.00	
8008	PROJ/8008/CSIR GRANT-PADMAJA.P.NAMBI	12990.00	0.00	0.00	12990.00	0.00	
8009	PROJ/8009/DBT/ DR.T.V.ANILKUMAR/DE... TISSUE	-719792.00	0.00	0.00	-719792.00	0.00	
8010	PROJ/8010/DBT/ DR.NIRANJAN/IMPLATED.... CONTROL	0.00	0.00	0.00	0.00	0.00	
8011	PROJ/8011/NANOFRONT/ DR.NIRANJAN/INTRAMAS	139900.00	0.00	0.00	139900.00	0.00	
8012	PROJ/8012/VSSC/ DR.NIRANJAN/DESIGN STUDIES	2148623.00	0.00	0.00	2148623.00	0.00	
8014	PROJ/8014/DBT/DR.ROY JOSEPH/DEV....V.GRAFT	-17063.00	0.00	0.00	-17063.00	0.00	

0.00	0.00	43200.00	42530.25	0.00	85730.25	85730.25	89585.75
0.00	0.00	403200.00	16380.00	0.00	419580.00	419580.00	13620.00
0.00	0.00	371330.00	0.00	0.00	371330.00	371330.00	18450.00
0.00	0.00	142258.00	500.00	12602.00	155360.00	155360.00	6898.00
0.00	0.00	150000.00	0.00	0.00	150000.00	150000.00	13000.00
0.00	0.00	264000.00	0.00	10000.00	274000.00	274000.00	10000.00
0.00	0.00	201600.00	0.00	0.00	201600.00	201600.00	10000.00
0.00	0.00	417097.00	15220.00	0.00	432317.00	432317.00	52038.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	93600.00
0.00	0.00	429678.00	0.00	0.00	429678.00	429678.00	55519.00
0.00	0.00	602000.00	14677.00	0.00	616677.00	616677.00	50460.00
0.00	0.00	154000.00	0.00	0.00	154000.00	154000.00	130000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-278345.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-98722.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	139019.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12990.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-719792.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	139900.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2148623.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-17063.00

8015	PROJ/8015/ DR.ANOOPKUMAR/ PROGRAMME...	4566.00	0.00	0.00	4566.00	0.00	
8018	PROJ/8018/ICMR/ DR.P.V.MOHANAN	-55191.00	0.00	0.00	-55191.00	0.00	
8019	PROJ/8019/STEC/ DR.P.RAMESH	82284.00	0.00	0.00	82284.00	0.00	
8020	PROJ/8020/CSIR/DR.LISSY KRISHNAN	190328.00	0.00	0.00	190328.00	0.00	
8021	PROJ/8021/ANGIOGENESIS EXP/DR.UMASHANKAR	79036.00	0.00	0.00	79036.00	0.00	
8022	PROJ/8022/AIR POLLUTION/SUJESH SREEDHAR	-306.00	0.00	0.00	-306.00	0.00	
8023	PROJ/8023/KSCSTE/ DR.H.K.VARMA	76545.00	0.00	0.00	76545.00	0.00	
8024	PROJ/8024/IIT/ DR.P.R.ANILKUMAR	2935.00	0.00	0.00	2935.00	0.00	
8026	PROJ/8026/	3339.00	0.00	0.00	3339.00	0.00	
8027	PROJ/8027/ DR.P.V.MOHANAN	79732.00	0.00	0.00	79732.00	0.00	
8028	PROJ/8028/DR.DIKSHA PAINULY	22332.00	0.00	0.00	22332.00	0.00	
8031	PROJ/8031	-305162.00	0.00	0.00	-305162.00	0.00	
8032	PROJ/8032/O.S.N.NAIR	128471.00	0.00	0.00	128471.00	0.00	
8033	PROJ/8033/DEV. OF IRON OXIDE-DR.R.S.JAYASREE	-7146.00	0.00	0.00	-7146.00	0.00	
8034	PROJ/8034/FLURO PASSI... DR.ROY JOSEPH	990521.00	0.00	0.00	990521.00	0.00	
8035	PROJ/EVALN OF SEWING RING-DR.UMASHANKAR	22201.00	0.00	0.00	22201.00	0.00	
8038	PROJ/DEV OF MISSION PROGRAM - DR.GSB	1182223.00	0.00	0.00	1182223.00	0.00	
8039	PROJ/DISPENSABLE & BIODEGR- DR.JAYABALAN	-431102.00	0.00	431102.00	0.00	0.00	
8040	PROJ/SYNTHESIS OF OXIDE-DR.H.K.VARMA	-30337.00	145869.00	0.00	115532.00	0.00	
8041	PROJ/DEV OF NANO DEVICES DNA-DR.C.P.SHARMA	-6255.00	0.00	0.00	-6255.00	0.00	
8046	PROJ/DIFF. OF ADULT PRO - DR.ASHA.S.MATHEW	739755.00	0.00	0.00	739755.00	0.00	
8047	PROJ/INVIVO GENOTOXICITY-DR.P.V.MOHANAN	467651.00	0.00	0.00	467651.00	0.00	
8049	PROJ/NEW VISION BIOMAT-DR.C.P.SHARMA	-44861.00	0.00	0.00	-44861.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	4566.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-55191.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	82284.00
0.00	0.00	0.00	170353.64	0.00	170353.64	170353.64	19974.36
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79036.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-306.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	76545.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3339.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79732.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22332.00
0.00	0.00	0.00	3891.00	0.00	3891.00	3891.00	-309053.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	128471.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-7146.00
0.00	0.00	0.00	182634.63	0.00	182634.63	182634.63	807886.37
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22201.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1182223.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	115532.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-6255.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	739755.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	467651.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-44861.00

8050	PROJ/GENOTOXICITY STUDY-DR.P.V.MOHANAN	130338.00	0.00	0.00	130338.00	0.00	
8051	PROJ/INVITRO ALTE.TEST-DR.P.V.MOHANAN	20144.00	0.00	0.00	20144.00	0.00	
8052	PROJ/ROLL OF TRANFORMN GROWTH-DR.ANOOP	137810.00	0.00	0.00	137810.00	0.00	
8054	PROJ/MUSCULOSKELETAL STEM CELL/DR.PDNAIR	4346643.00	0.00	251300.00	4597943.00	0.00	
8055	PROJ/MUSCULASKELETAL STEM /DR.H.K.VARMA	54577.00	0.00	0.00	54577.00	0.00	
8058	PROJ/AORC FELLOWSHIP/ MAYURI.P.V.	182.00	423018.00	0.00	423200.00	0.00	
8059	PROJ/CELL SHEET ENGG-DR.P.R.ANILKUMAR	108000.00	0.00	0.00	108000.00	0.00	
8060	PROJ/DEVELOPMENT OF SKIN GRAFT	0.00	0.00	7519.00	7519.00	0.00	
8061	PROJ/VISIBLE LIGHT INDUCED../ DR.RADHAKUMARI	131583.00	0.00	0.00	131583.00	0.00	
8062	PROJ/ACCELERATED AREING../MR.C.V.MURALI	213728.00	0.00	0.00	213728.00	0.00	
8063	PROJ/EFFECTS OF MATERIAL SLEEP/DR.K.GULIA	209861.00	0.00	0.00	209861.00	0.00	
8064	NONVIRAL GENE DELIVERY VECTORS- DR.REKHA	35373.00	0.00	0.00	35373.00	0.00	
8065	PROJ/8065/RATE EARTH BASED MATERIALS	30555.00	0.00	58652.00	89207.00	0.00	
8066	TO INVESTIGATE THE EFFECTS OF/ DR.GULIA	257441.00	0.00	7664.00	265105.00	0.00	
8067	QUANTUM DOT CONJUGATED -DR.R.S.JAYASREE	-5090.00	0.00	0.00	-5090.00	0.00	
8068	INSPIRE RESEARCH PROJECT -DR.BINDU.P.NAI R	1263976.00	0.00	0.00	1263976.00	0.00	
8069	PROJ/8069/STUDIES BIODEGRADABLE	1425.00	0.00	0.00	1425.00	0.00	
8070	PROJ/8070/PINSPIRE FACULTY AWARD-DR.SHIV	365852.00	1345839.00	0.00	1711691.00	3904.00	
8071	PROJ/8071/REGEN .OF INTERVERTEBRAL DISC	88489.00	0.00	11733.00	100222.00	0.00	
8072	PROJ/8072/NANO CALCIUM PHOSPHATE	249948.00	0.00	4753.49	254701.49	0.00	
8073	PROJ/8073/DEVELOP.OF CARDIOPULMONARY	344860.00	0.00	90000.00	434860.00	0.00	
8074	PRODUCTION OF NOVEL NANO INDO-UK DR.CP.S	303180.00	0.00	0.00	303180.00	0.00	

