SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

TRIVANDRUM - 695 011, KERALA

ANNUAL REPORT

2015-16

Annual Report 2015-16

Sree Chitra Tirunal Institute for
Medical Sciences and Technology
Trivandrum - 695 011

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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 Center 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 medical devices development, high quality patient care, and health science studies

MESSAGE FROM THE PRESIDENT

"Do not go where the path may lead; go instead where there is no path and leave a trail." The passionate exhortation of Ralph Waldo Emerson may well have inspired the inception of Sree Chitra Tirunal Institute in the mid-seventies when there was a crying need in the country for import substitution, particularly in the domain of healthcare that relied overwhelmingly upon medical devices at unaffordable costs. The seeds sown more than four decades ago at Sree Chitra have since sprouted in many institutions across the country. For its part, the Institute is credited with the indigenous development of several biomedical technologies that have been transferred to industry and commercialized. Prominent among these are the TTK-Chitra heart valve, blood bag, hydrocephalus shunt, bubble oxygenator and cardiotomy reservoir, membrane oxygenator, hemoconcentrator and hormone-releasing intrauterine device that are shining examples of purposeful innovation. Other technology development projects include, but are not limited to, coronary stent, vascular graft, centrifugal blood pump, blood flow meter and bioceramic materials for different clinical applications. Looking back at these and other past accomplishments of the Institute, I feel a sense of legitimate pride.

One cannot, however, rest on past laurels. Life has to be, in the words of Kierkegaard, "lived forwards". As they say, change is inevitable in life but improvement is optional. In the year that has gone by, Sree Chitra chose to take the option of improvement, even in these times, in order to emerge stronger as a result. A year ago, the Department of Science and Technology made an

important decision to have a dynamic leader, commendably committed to her calling, to direct the Institute through its forward trajectory in the years to come. As President of the Institute, I see that a lot has changed at Sree Chitra in the past year – changed for the better, and admirably in sync with its mandate.

As I peruse the details of this Report and the Overview by the Director, I note that the past year witnessed several new initiatives such as the launching of the Technology Business Incubator for Medical Devices and Biomaterials and the initiation of work toward setting up a Biomedical Device Technology Research Centre. Many important Committees, comprising eminent people from premier institutions, were constituted to monitor research activities with translational value in biomedical technology. While these new initiatives held out immense promise for the future, the hospital continued to offer high quality services in Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences and Interventional Radiology. By any reckoning, the Institute did well in the realms of device development, biomedical research, patient care and public health during the past year.

While commending the Institute for its impressive performance, it is important to recognize that budgetary challenges and spiraling costs threaten to thwart the Institute's plans for a larger role as a unique research centre and major provider of high quality healthcare, particularly to the under-privileged. In the past, we had drawn strength from the staunch support of the Department of Science and Technology and successive governments at the Centre but, today, it is necessary to look beyond the government and tap multiple sources to build our financial resilience in accordance with our grand vision. Making a significant departure from the past, the Institute has drawn up elaborate plans to reach out to philanthropists and appeal to corporate conscience and sensibility to augment its resources. After all, in these trying times, 'reaching out and taking someone's hand is the beginning of a journey' with renewed vigour.

As the Institute marches on, hurdles are bound to arise but these should not dampen our unswerving commitment to our mandate. Every effort should be made to overcome the challenges, regardless of how daunting they are, and keep the system efficient and productive. As Ronald Reagan famously remarked, "there are no constraints on the human mind, no walls around the human spirit, no barriers to our progress except those we ourselves erect." The commendable accomplishments recounted in this Report speak of the extraordinary determination and teamwork of the Institute's most important asset - its faculty, the staff and students. I have no doubt that, in the times to come, each would play a valued part to ensure that Sree Chitra moves on. The future is ours to create. Let us script yet another glorious chapter for our Institute.