0.00	0.00	0.00	0.00	0.00	0.00	0.00	130338.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	20144.00
0.00	0.00	0.00	25422.53	0.00	25422.53	25422.53	112387.47
0.00	0.00	317032.00	3662103.22	11819.00	3990954.22	3990954.22	606988.78
0.00	0.00	0.00	54574.00	0.00	54574.00	54574.00	3.00
0.00	0.00	302400.00	19991.00	0.00	322391.00	322391.00	100809.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	108000.00
0.00	0.00	0.00	0.00	7519.00	7519.00	7519.00	0.00
0.00	0.00	0.00	131583.00	0.00	131583.00	131583.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213728.00
0.00	0.00	0.00	209861.00	0.00	209861.00	209861.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	35373.00
0.00	0.00	0.00	89207.00	0.00	89207.00	89207.00	0.00
0.00	0.00	0.00	265104.45	0.00	265104.45	265104.45	0.55
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-5090.00
0.00	0.00	9039.00	189380.00	1061600.00	1260019.00	1260019.00	3957.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1425.00
0.00	3904.00	288279.00	197196.00	23407.00	508882.00	512786.00	1198905.00
0.00	0.00	94382.00	0.00	0.00	94382.00	94382.00	5840.00
0.00	0.00	0.00	239289.39	0.00	239289.39	239289.39	15412.10
0.00	0.00	175375.00	226518.00	0.00	401893.00	401893.00	32967.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	303180.00

8075	DST INSPIRE FELLOWSHIP - ASWATHY B S	20000.00	380000.00	0.00	400000.00	0.00	
8076	ICMR - DR K SREENIVASAN	966897.00	0.00	0.00	966897.00	0.00	
8077	HOME BASED VITAL SIGNS - DR.NIRANJAN.D.	579135.00	0.00	0.00	579135.00	0.00	
8078	PROJ/8078/AN INVITROSKIN TISSUE ENG	229434.00	0.00	14222.00	243656.00	0.00	
8079	DOSE RANGING STUDY FOR DES / DR.SABAREES	731710.00	0.00	0.00	731710.00	0.00	
8080	PROJ/8080/DETECTION OF ZINC IN EPILEPTIC	445111.00	1237000.00	30150.00	1712261.00	638541.00	
8081	EXPLORING THE POTENTIALOF ISLET-DR. PRABH	83410.00	0.00	230400.00	313810.00	0.00	
8082	ASSESSMENT OF CERAMICCONSTRUCTS - FRANC	37118.00	0.00	0.00	37118.00	0.00	
8083	IN VITRO OSTEOARTHRICITIC-DR. NEETHUMOHAN	722438.00	300000.00	122996.00	1145434.00	0.00	
8084	ROLE OF NMDA-DR.PRADEEP PUNNAKKAL-RAM	1485955.00	1610000.00	30982.00	3126937.00	438326.00	
8085	PROJ/8085/ ELECTROCHEMICALLY ASSISTED	28622.00	0.00	0.00	28622.00	0.00	
8086	PROJ/8086/GOLD NANORODS FOR THERAPY	2339060.00	581366.00	2000.00	2922426.00	2135434.00	
8087	PROJ/8087/CONTROLLED DELIVERY	1593845.00	1181946.00	396000.00	3171791.00	0.00	
8088	CANCER TISSUE ENGINEERING A 3D - ARAVIN	68169.00	0.00	0.00	68169.00	0.00	
8089	DO PLATELETS IN PATIENTS -DR.ANUGYABHATT	682731.00	735807.00	0.00	1418538.00	0.00	
8090	INSPIRE FELLOW PHD KEERTHI S JRF	20620.00	0.00	0.00	20620.00	0.00	
8091	BIORESORBABALE NANO- DR H K VARMA	1472448.00	550000.00	77651.00	2100099.00	1358346.00	
8092	BIOLOGICALSTRUCTURES	450147.00	715950.00	106500.00	1272597.00	0.00	
8093	A NEW DRUG-CERAMIC MOD SUPER-DR. H K VARMA	2861.00	0.00	21817.00	24678.00	0.00	
8094	ALTERNATE	445100.00	1500000.00	14400.00	1959500.00	0.00	
8095	DEV RAPID UTI DR. MAYA-DST	2069574.00	0.00	1593.00	2071167.00	0.00	
8096	PREP OF HYDROGEL -DR AKHILA RAJAN	597084.00	800000.00	0.00	1397084.00	0.00	

0.00	0.00	360000.00	39870.00	0.00	399870.00	399870.00	130.00
0.00	0.00	0.00	86692.00	880205.00	966897.00	966897.00	0.00
0.00	0.00	0.00	374625.25	0.00	374625.25	374625.25	204509.75
0.00	0.00	110000.00	133219.00	437.00	243656.00	243656.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	731710.00
0.00	638541.00	465806.00	224058.67	35228.00	725092.67	1363633.67	348627.33
0.00	0.00	0.00	53187.00	9404.00	62591.00	62591.00	251219.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	37118.00
0.00	0.00	497351.00	526453.18	113335.00	1137139.18	1137139.18	8294.82
0.00	438326.00	918477.00	482390.49	7836.00	1408703.49	1847029.49	1279907.51
0.00	0.00	0.00	0.00	28582.00	28582.00	28582.00	40.00
0.00	2135434.00	364215.00	69579.44	18962.00	452756.44	2588190.44	334235.56
0.00	0.00	700000.00	1539838.86	0.00	2239838.86	2239838.86	931952.14
0.00	0.00	58526.00	9545.00	0.00	68071.00	68071.00	98.00
0.00	0.00	146389.00	608744.75	0.00	755133.75	755133.75	663404.25
0.00	0.00	19536.00	0.00	0.00	19536.00	19536.00	1084.00
0.00	1358346.00	86400.00	668088.84	0.00	754488.84	2112834.84	-12735.84
0.00	0.00	373936.00	490488.24	28418.00	892842.24	892842.24	379754.76
0.00	0.00	0.00	24677.15	0.00	24677.15	24677.15	0.85
0.00	0.00	417212.00	1435171.71	0.00	1852383.71	1852383.71	107116.29
0.00	0.00	0.00	2062993.85	0.00	2062993.85	2062993.85	8173.15
0.00	0.00	660000.00	135721.23	3230.00	798951.23	798951.23	598132.77

8097	MULTIFUNCN - DBT SUNITHA PREM	587790.00	842000.00	128005.00	1557795.00	24028.00	
8098	HOW ACTIN FILAMENT STRUCTUDR RENU MOHAN	1129.00	0.00	0.00	1129.00	0.00	
8099	INSPIRE FELLOW RESHMA S	234395.00	0.00	0.00	234395.00	0.00	
8100	DETAILED ...CONDITIONS-ARUN ANIRUDHAN	162724.00	650054.00	0.00	812778.00	0.00	
8102	"ENGINEERING BIOMIMETIC.... NICHE TARA.S"	2458.00	547202.00	0.00	549660.00	0.00	
8103	"CORNEL REGENERATIVE THERAPY...Dr.ANNIE JOHN"	1332801.00	0.00	0.00	1332801.00	648581.00	
8104	"PROJ/8104/CORNEL REGENERATIVE THERAPY"	446063.00	250000.00	12384.34	708447.34	0.00	
8105	"PROJ/8105/STUDY IN MOLECULAR MECHANISM"	51855.00	377724.00	43412.00	472991.00	0.00	
8106	PROJ/8106/MECHANISM OF ANGIOGENESIS	6780.00	330731.00	0.00	337511.00	0.00	
8107	"PROJ/8107/MECHANO -BIOLOGY"	764016.00	1200000.00	0.00	1964016.00	222296.00	
8108	"PROJ/8108/DEVELOPMENT OF A DENTAL RES..."	883698.00	991760.00	115834.10	1991292.10	0.00	
8109	PROJ/8109/CHRONIC WOUND HEALING	431968.00	800000.00	0.00	1231968.00	0.00	
8110	"PROJ/8110/TO ALLEVIATE COGNITIVE DEFECTS"	2308378.00	700000.00	518492.00	3526870.00	1529809.00	
8111	"PROJ/8111/FILAMENT STRUCTURES"	1051745.00	1769000.00	188.00	2820933.00	0.00	
8112	"PROJ/8112/DEVELOPMENT THYROID COLLAR"	845445.00	969848.00	0.00	1815293.00	0.00	
8113	"PROJ/8113/TREATMENT OF BONE DEFECTS"	139800.00	0.00	0.00	139800.00	0.00	
8114	"PROJ/8114/NANO PARTICLES WITH CELLS"	8355.00	390000.00	0.00	398355.00	0.00	
8115	"PROJ/8115/TECHNOLOGY RESEARCH CENTRE"	228075516.55	189000000.00	400109161.00	817184677.55	51240454.00	
8116	"PROJ/8116/PROGRAMME SUPPORT ON TRAN..."	3367612.00	0.00	362.00	3367974.00	18192.00	
8117	"PROJ/8117/GOLD NANOROD BASED TARGETED"	1154000.00	0.00	6.00	1154006.00	0.00	
8118	PROJ/8118/THE ROLE OF NMDA	6744800.00	1160000.00	0.00	7904800.00	1100229.00	
8119	PROJ/8119/MESENCHYMAL STEM CELLS	2009000.00	930000.00	60000.00	2999000.00	0.00	

0.00	24028.00	566696.00	545171.36	0.00	1111867.36	1135895.36	421899.64
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1129.00
0.00	0.00	236882.00	0.00	0.00	236882.00	236882.00	-2487.00
0.00	0.00	312000.00	433767.90	6357.00	752124.90	752124.90	60653.10
0.00	0.00	115794.00	10063.00	0.00	125857.00	125857.00	423803.00
0.00	648581.00	225000.00	165163.98	14554.00	404717.98	1053298.98	279502.02
0.00	0.00	0.00	239516.82	191845.00	431361.82	431361.82	277085.52
0.00	0.00	367469.00	60413.92	0.00	427882.92	427882.92	45108.08
0.00	0.00	337511.00	0.00	0.00	337511.00	337511.00	0.00
0.00	222296.00	1092936.00	621997.20	0.00	1714933.20	1937229.20	26786.80
0.00	0.00	171000.00	1533369.73	14108.00	1718477.73	1718477.73	272814.37
0.00	0.00	480000.00	484702.23	115000.00	1079702.23	1079702.23	152265.77
0.00	1529809.00	259633.00	732040.00	69744.00	1061417.00	2591226.00	935644.00
0.00	0.00	1110000.00	1069846.00	0.00	2179846.00	2179846.00	641087.00
0.00	0.00	349800.00	822101.65	0.00	1171901.65	1171901.65	643391.35
0.00	0.00	0.00	0.00	0.00	0.00	0.00	139800.00
0.00	0.00	330000.00	9697.35	1175.00	340872.35	340872.35	57482.65
0.00	51240454.00	179032.00	521985340.25	0.00	522164372.25	573404826.25	243779851.30
0.00	18192.00	352800.00	497105.15	13447.00	863352.15	881544.15	2486429.85
0.00	0.00	240000.00	209532.68	15854.00	465386.68	465386.68	688619.32
0.00	1100229.00	360000.00	459720.00	0.00	819720.00	1919949.00	5984851.00
0.00	0.00	180000.00	316183.01	0.00	496183.01	496183.01	2502816.99

8122	PROJ/8122/DEV. OF CENTRIFUGAL BLOOD PUMP	0.00	5588000.00	95448.00	5683448.00	0.00	
8123	PROJ/8123/DEV.OF LEFT VENTRICULAR DEVICE	0.00	20926000.00	93946.00	21019946.00	0.00	
8124	PROJ/8124/DEV. OF AORTIC STENT GRAFT	0.00	9844000.00	59699.00	9903699.00	0.00	
8125	PROJ/8125/DEV. OF DEEP BRAIN STIMULATOR	0.00	16214000.00	120676.00	16334676.00	0.00	
8127	PROJ/8127/DEVELOPMENT OF LEUKODEPLETION	0.00	1983000.00	0.00	1983000.00	0.00	
8130	"PROJ/8130/INTER VERTEBRAL SPACER"	0.00	2983000.00	38400.00	3021400.00	0.00	
8131	PROJ/8131/BIOACTIVE MATERIAL PLATFORM	0.00	5505000.00	50940.00	5555940.00	0.00	
8132	PROJ/8132/DEV. INTRACRANIAL ELECTRODES	0.00	2537000.00	24000.00	2561000.00	0.00	
8133	PROJ/8133/OPTICAL PERIPHERAL NERVE	0.00	2854000.00	0.00	2854000.00	0.00	
8135	PROJ/8135/ STANDARDIZATION OF ALBUMIN	0.00	3514000.00	2240.00	3516240.00	0.00	
8140	PROJ/8140/REPAIR OF CARTILAGE INJURY	0.00	4351000.00	33300.00	4384300.00	0.00	
8141	PROJ/8141/3D PRINTING OF LIVER TISSUE	0.00	34059000.00	61417.04	34120417.04	208612.00	
8142	PROJ/8142/DEVELOPMENT OF ASSAY PLATFORM	0.00	2492000.00	0.00	2492000.00	0.00	
8143	PROJ/8143/POLYMERIC WOUND	0.00	1268000.00	5965.77	1273965.77	0.00	
8144	PROJ/8144/WOUND HEALING MATRIX	0.00	2820000.00	2608.82	2822608.82	0.00	
8145	PROJ/8145/LINT FREE ABSORBENT DRESSING	0.00	3301000.00	48710.00	3349710.00	0.00	
8147	PROJ/8147/POINT OF CARE DIAGNOSIS	0.00	375000.00	11104.00	386104.00	0.00	
8148	PROJ/8148/ALGINATE SCAFFOLD	0.00	4080000.00	14400.00	4094400.00	0.00	
8149	PROJ/8149/EVALUATION OF PLGC	0.00	1149000.00	17400.00	1166400.00	0.00	
8150	PROJ/8150/DEV. OF OCCLUSION DEVICE	0.00	3553000.00	42539.00	3595539.00	59296.00	
8151	PROJ/8151/DEV. EMBOLIZATION DEVICE	0.00	3435000.00	36062.00	3471062.00	0.00	
8160	PROJ/8160/TOXICOLOGICAL EVALUATION	0.00	4284000.00	18052.00	4302052.00	0.00	
8161	PROJ/8161/LARGE ANIMAL EVALUATION	0.00	3777000.00	23400.00	3800400.00	0.00	

0.00	0.00	264600.00	395673.92	0.00	660273.92	660273.92	5023174.08
0.00	0.00	585240.00	831948.74	0.00	1417188.74	1417188.74	19602757.26
0.00	0.00	386400.00	196902.50	0.00	583302.50	583302.50	9320396.50
0.00	0.00	514270.00	366825.06	0.00	881095.06	881095.06	15453580.94
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1983000.00
0.00	0.00	192000.00	395161.65	0.00	587161.65	587161.65	2434238.35
0.00	0.00	285600.00	939577.77	0.00	1225177.77	1225177.77	4330762.23
0.00	0.00	172800.00	149570.81	0.00	322370.81	322370.81	2238629.19
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2854000.00
0.00	0.00	205150.00	2240.00	0.00	207390.00	207390.00	3308850.00
0.00	0.00	190142.00	61687.27	0.00	251829.27	251829.27	4132470.73
0.00	208612.00	197078.00	3918686.87	0.00	4115764.87	4324376.87	29796040.17
0.00	0.00	0.00	45374.00	0.00	45374.00	45374.00	2446626.00
0.00	0.00	0.00	205698.54	0.00	205698.54	205698.54	1068267.23
0.00	0.00	0.00	545366.66	0.00	545366.66	545366.66	2277242.16
0.00	0.00	104400.00	217450.62	0.00	321850.62	321850.62	3027859.38
0.00	0.00	57600.00	91273.99	0.00	148873.99	148873.99	237230.01
0.00	0.00	86400.00	93881.60	0.00	180281.60	180281.60	3914118.40
0.00	0.00	87000.00	373996.73	0.00	460996.73	460996.73	705403.27
0.00	59296.00	287384.00	8994.00	0.00	296378.00	355674.00	3239865.00
0.00	0.00	252716.00	196261.43	0.00	448977.43	448977.43	3022084.57
0.00	0.00	0.00	18052.00	0.00	18052.00	18052.00	4284000.00
0.00	0.00	0.00	48873.00	0.00	48873.00	48873.00	3751527.00