K M Chandrasekhar

AN OVERVIEW FROM THE DIRECTOR

As I complete my first year in office as Director, I am immensely happy to note that the values that underpinned the establishment of this Institute many years ago have been an important guide during the past year as well. From the time of its inception, Sree Chitra Tirunal Institute had set itself apart from similar institutions through its conspicuously holistic approach that encompasses high quality patient care, research in frontier areas of medical sciences, unswerving focus on indigenous and affordable technology for clinical application and engagement with public health. I take personal pride and satisfaction in being surrounded by talented individuals who cherish the common goal of not only providing high standards of patient care but also engaging in research in the key areas of neurology, cardiology, molecular cardiology, biochemistry, medical devices engineering, tissue engineering, drug delivery, bioactive ceramics, biodegradable polymers, nanotechnology and so on. All of these have significantly pushed the frontiers of knowledge in these disciplines and led to transfer of useful technology to industry that in turn reaches the common man of this country as cost-effective solutions to human ailments.

Each year, we are called upon to renew and deepen the meaning of this uncommon heritage. Last year, our major focus was on building translational research programs aimed at indigenous development of biomedical technologies at affordable costs. Toward this end, the Biomedical Technology Wing of the Institute was re-organized by integrating functionally similar laboratories into the Departments of Applied Biology, Biomaterials Science and Technology, Medical Devices Engineering, and Technology and Quality Management. The re-structuring is expected to foster integration of the R & D strategies of the groups and evolve challenging mission mode programs.

An important step relevant to the objectives of the Biomedical Technology Wing was the launch of SCTIMST-TIMed, a technology business incubator for medical devices and biomaterials, on 16th May 2015 by Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, and Earth Sciences, to promote technology incubation activity by start-up companies. The President's Committee, chaired by Prof M S Valiathan, National Research Professor and Founder of Sree Chitra, and the Research Council, chaired by Prof P Balaram, former Director, Indian Institute of Science, were set up during the year to provide direction to our researchers and to design a road map to achieve our mission in translational research and medical devices development. A Technical Research Centre for Biomedical Devices, which is one among five such initiatives of the Government of India through the Department of Science and Technology, was awarded to the Institute. The Technical Research Centre for Biomedical Devices at the Institute proposed mission mode R & D programs with translational value in the areas of cardiovascular devices, neuroprosthetic devices, hard tissue devices, in vitro diagnostics and biological and combinational products.

A project in collaboration with the Bhabha Atomic Research Centre was initiated under the Technical Research Centre for the development of an indigenous deep brain stimulation system. A major program, undertaken jointly with the Wake Forest Institute for Regenerative Medicine, North Carolina, USA, got under way for 3D bioprinting of tissue constructs for evaluation of drug toxicity. Left Ventricular Assist Device, Aortic Stent Grafts, Atrial Septal Defect Occluders, biomaterials for drug delivery and tissue regeneration were some of the other initiatives with translational potential to have been flagged off during the year. The hormone-releasing intrauterine device and the Chitra vascular graft won national innovation awards.

During the year, 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. Cardiac services included treatment of complex heart diseases and pediatric congenital cardiac problems, interventional cardiology, cardiac electrophysiology, comprehensive heart failure care, and cardiac and thoracic surgery. On the other hand, neuro services included treatment of brain tumours, developmenal brain disorders, Parkinsonism, strokes, epilepsy, dementia, neuromuscular disorders, multiple sclerosis, sleep disorders and autism. A dedicated sub-section for Pediatric Neurology was started in the Institute in July 2015 and a multidisciplinary 'Autism Clinic' catering to neuro-developmental disorders became active in August 2015. The Institute acquired a 3 Tesla MRI machine, which was inaugurated along with a well-equipped processing laboratory on 14 December 2015. Vascular surgery, cardiac and neuro anesthesia and imaging services lent a critical dimension to patient care. The Institute provided free treatment to 4% and subsidized treatment to 60% of the patients based on socio-economic background.

Academic life at the Institute never lagged behind technology development- and patient care-related engagements. The Institute continued to be a much sought-after destination for super-specialty courses leading to DM or MCh degrees and post-doctoral fellowship programs in the sub-specialties of cardiac and neurosciences. In addition, Masters and PhD courses in medical, biomedical and public health sciences drew students from all over India. Many MoUs were signed with organisations within the country and abroad.

This Report recounts the impressive quantum of work undertaken in the Institute and the outcome, gauged in terms of product development, publications, patents and research grants received from national and international agencies.

On a somber note, the grand vision of the Institute has in recent years been riddled with ominous fiscal hurdles. There is an urgent need to break free of the burden of budget deficit. In a bid to shore up the Institute's resources, an internal committee was constituted to identify and project programs for funding from philanthropists, industries and corporate bodies. The Tata Trust was quick to donate 317 lakhs for purchase of equipment for the Heart Failure-Cardiac Transplant Program of the Institute. The State Bank of Travancore made a generous gift to buttress the Cardiac Transplant Program. Donations toward patient welfare fund were also received from the staff and Pensioners' Forum. We gratefully acknowledge these timely and noble gestures that, in a sense, are an affirmation that what we do here at Sree Chitra is important and worthy of support.

As we journey forward along new directions, led by our core values, there can be pain but, make no mistake, there will be gain as well. As Henry Ford insightfully remarked, "Obstacles are those frightful things you see when you take your eyes off your goal." If we have the courage and the conviction to remain unique and pursue the path of innovation relentlessly, the outcome of our good work may even exceed our expectations. But that makes our twin commitment today - to ride out the fiscal deficit and to be productive - all the more challenging. I have no doubt that our indomitable will and extraordinary teamwork would ensure that we are the best at what we do regardless of the difficulties we may experience along the way. I look forward, with great anticipation, to all that we can accomplish in the years to come.

Asha Kishore

Highlights of the Year

- Grant-in-aid

  During the year, the Institute received Rs. 116,04,10,000/- as grant-in-aid for salary, general expenditure and creation of capital assets from the Department of Science and Technology, Government of India. In addition, an amount of Rs. 22,90,00,000/- was received towards 'Technical Research Centre (TRC) for Biomedical Devices' Initiative.

- Re-organization of BMT Wing

  The Biomedical Technology Wing of the Institute was re-structured by integrating functionally similar laboratories into four major departments: the Departments of Applied Biology, Biomaterials Science and Technology, Medical Devices Engineering, and Technology and Quality Management. The re-organization would integrate the R & D activities of the groups and evolve challenging programs with translational value.

- SCTIMST-TIMed

  SCTIMST-TIMed, the Technology Business Incubator of SCTIMST for promoting start-ups in medical devices and biomaterials, was launched on 16 May 2015 by Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, and Earth Sciences, Government of India, in the presence of Dr Ashutosh Sharma, Secretary, DST, Shri K M Chandrasekhar, President, SCTIMST, Shri T K A Nair, Chairman, Kerala State Industrial Development Corporation and other dignitaries. The first incubatee company commenced its operations at TIMed from August 2015 and the number of incubatees rose to five during the year.

- Technical Research Centre for Biomedical Devices

  The 'Technical Research Centre (TRC) for Biomedical Devices' was set up to foster mission mode research and development programs with translational potential. This is one among five such initiatives of the Government of India through DST to strengthen the core areas of Science and Technology. TRC at SCTIMST will concentrate on cardiovascular devices, neuroprosthetic devices, hard tissue devices (dental, craniofacial and orthopedic segments), in vitro diagnostics and biological and combinational products. In each of the five programs, projects were identified for translational R&D over the next five years. Apart from product development programs, TRC also includes TBI (Technology Business Incubator), MDRCF (Medical Device Regulatory Compliance Facility) and IIPC (Industry-Institute Partnership Cell).