8162	PROJ/8162/BLOOD COMPATIBILITY	0.00	2249000.00	14400.00	2263400.00	0.00	
8163	PROJ/8163/ CYTOCOMPATIBILITY	0.00	1335000.00	33166.00	1368166.00	0.00	
8164	PROJ/8164/ HISTOPATHOLOGICAL EVALUATION	0.00	2375000.00	14400.00	2389400.00	0.00	
8165	PROJ/8165/ MICROBIOLOGICAL EVALUATION	0.00	1480000.00	14040.00	1494040.00	0.00	
8166	PROJ/8166/ANALYTICAL CHARACTERISATION	0.00	1588000.00	0.00	1588000.00	0.00	
8167	PROJ/8167/DESIGN & PROTOTYPING	0.00	3576000.00	34200.00	3610200.00	0.00	
8170	PROJ/8170/ORTHOPAEDIC IMPLANTS	0.00	523000.00	0.00	523000.00	0.00	
8171	PROJ/8171/ENTERIC COATING	0.00	698670.00	0.00	698670.00	0.00	
8172	PROJ/8172/BIOACTIVE BONE CEMENT	0.00	614800.00	1229600.00	1844400.00	0.00	
8173	PROJ/8173/BLOOD BRAIN BARRIER	0.00	1145200.00	0.00	1145200.00	0.00	
8174	PROJ/8174/SCAFFOLDS BASED ON SELF-ASSE..	0.00	1040000.00	0.00	1040000.00	0.00	
8175	PROJ/8175/MUSTER-MUSCULOSKELETAL STEM..	0.00	7683000.00	0.00	7683000.00	0.00	
8176	PROJ/8176/MUSTER-MUSCULOSKELETAL STEM..	0.00	3406000.00	0.00	3406000.00	0.00	
	Total of external projects BMT (C1)	295842187.14	402458905.00	427519689.76	1125820781.90	60048712.00	
	INTERNAL PROJECTS						
6200	SCALE UP AND SMALL SCALE PRODUC-Dr Lissy	0.00	0.00	670126.36	670126.36	0.00	
6202	"VALIDATION OF DIAMOND-DR.MANOJ.KOMATH"	0.00	0.00	75832.00	75832.00	54141.00	
6205	BIPHASIC HYDRO OXYAPATITE	0.00	0.00	38880.00	38880.00	0.00	
6206	DEV NON INVASIVE STRESS - DR V S HARIKRISHNAN	7324.00	0.00	0.00	7324.00	0.00	
6208	IN VITRO DIFFERENTIATION	86042.00	0.00	0.00	86042.00	0.00	
6209	MENISCAL DR ANNIE	10593.00	0.00	0.00	10593.00	0.00	
6210	DEV OF BIO ...APPLCN P P LIZYMOL	0.00	317486.90	0.00	317486.90	0.00	
6211	"DEV OF PROTOTYPE ANURYSM SUJESH SREEDHAR"	0.00	159228.00	0.00	159228.00	52853.00	

0.00	0.00	28800.00	0.00	0.00	28800.00	28800.00	2234600.00
0.00	0.00	152380.74	0.00	0.00	152380.74	152380.74	1215785.26
0.00	0.00	0.00	28285.00	0.00	28285.00	28285.00	2361115.00
0.00	0.00	0.00	292126.21	0.00	292126.21	292126.21	1201913.79
0.00	0.00	0.00	35150.00	0.00	35150.00	35150.00	1552850.00
0.00	0.00	97741.00	0.00	0.00	97741.00	97741.00	3512459.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	523000.00
0.00	0.00	72000.00	14017.00	6885.00	92902.00	92902.00	605768.00
0.00	0.00	0.00	1239436.00	0.00	1239436.00	1239436.00	604964.00
0.00	0.00	0.00	360937.50	0.00	360937.50	360937.50	784262.50
0.00	0.00	0.00	17273.07	0.00	17273.07	17273.07	1022726.93
0.00	0.00	0.00	100000.00	0.00	100000.00	100000.00	7583000.00
0.00	0.00	0.00	125000.00	0.00	125000.00	125000.00	3281000.00
0.00	60048712.00	22486932.74	558978048.39	39735854.43	621200835.56	681249547.56	444571234.34
0.00	0.00	83700.00	586426.36	0.00	670126.36	670126.36	0.00
0.00	54141.00	0.00	21691.00	0.00	21691.00	75832.00	0.00
0.00	0.00	0.00	38880.00	0.00	38880.00	38880.00	0.00
0.00	0.00	0.00	7324.00	0.00	7324.00	7324.00	0.00
0.00	0.00	0.00	86042.00	0.00	86042.00	86042.00	0.00
0.00	0.00	0.00	10593.00	0.00	10593.00	10593.00	0.00
0.00	0.00	201600.00	115886.90	0.00	317486.90	317486.90	0.00
0.00	52853.00	0.00	106375.00	0.00	106375.00	159228.00	0.00

6212	"DEV OF ...VALVE CORRECTION RANJITH G"	0.00	297416.00	0.00	297416.00	0.00	
6213	"WEB BASED REGISTRY DR. SANJEEV THOMAS"	0.00	143638.00	0.00	143638.00	0.00	
6214	"PROJ/6214/GRAPHENE BASED NANOPROBES"	129101.00	0.00	0.00	129101.00	0.00	
6215	PROJ/6215/PROTOTYPE SAFETYSYSTEM	0.00	173941.00	0.00	173941.00	0.00	
6500	OHF PROJECT DR. ANNIE JOHN	1397.00	0.00	0.00	1397.00	0.00	
6501	OHF PROJECT DR KALADHAR	160000.00	0.00	0.00	160000.00	0.00	
6502	OHF PROJECT DR SATHIN J SHENOY	180000.00	0.00	0.00	180000.00	0.00	
6503	CONSTRUCTION OF TEBV	-11120.00	24660.00	0.00	13540.00	0.00	
6504	DEVELOPMENT OF IRON NANO PRACTICLE	92947.00	0.00	35860.00	128807.00	0.00	
6505	REM SLEEP RESTRICTION	115685.00	0.00	0.00	115685.00	0.00	
7380	"NETWORKING SERVICES-NTC BLDING-ARUN ANIRUDHAN"	0.00	0.00	149380.00	149380.00	0.00	
7400	BIPHASIC HYDROXYAPATETITE BASED - DR.SAB	-38880.00	0.00	38880.00	0.00	0.00	
7410	APPLICATION OF DECELLULARISED - DR. BIJU	0.00	0.00	819517.00	819517.00	0.00	
2622	OHF- FOR INNOVATIVE PROJECTS	1460000.00	0.00	0.00	1460000.00	0.00	
2621	IIPC FUND(INDUSTRY INSTITUTE PARTNERSHIP - BMT	260769.00	0.00	0.00	260769.00	0.00	
	Total of internal projects BMT (C2)	2453858.00	1116369.90	1828475.36	5398703.26	106994.00	
C	Total of external & internal projects BMT (C1+C2)	298296045.14	403575274.90	429348165.12	1131219485.16	60155706.00	
	GRAND TOTAL SCHEDULE 3 (A)+(B)+(C)	568504317.60	513555692.47	854860129.42	1936920139.49	93950754.15	

Sd/-
Chief Financial Adviser

Sd/-
Director

0.00	0.00	176316.00	121100.00	0.00	297416.00	297416.00	0.00
0.00	0.00	63688.00	79950.00	0.00	143638.00	143638.00	0.00
0.00	0.00	0.00	129101.00	0.00	129101.00	129101.00	0.00
0.00	0.00	150038.00	23903.00	0.00	173941.00	173941.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1397.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	160000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	180000.00
0.00	0.00	13540.00	0.00		13540.00	13540.00	0.00
0.00	0.00	0.00	121889.28	0.00	121889.28	121889.28	6917.72
0.00	0.00	0.00	98991.00	0.00	98991.00	98991.00	16694.00
0.00	0.00	0.00	0.00	149380.00	149380.00	149380.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	41900.00	777617.00	819517.00	819517.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1460000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	260769.00
0.00	106994.00	688882.00	1590052.54	926997.00	3205931.54	3312925.54	2085777.72
0.00	60155706.00	23175814.74	560568100.93	40662851.43	624406767.10	684562473.10	446657012.06
0.00	93950754.15	54713471.74	563299383.87	427754930.74	1045767786.35	1139718540.50	797201598.99

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 4-SECURED LOANS AND BORROWINGS:	2016-2017	2015-2016
1. Central Government	--	--
2. State Government (Specify)	--	--
3. Financial Institutions	--	--
a) Term Loans	--	--
b) Interest accured and due	--	--
4. Banks:	--	--
a) Term Loans-Interest accured and due	--	--
b)Other Loans(specify)- Interest accured 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	2016-2017	2015-2016
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:	2016-2017	2015-2016
a) Acceptances secured by hypothecation of capital equipment and other assets	--	--
b) Others		
TOTAL	--	--

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS		2016-2017	2015-2016
	A. CURRENT LIABILITIES		
	1. Acceptances		
	2. Sundry Creditors:		
	a) For Goods	118678936	120734953
	b) Others	0	0
	3. Advances Received	52397159	196048250
	4. Interest accured 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		0
	b) Others	13575440	11610263
	6. Other current Liabilities	61659150	63026533
	TOTAL(A)	**246310686**	**391419999**
	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	230000	175000
	Emergency Reserve Fund contribution	0	0
	Technology Development Fund contribution	1690457	520821
	TOTAL(B)	**1920457**	**695821**
	TOTAL(A+B)	**248231143**	**392115820**

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL

SCHEDULE 8- FIXED ASSETS

PARTICULARS	GROSS BLOCK			
	Cost/valuation as at the beginning of the year (01.04.2016)	Additions during the year 2016-17	Deductions during the year 2016-17	
A. FIXED ASSETS:				
1. LAND:				
a) Freehold	16894606	0	0	
b) Leasehold				
2.BUILDINGS:				
a) On Freehold Land *	47037608	145205205	0	
b) On Leasehold Land				
c) Ownership Flats/Premises				
d) Superstructures on Land not belonging to the entity	155974660	176002492		
3. PLANT MACHINERY & EQUIPMENT	2301789846	497267168	11867211	
4. VEHICLES	7474234	1058600	0	
5. FURNITURE,FIXTURES	51343360	29322214	325792	
6. OFFICE EQUIPMENT	1236622	0	0	
7. COMPUTER/PERIPHERALS	6617685	349798	109500	
8. ELECTRIC INSTALLATIONS	118158435	50832557	38240	
9. LIBRARY BOOKS	180587744	12703306	8695	
10. TUBEWELLS & W.SUPPLY	301965	0		
11. OXYGEN CYLINDERS/GAS PLANT INSTALLATIONS	1405581	0		
12) KITCHEN/CANTEEN EQUIPMENTS	1764138	856539		
13) PAINTINGS	450216	0		
14) SURGICAL EQUIPMENTS	7203975	0	67600	
Total for the year (Total -A)	2898240672	913597880	12417038	
Total for the previous year	2621224278	291071265	14054871	
Captial Work in Progress (B)	701479540		701479540	
Total for the year (A+B)	3599720212	913597880	713896578	
* Depreciation for item2(a) has been provided along with depreciation on 2(d)				

Sd/-
Chief Financial Adviser

Sd/-
Director

SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

	DEPRECIATION				NET BLOCK	
Cost/valuation at the year end (31.03.2017)	Depreciation as at the beginning of the year (01.04.2016)	Depr on items written off	During the year 2016-17	Total up to the year end (31.03.2017)	As at the end of current year end (31.03.2017)	As at the previous year end (31.03.2016)
16894606	0	0	0	0	16894606	16894606
192242813	0		0	0		
331977152	127417608	0	137967988	265385596	258834369	75594660
2787189803	1480582129	10522479	504170160	1984752289	802437512	821207716
8532834	6241991		343626	6585617	1947216	1232243
80339782	35869463	228852	4241065	40110528	40229253	15473897
1236622	1000629		23599	1024228	212393	235992
6857983	5849545	109498	561264	6410809	447174	768140
168952752	71264579	24055	18139166	89403745	79549007	46893857
193282355	173391496	8695	11931037	185322533	7959821	7196248
301965	199077		10289	209366	92599	102888
1405581	1393115		7479	1400594	4986	12465
2620678	1304718		131596	1436314	1184364	459421
450216	392078		5814	397892	52324	58137
7136375	6669541	43264	160775	6830316	306059	534433
3799421513	1911575969	10936843	677693859	2589269828	1210151684	986664702
2898240672	1750407888	11714269	161168080	1911575968	986664703	870816389
0	0	0	0	0	0	701479540
3799421513	1911575969	10936843	677693859	2589269828	1210151684	1688144242

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		2016-2017	2015-2016
	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)		0
	Pension & staff funds	128385834	67637624
	Project funds	573306040	0
	TOTAL	**763387543**	**129333293**
SCHEDULE 10-INVESTMENTS-OTHERS		2016-2017	2015-2016
	1. In Government Securities	--	--
	2. Other approved Securities	--	--
	3. Shares	--	--
	4. Debentures and Bonds	--	--
	5. Subsidiaries and Joint Ventures	--	--
2388	6. Others (to be specified) Sinking Fund Investments	150000000	400000000
	Technology Fund	71557820	68881828
	6. Others (to be specified)	--	--
	TOTAL	221557820	468881828
SCHEDULE 11-CURRENT ASSETS,LOANS,ADVANCES ETC		2016-2017	2015-2016
	A. CURRENT ASSETS		
	1. Inventories:		
	a) Stores and Spares	0	218182275
	b) Instruments & Loose Tools	0	50741374
	c) Stock-in trade		
	Store items	81067247	98847467
	Stamps	104103	124574
	Medicine	20022734	15371287
	2. Sundry Debtors:		
	a) Debts Outstanding for a period exceeding six months	31403530	39961872
	b) Others	134011955	283098742
	2.1 Income tax deducted at source	9936975	11007009
	3. Cash balances in hand(including cheques/ drafts and imprest)	1156161	1435619

	4. Bank Balances:		
	a) With Scheduled Banks:		
	-On Current Account	1	1
	-On Deposit Accounts(L.C. margin & Commitment deposit)	314339793	36917317
	-On Savings Accounts	440769296	632573775
	b) With non-Scheduled Banks:		0
	-On Current Account	0	0
	-On Deposit Accounts	0	0
	-On Savings Accounts	0	0
	5. Post-Office-Savings Accounts	0	0
	TOTAL(A)	**1032811794**	**1388261312**
	B.LOANS, ADVANCES AND OTHER ASSETS		
	1. Loans:		
	a) Staff	7930433	9782254
	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	97769779	111729799
	b) Prepayments		0
	c) Others	223473315	20540570
	3. Income Accured:	0	0
	a) On Investments from Earmarked/ endowment Funds	17894350	27615835
	b) On Investments-Others	0	0
	c) On Loans and Advances	0	0
	d) Others (Royalty)	1509574	571043
	(includes income due unrealised)	0	0
	4. Claims Receivable	0	0
	From Govt of India on Plan Funds	0	0
	TOTAL(B)	**348577450**	**170239500**
	TOTAL(A+B)	**1381389244**	**1558500813**
	Savings bank account includes Rs.15/- (GL code No.2410-Synd Bank vikas certificate)		
SCHEDULE 12- INCOME FROM SALES/SERVICES		2016-2017	2015-2016
	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	1072210809	896942242
		0	0
	From Projects	7643567	3082056
	Testing & Facility charges received	4103107	4094955
	TOTAL	**1083957483**	**904119253**
SCHEDULE 13- GRANTS/SUBSIDIES		2016-2017	2015-2016
	(Irrevocable Grants & Subsidies Received)		
	1. Central Government - Plan	1119243000	937813000
	- Non Plan	4400000	20000000
	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	**1123643000**	**957813000**
SCHEDULE 14-FEES/SUBSCRIPTIONS		2016-2017	2015-2016
	1. Entrance Fees	351590	1351750
	2. Annual Fees/ Subscriptions	8972570	6172570
	3. Seminar/Program Fees	0	0
	4. Consultancy Fees	0	0
	5. Examination Fees and others	1020774	908130
	TOTAL	**10344934**	**8432450**
SCHEDULE 15- INCOME FROM INVESTMENTS		2016-2017	2015-2016
	(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	8888462	25707124
	2.Withdrawal from Sinking Fund	250000000	100000000
	3.Interest on Technology Fund	3637056	1275863
	TOTAL	262525518	126982987
SCHEDULE 16- INCOME FROM ROYALITY,PUBLICATION ETC		2016-2017	2015-2016
	1) Income from Royalty	2628988	1091864
	2) Income from Publications	0	0
	3)Others(Specify)	0	0
	TOTAL	**2628988**	**1091864**
SCHEDULE 17- INTEREST EARNED		2016-2017	2015-2016
	1) On Term Deposit		
	a) With Scheduled Banks	34642537	20748835
	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	6012849	9079829
	b) With non-scheduled banks	0	0
	c) Post Office Savings Account	0	0
	d) Others(accrued)	13323025	19956067
	3) On Loans	0	0
	a) Employees/Staff	1250301	763732
0	b) Others	0	0
	4) Interest on Debtors and other Receivables		
	TOTAL	**55228711**	**50548463**
SCHEDULE 18- OTHER INCOME		2016-2017	2015-2016
	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 Maintanance	0	0
	2. Rent	1649260	1880101

	3. Fees for Miscellaneous Services	0	0
	4. Miscellaneous Income Rent	291500	4200
	Other Income	5050495	9186380
	Prior period income	3600000	0
	TOTAL	**10591255**	**11070681**
SCHEDULE 20-ESTABLISHMENT EXPENSES		2016-2017	2015-2016
	a) Salaries and Wages		
	1. from PLAN Grant	674360000	641067000
	2. from PLAN (SC)	53065000	27168000
	3. from Internal generation	119461427	129293779
	b) Allowances and Bonus	11626279	6904358
	c) Contribution to Provident Fund	0	0
	d) Contribution to other fund(specify)	0	0
	e) Staff Welfare Expenses	20612256	17211993
	f) Expenses on Employee's Retirement and Terminal Benefits	275984547	182928682
	g) Others(Specify) PG Training & Accademic payments	166332032	139955990
	TOTAL	**1321441541**	**1144529802**
SCHEDULES 21- ADMINISTRATIVE EXPENSES		2016-2017	2015-2016
	a) Purchases		
	1. from PLAN Grant	371818000	269578000
	2. from Internal Generation	241988951	269057803
	b) Concession to Poor patients/Labour and processing expenses	89203829	125223366
	c) Cartage and Carriage Inwards	136084	111392
	d) Electricity and power	0	0
	1. from NON-PLAN Grant	4400000	20000000
	2. from Internal Generation	48529779	36113763
	e) Water charges	5669840	7167544
	f) Insurance	164539	275357
	g) Repairs and maintenance	59446099	79097437
	h) Excise duty	0	0
	i) Rent,Rates and Taxes	581262	472977
	j) Vehicles Running and Maintenance	851277	723725
	k) Postage,Telephone and Communication Charges	3375826	2269212
	l) Printing and Stationary	49900	2009349
	m) Travelling and Conveyence Expenses	4163460	4341131
	n) Expenses on Seminar/Workshop	751494	1287785
	o) Subscription Expenses	148768	203720

	p) Expenses on Fees	0	0
	q) Auditors Renumeration	301386	352544
	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	270982456	0
	y) Distribution Expenses	0	0
	z) Advertisement and Publicity	2624240	4018696
	z1) Others(specify)	42269008	79521880
	TOTAL	**1147456199**	**901825681**
SCHEDULE 23-INTEREST		2016-2017	2015-2016
	a) On Fixed Loans		
	b) Bank Charges)	91172	118506
	c) Others(specify)	0	0
	TOTAL	**91172**	**118506**

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

RECEIPTS & PAYMENTS ACCOUNTS FOR THE PERIOD FROM 01-04-2016 TO 31-03-2017

	RECEIPTS	2016-17	2015-16		Payments	2016-17	2015-16
		Rs.	Rs.			Rs.	Rs.
I	Opening Balances			I	Expenses		
a)	Cash In Hand	1435619.28	1441133.06				
b)	Bank Balances				a)Establishment expenses	1676478837.90	875899245.60
	I) In Current Account	1.15	1.15		b) Administrative Expenses		
	ii)In deposit Account				For Purchases	24194990.00	336382577.00
	iii)Savings Account *	636457679.22	134438733.43		Other expenses	77177770.00	125864508.00
				II	Payments made against funds for various		
II	Grant Received				Projects		
	From Government of India				As Per schedule	444272554.66	99874350.50
	Under Plan - Capital scheme	485692000.00	202597000.00				
	Under Plan Salary/ General scheme	1119243000.00	937813000.00	III	Investments & Deposits made		
	Unde Plan scheme -NCMMR	0.00	0.00				
	Non-Plan scheme	4400000.00	20000000.00		a) Out of Earmarked funds	149735715.00	128496931.00
					b) Out of own funds		
III	Receipts against Earmarked Funds						
				IV	Expenditure on Fixed Assets & Capital work		
	a) Earmarked funds	250797596.75	66516470.00		-in- progress		
	b) Own funds						
					a) Purchase of Fixed Assets	84917462.00	56367336.05

IV	Interest Received				b)Capital work-in-progress		
	a) On Bank deposits	44649064.68	93608240.40	V	Refund of Loans		
	b) Loans Advances etc	16.00	5092.00				
	c) On NCMMR funds	144544.00	144567.00				
V	Receipts from services			VI	Finance Charges(Bank charges)	61924.05	33411.24
	Receipts from Patient services	979899145.88	718580678.98				
	Other receipts including Royalty	22888284.47	23736885.35	VII	Other Payments		
					To Funds/ Deposit- refunds	1228867514.75	832014198.90
VI	Other receipts			VIII	Closing Balance		
	Grant received for Projects	269544918.57	466953778.57		a) Cash in hand	1156161.00	1435619.28
	Refund of Deposits(LC Margin)				b) Bank Balances		
	Other receipts	316508804.13	426990278.00		I) In current Account	1.15	1.15
					ii) In Deposit Account		
					iii) Savings Account	444797743.62	636457679.22
	Total	4131660674.13	3092825857.94		Total	4131660674.13	3092825857.94
	*Closing balance of Bank include grant amount received from DST for setting up of NCMMR, Thiruvananthapuram						

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

Provident Fund Account for the Year ended 31-03-2017

Particulars	2016-17	2015-16
	[Rupees]	[Rupees]
LIABILITIES		
MEMBERS BALANCE	216470304	232906381
MEMBERS CREDITS [for march]	3532121	3817426
BALANCE DUE TO MEMBERS NOT IN SERVICE		
Under EPF scheme	7696198	7696523
,, GPF ,,	532055	532055
PENSION FUND DUES	0	51168169
RESERVES&SURPLUS-INTEREST	154637651	113307672
TOTAL	382868329	409428226
ASSETS		
INVESTMENT AT COST	345078659	365572702
DUES TO PF ACCOUNT		
FROM INSTITUTE	3532121	3817426
FROM PF COMMISSIONER	8403467	8403467
INTEREST ACCRUED NOT DUE	13696323	24065966
BALANCE WITH BANKS		
SBT -GPF A/C	12157759	7568664
TOTAL	382868329	409428226
	0.00	0.00

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH

Receipts & Payments Account for the period 01.04.2016 -31.03.2017

	2016-17	2015-16		2016-17	2015-16
Receipts	**Rs.**	**Rs.**	**Payments**	**Rs.**	**Rs.**
Opening Balance - Bank	3883904	3739337	Printing & Stationery		480
Grant in aid	0	0	Bank Charges		
Interest earned	144544	145047	Closing Balance - Bank	4028448	3883904
	4028448	3884384		4028448	3884384

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH

Income & Expenditure Account for the period 01.04.2016 -31.03.2017

	2016-17	2015-16		2016-17	2015-16
Expenses	**Rs.**	**Rs.**	**Income**	**Rs.**	**Rs.**
Printing and Stationery	0	480	Interest	144544	145047
Excess of Income over expenditure	144544	144567	Excess of Expenditure over income		
	144544	145047		144544	145047

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH -

BALANCE SHEET AS ON 31-03-2017

Particulars	**2016-17**	**2015-16**
	[Rs]	**[Rs]**
LIABILITIES		
CAPITAL FUND		
Opening Balance	3883904	3739337
Add: Grant received	0	
Add/Less (-): Excess of Income over Expenditure	144544	144567
TOTAL	**4028448**	**3883904**
ASSETS		
BANK BALANCE	4028448	3883904
(Union Bank of India Account No.541502010002675)		
TOTAL	**4028448**	**3883904**

Sd/-
Chief Financial Adviser

Sd/-
Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF ACCOUNTS AS AT 31-03-2017

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.

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.

7. FOREIGN CURRENCY TRANSACTIONS

Transactions denominated in foreign currency are accounted at exchange rate prevailing at the date of transactions.

8. RETIREMENT BENEFITS

Gratuity: From the year 2006, (with the implementation 6th Pay Commission report), the gratuity payments are treated as Institute expenses and accounted on actual payment basis.

Leave Salary: Leave encashment eligible at the time of retirement/reliving is treated as Institute expenses and accounted on actual payment basis.

Pension: From the year 2006, (with the implementation 6th Pay Commission report) 12% of the salary is transferred to the Pension Fund.

New Pension Scheme: In the case of employees who joined on or after 01.01.2004, 10% of the salary is deducted as employees subscription and equal contribution is being made by the Institute. The funds are remitted to NPS Trust Account maintained by GOI and subscription details forwarded to NSDL/CRA every month.

9. PROVIDENT FUND

Assets and Liabilities of General Provident Fund account were separated from Balance sheet of Institute and shown as separate statement. Interest is provided on the accumulations as per the rates prescribed by Central Government from time to time.

10. EMERGENCY RESERVE FUND

An amount equal to 7.50 percent of receipts from patient is to be transferred to a Fund for meeting unexpected requirements for Fixed assets subject to a maximum of Rs.50 Crore. It was decided to reduce the limit of ERF to Rs.15 crore and to utilize the remaining funds and the guideline of recouping these funds do not apply till further decision.

11. TECHNOLOGY DEVELOPMENT FUND

Receipts against technology developed by the Institute are transferred to the above fund and interest earned is utilized for meeting additional expenses on Improvement of technologies already developed.

12. OVER HEAD SCHEME

Overhead Funds scheme for Innovative Projects has been introduced from the year 2012-13. An amount of upto Rs.10 lakhs can be transferred to this account every year and utilised for innovative projects.

Sd/-	Sd/-
Chief Financial Adviser	Director

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULE 25-CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES

Rs. In lakhs

	2016-17	2015-16
Claims against the Institute not acknowledged as debts	NIL	13.20
Bank Guarantee given by Institute	41.66	39.37
Letters of credit opened on behalf of Institute	10.94	0.00
In respect of claims from parties for non- execution	NIL	NIL

Service Tax :

" The office of the Commissioner of Central Excise and Customs vide order no: C.No.IV/16/152/2014 ST ADJ. Dated 08.06.2015 confirm demand of Service tax Rs.4.72 Lakhs under section 73(2) of the Finance Act 1994, being service tax short paid under the category "Technical Inspection and certification service" during the period 1.4.2009-31.03.2012 . Further impose a penalty of Rs 2.36 lakhs towards penalty under section 78 and Rs.0.05 lakhs for contravention of section 70 of the Act. In order to file appeal against the order, the institute paid Rs.0.35 lakhs towards deposit (i e 7.5% of demand confirmed)."

Name of the Statute	Nature of Dues	Amount in Rs. in lakhs	Period to which the amount relates	Forum where dispute is pending.
Service Tax	Service tax and penalty	7.13	01/04/2009 to 31/03/2012	Commissioner Appeals, Central Excise

2. UNEXPIRED CAPITAL COMMITMENTS

Rs. in lakh

	2016-17	2015-16
Estimated value of orders remaining to be executed on Capital Account	326.13	1809.83
Construction of new Hospital block	21000.00	.....

(Ministry of Health and Family Welfare approved the construction of a new Hospital Block in the Institute at a cost of Rs.23000 lakh. The project will be funded by Ministry of Health and Family Welfare (Rs.12000 lakh) and Department of Science & Technology (Rs.11000 lakh). During the year 2016-17 Rs. 2000 lakh was released to CPWD, the executing agency).

Lease obligation for rentals for Plant & Machinery NIL NIL

3. CURRENT ASSETS, LOANS & ADVANCES

The aggregate amount shown in the Balance sheet for the Current assets, Loans and Advances, have the value, which is realisable in the ordinary course of business.

4. PROVISIONS

Provision for Income tax not made since there is no taxable income for Institute under Income tax Act 1961, during the year.

5. FOREIGN CURRENCY TRANSACTIONS:

Rs. in lakh

	2016-17	2015-16
5.1 Value of Imports		
Capital Goods	**1141.02**	76.18
Stores Spare & onsumables	**29.50**	31.18
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.53.20 lakh (previous year Rs.22.96 lakh).

7 Claim for Audit fees by C&AG amounting to Rs.1.62 lakhs has been paid during the year. Provision for Audit fees has been made for current year amounting to Rs.2.30 lakhs.

8 As suggested by C&AG Auditors, Plan and Non Plan expenditure on account of Salary and General Expenses has been separately disclosed in the accounts.

9 Accrued Interest on Investment amounting Rs.178.94 lakhs (previous year Rs. 199.56 lakhs) has been provided in the current year accounts.

10 In order to release the pension dues as per the CCS pension rules, an additional amount of Rs.1693.97 lakhs has been expended over and above the sanctioned 12% Institute contribution (amounting to Rs.361.03 lakhs) 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.2527.48 lakhs
Present value of the pensionary liability for serving employees	Rs.5947.54 lakhs
Present value of the pensionary liability for Existing pensioners	Rs.9854.04 lakhs
Present value of the past service leave encashment	Rs.2514.97 lakhs

12 Value of assets acquired from externally funded projects during the last three years has been identified as detailed below:-

FY 2013-14	Rs.106.39 lakh
FY 2014-15	Rs. 15.36 lakh
FY 2015-16	Rs.117.22 lakh
FY 2016-17	Rs. 718.52lakh

Since the cost of acquisition of these assets is nil, no depreciation has been charged on these assets.

13 Emergency Reserve Fund & Technology Development Fund

During the year Rs.2500.00 lakhs was utilized from Emergency Reserve Fund for meeting the various liabilities of the Institute.

An amount of Rs.26.76 lakhs (previous year Rs.18.62 lakhs) was tansferred to Technology Development Fund. During the year Rs.14.88 lakhs has been spent from Technology Development Fund.

14. Overhead Fund Scheme

During the year an amount of Rs.NIL (previous year Rs.2.00 Lakhs) 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.87.03 lakhs (Previous year Rs.449.35 lakhs) transferred to nullify the negative balances in the In house projects accounts.

16 Capitalisation of work in progress

During the year 2016-17 amount of Rs.6149.98 lakh classified under work in progress was capitalized and accumulated depreciation amounting to Rs.4238.03 lakh has been charged to Income and Expenditure account under the head 'Accumulated depreciation'.

17 Prior period items

Prior period expenses of Rs.2709.82 lakh includes an amount of Rs.2689.23 lakh being the current assets (Spares, Glasswares, Instruments & Loose tools) representing stores issues not accounted in financial records during the period from 2004-05 to 2015-16 which has been written off after a due diligence study by an Internal Committee.

(Rs. in lakh)

Year	Consumption	Year	Consumption
2003-04	111.04	2010-11	170.77
2004-05	9.37	2011-12	162.12
2005-06	224.60	2012-13	532.60
2006-07	32.27	2013-14	515.96
2007-08	8.06	2014-15	256.82
2008-09	262.82	2015-16	-35.98
2009-10	438.78	Total	2689.23

Prior period income includes Rs.36 lakh being the value of work in progress inadvertently booked as expense during the year 2013-14, now 4 brought back to books ofaccounts while capitalizing the Hostel Building(SRISHTY).

18 Corpus fund for M Tech Clinical Engineering Program

As decided by the GB, an amount of Rs.16 lakhs each is due to partner Institutes viz., CMC Vellore and IIT Madras for the year 2013-14 & 2014-15.

19 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.

20 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 31-03-2017, and Income & Expenditure Account for the year ended on that date.

Sd/-
Chief Financial Adviser

Sd/-
Director

Separate Audit Report of the Comptroller & Auditor General of India on the Accounts of the Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum for the year ended 31 March 2017

1. We have audited the Balance Sheet of the Sree ChitraTirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram as at 31 March 2017, 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 officeon 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) Revision in Accounts

Based on the Audit Observation, SCTIMST had effected revisions in their accounts and revised accounts duly approved by the competent authority was submitted. The following revisions were made based on the comments of Audit.

- SCTIMST did not include interest on saving account of ₹ 43908 under schedule 17-Interest earned

and application fee amount of ₹1,63,0424 as income under Schedule 18 : Other Income. With the result these income side of the Income and Expenditure Account were understated by ₹16.74 lakh and bank balances under Schedule-11 current asset of the Balance sheet were understated by the same amount. On being pointed out SCTIMST revised their accounts.

- Amount received as Advances amounting to Rs.46.30 lakh shown under Sundry debtors account of the previous year (2015-16) were rectified and correctly shown under Schedule 11 Current Liabilities of the previous year.
- The disclosures under Grants-in-aid Salary, General were correctly disclosed under 'Schedule-20: Establishment expenses' and 'Schedule 21-Other Administrative Expenses'.
- The PF investment as per the investment register was closed to the balance of Rs. 34.51 crore (as on 31st March 2017), the figures under the asset side of PF balance sheet was Rs. 30.78 crore. Thus, the financial statement of the PF asset/ investment account was understated by Rs.3.73 crore. SCTIMST since rectified in the financial statement of PF account.
- Though Emergency Reserve Fund was reduced from Rs. 50 crore to Rs. 15 crore the same was not disclosed. The revision is now disclosed under Para 10 of Schedule-24: Significant Accounting Policies of the Institute.

(B) Balance Sheet

B.1 Current Assets (Schedule 11) of Rs.103.11 crore

During the year 2016-17 SCTISMT in two cases (1000 number of disposable MRI syringes amounting to ₹12 lakh and 1000 number of DVD amounting to ₹0.20 lakh) misclassified consumables worth Rs. 12.20 lakh as equipment/fixed assets. This resulted in understatement of Current Assets account and overstatement of Fixed Assets account by Rs.12.20 lakh each.

B.2 Understatement of Reserves and Surplus (Schedule-2) of Rs. 22.16 crore by Rs.33.47 lakh

According to the Uniform Format of Accounts prescribed by Ministry of Finance for Central Autonomous Bodies Fixed Assets received by way of non-monetary grants (other than towards the Corpus Funds), are to be capitalized at values stated, by corresponding credit to Capital Reserve.
SCTIMST received four Infant Warmer Bed Units amounting to ₹ 33.47 lakh as non-monetary grant (of Rs.33,47,000 during the year 2016-17 under Member of Parliament Local Area Development Scheme in the form of four Infant Warmer Bed Units for its Paediatric Cardiac Surgery Division. However, SCTIMST did not disclose this amount under its Capital Reserve. The expenditure be incurred from this fund to control the expenditure. This resulted in understatement of Reserves and Surplus account (Capital Reserves) of liability sideby Rs.33.47 lakh.

B.3 Current liabilities and provisions (Schedule-7) of Rs.24.82 crore

As per Accrual Valuation Rs. 208.44 crore to be provided for retirement benefits, SCTIMST has created the provision of Rs. 17.17 crore only. Short provision for retirement benefit by Rs. 190.67 crore has resulted in Overstatement of Current Liabilities & Provisions and Administrative Expenses by Rs. 190.67 crore.

(C) Income and Expenditure Account

C.1Other Income of Rs.89.61 lakh

The expenses on the in-house projects (both revenue and capital expenses) are to be expended from the income of the Institute. In-house projects are direct appropriation from the Institute Income, close to accounts and would not hold any balance.

Audit scrutiny, however revealed that out of a total of 24 in-house projects, in sixteen projects institute held a balance of Rs. 16.89 lakh as on 31st March 2017. These balances may be credited immediately to 'Other Income'. Thus, 'Other Income' account of 'Income and Expenditure Account' is understated by Rs. 16.89 lakh.

(D) General

D.1Provident fund

The institute maintains the provident fund account of its employees. Prior to 1989 it was maintained by Regional Provident Fund Commissioner, Trivandrum. As of 31 March 2017, an amount was Rs.84.03 lakh was still receivable from the EPF Commissioner. This amount is constantly appearing in Provident Fund account for 2011-12, 2012-13, 2013-14, 2014-15, 2015-16 and 2016-17. However, SCTIMST could not obtain confirmation of the balance.

D.2Grant in aid

Grant-in-aid of Rs.160.93 crore (39.62 crore + 72.74 crore + 48.57 crore) was received from Government of India and utilized during the current year viz. 2016-17.

(E)Management letter

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.

i) Subject to our observations in the preceding paragraphs, we report that the Balance Sheet, Income & Expenditure Account and Receipts & Payment Account dealt with by this report are in agreement with the books of accounts.

ii) In our opinion and to the best of our information and according to the explanations given to us, the said financial statements read together with the Accounting Policies and Notes on Accounts, subject to the significant matters stated above and other matters mentioned in Annexure to this Audit Report give a true and fair view in conformity with accounting principles generally accepted in India.

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 31stMarch 2017; and

b. In so far as it relates to Income & Expenditure Account of the deficit for the year ended on that date.

Sd/-

Principal Director of Audit

Reply to 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 2017

Audit Comments	Reply of the Institute
(A) Revision in Accounts	
Based on the Audit Observation, SCTIMST had effected revisions in their accounts and revised accounts duly approved by the competent authority was submitted. The following revisions were made based on the comments of Audit. • SCTIMST did not include interest on saving account of Rs. 43908 under schedule 17-Interest earned and application fee amount of Rs. 1,63,0424 as income under Schedule 18 : Other Income. With the result these income side of the Income and Expenditure Account were understated by Rs. 16.74 lakh and bank balances under Schedule-11 current asset of the Balance sheet were understated by the same amount. On being pointed out SCTIMST revised their accounts. • Amount received as Advances amounting to Rs.46.30 lakh shown under Sundry debtors account of the previous year (2015-16) were rectified and correctly shown under Schedule 11 Current Liabilities of the previous year. • The disclosures under Grants-in-aid Salary, General were correctly disclosed under 'Schedule-20: Establishment expenses' and 'Schedule 21-Other Administrative Expenses'. • The PF investment as per the investment register was closed to the balance of Rs. 34.51 crore (as on 31st March 2017), the figures under the asset side of PF balance sheet was Rs.30.78 crore. Thus, the financial statement of the PF asset/ investment account was understated by Rs.3.73 crore. SCTIMST since rectified in the financial statement of PF account. • Though Emergency Reserve Fund was reduced from Rs. 50 crore to Rs. 15 crore the same was not disclosed. The revision is now disclosed under Para 10 of Schedule-24: Significant Accounting Policies of the Institute.	Based on the audit observations, the account for the year 2016-17 has been corrected wherever required. The corrected Accounts were submitted to audit duly signed by the Competent Authority. The accounts placed before the Governing Body/ Institute body along with the SAR for final approval.

(B) Balance Sheet	
B.1Current Assets (Schedule 11) of Rs.103.11 crore During the year 2016-17 SCTISMT in two cases (1000 number of disposable MRI syringes amounting to Rs. 12 lakh and 1000 number of DVD amounting to Rs. 0.20 lakh) misclassified consumables worth Rs. 12.20 lakh as equipment/fixed assets. This resulted in understatement of Current Assets account and overstatement of Fixed Assets account by **Rs.12.20 lakh** each.	The audit observation is noted and consumables are to be classified as revenue expenditure. Necessary accounting entries have been made during the month of August 2017 and will be reflected in the accounts for the year 2017-18. (Journal voucher Number 2748 dated 10.08.2017).
B.2 Understatement of Reserves and Surplus (Schedule-2) of Rs. 22.16 crore by Rs.33.47 lakh According to the Uniform Format of Accounts prescribed by Ministry of Finance for Central Autonomous Bodies Fixed Assets received by way of non-monetary grants (other than towards the Corpus Funds), are to be capitalized at values stated, by corresponding credit to Capital Reserve. SCTIMST received four Infant Warmer Bed Units amounting to Rs. 33.47 lakh as non-monetary grant (of Rs.33,47,000 during the year 2016-17 under Member of Parliament Local Area Development Scheme in the form of four Infant Warmer Bed Units for its Paediatirc Cardiac Surgery Division. However, SCTIMST did not disclose this amount under its Capital Reserve. The expenditure be incurred from this fund to control the expenditure. This resulted in understatement of Reserves and Surplus account (Capital Reserves) of liability side by Rs.33.47 lakh.	Institute received non-monetary grant for the first time during 2016-17. Suitable Accounting policy is being evolved and assets received by way of non-monetary grants will be capitalized and proper disclosure made in the accounts for the year 2017-18.
B.3Current liabilities and provisions (Schedule-7) of Rs.24.82 crore As per Accrual Valuation Rs. 208.44 crore to be provided for retirement benefits, SCTIMST has created the provision of Rs. 17.17 crore only. Short provision for retirement benefit by Rs. 190.67 crore has resulted in Overstatement of Current Liabilities & Provisions and Administrative Expenses by Rs. 190.67 crore.	The liability in respect of Gratuity, Pension and Leave Encashment is disclosed in para 11 of Schedule No. 25- Notes on accounts. Governing Body of the Institute in its meeting held on 30.07.2016 and 08.07.2017 discussed the need for creation of a separate fund for Gratuity, Pension and Leave Encashment and transfer required contribution to those funds so as to comply with the requirements of Accounting Standards 15. However, considering the present financial position of the Institute, GB decided to continue the existing practice of settling the payments on cash basis and creation of funds to be considered once the financial position improves. GB also approved that, every year the liability may be reassessed and proper disclosure made in the financial statements.

(C) Income and Expenditure Account	
C.1 Other Income of Rs.89.61 lakh The expenses on the in-house projects (both revenue and capital expenses) are to be expended from the income of the Institute. In-house projects are direct appropriation from the Institute Income, close to accounts and would not hold any balance. Audit scrutiny, however revealed that out of a total of 24 in-house projects, in sixteen projects institute held a balance of Rs. 16.89 lakh as on 31st March 2017. These balances may be credited immediately to 'Other Income'. Thus, 'Other Income' account of 'Income and Expenditure Account' is understated by Rs. 16.89 lakh.	In order to meet the objectives of the Institute, i.e. Research & Development, funds have been allocated to various internal projects. The balance funds in these projects will be transferred to Institute account after completion of the project. If in any case the project is abandoned or not pursued then the amount will be re paid to the Institute. The audit comment is noted for evolving a policy in this regard.
(D) General	
D.1 Provident fund The institute maintains the provident fund account of its employees. Prior to 1989 it was maintained by Regional Provident Fund Commissioner, Trivandrum. As of 31 March 2017, an amount was Rs.84.03 lakh was still receivable from the EPF Commissioner. This amount is constantly appearing in Provident Fund account for 2011-12, 2012-13, 2013-14, 2014-15, 2015-16 and 2016-17. However, SCTIMST could not obtain confirmation of the balance.	Institute requested EPF authorities to confirm the balance in the previous years. No reply has been received so far. EPF authorities settled the dues after constant follow up by the Institute and they have migrated to fully computerized program. On enquiry EPF authorities informed that they have settled all the dues as per the available records and they have migrated to new computerized system and therefore old records cannot be further traced. Once again the matter will be followed up with EPF authorities and after getting a written confirmation, Institute will settle the account after getting the approval of competent authority.
D.2 Grant in aid Grant-in-aid of Rs.160.93 crore (39.62 crore + 72.74 crore + 48.57 crore) was received from Government of India and utilized during the current year viz. 2016-17.	Noted.
(E)Management letter	
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.	The observations mentioned in the Management letter have been noted for future guidance.