- Important Committees were constituted to lead the Institute forward:

  a. The President's Committee, under the Chairmanship of Prof M S Valiathan, was set up in June 2015 to monitor and review research in Biomedical Technology with translational potential.

  b. The Research Council, with Prof P Balaram as Chairman, was constituted to provide direction to researchers and to design a road map to achieve the Institute's mission in medical devices development.

  c. The IT Committee was set up as an Ad hoc Committee of external experts to modernize the Information Technology Systems in the Institute.

  d. 3-3-4 Promotion: A Committee to formulate guidelines for assessment of eligibility for promotion under the 3-3-4 scheme in the three Wings of the Institute was constituted as per a Governing Body Resolution.

  e. Committee for endowment funds: An internal committee was constituted to project programs for funding from philanthropists, industries and Corporate Bodies that have funds earmarked under 'Corporate Social Responsibility'. The Committee would identify internal projects that can attract funding from non-governmental agencies.

- The following Memorandums of Understanding were signed between the Institute and organizations within the country and abroad:

  a. with the Graduate School of Medicine, Osaka City University, Japan, on 9th Oct 2015 to collaborate in academic activities, research and teaching programs.

  b. with Toyo University, Japan, on 1st September 2015 to work together towards the development of research in areas of common interest.

  c. with Technology Business Incubator for Medical Devices & Biomaterials (TIMed) on 26th September 2015.

  d. with the Association of Indian Medical Device Industry on 6th November 2015.

  e. with the Public Health Foundation of India/ Indian Institute of Public Health, Delhi, on December 28th, 2015.

f. with GE Healthcare to facilitate research in neurodegenerative and cardiac diseases.

g. with the Department of Neurosurgery, Osaka City University School of Medicine, in October 2015.

- A project in collaboration with the Bhabha Atomic Research Centre was initiated under the Technical Research Centre for the development of an indigenous deep brain stimulation system.
- A program, undertaken jointly with the Wake Forest Institute for Regenerative Medicine, North Carolina, USA, got under way for 3D bioprinting of tissue constructs for evaluation of drug toxicity.
- Left Ventricular Assist Device, Aortic Stent Grafts, Atrial Septal Defect Occluders, biomaterials for drug delivery and tissue regeneration were some of the product development initiatives with translational potential to have been flagged off during the year.
- As a joint programme supported by DBT, bioceramic scaffolds produced for bone tissue engineering entered clinical trial stage at CMC Vellore.
- A compendium of products already developed and those that are at various stages of development at the Institute was compiled to impart awareness to the medical devices industry and facilitate collaboration. Many new industry interests were received and the feasibility of partnerships are under consideration.
- A dedicated sub-section for Paediatric Neurology was started in the Institute in July 2015 and a multidisciplinary 'Autism Clinic' catering to neuro-developmental disorders became active in August 2015.
- The Institute acquired a 3 Tesla MRI machine, which was inaugurated along with a well-equipped processing laboratory, on 14 December 2015.
- An amount of 299,992 USD was received from the Michael J Fox Foundation, USA, for an Indo-German international collaborative project on genetic study in Parkinson's Disease. The Government of Kerala sanctioned a grant of Rs 4,95,56,060 for a project on the prevention and control of non-communicable diseases in Kerala. Tata Trust made a generous donation of 317 lakhs for the purchase of equipment for the Heart Failure-Cardiac Transplant Program of the Institute. The State Bank of Travancore gifted an amount of 10 lakhs for the Cardiac Transplant Program.
- COFRAC, the French Accreditation Agency, carried out surveillance assessment in October 2015 and extended the accreditation of the Institute's testing services as per ISO 17025 until May, 2018.
- Steps were initiated to update and revise the Service and Personnel Conduct Rules, Recruitment Rules and Modified Flexible Complimenting Promotion Rules of non-academic staff, and correct the discrepancies in the Pay Structure Review Committee Report dated 22.07.2010, 24.08.2012 and 15.07.2013.
- About 163 research papers were published and 13 Indian patent applications were filed during the year.
- The hormone-releasing intrauterine device and the Chitra vascular graft won national innovation awards.
- A novel mechanism of regulation of collagen gene expression in cardiac fibroblasts, published in the prestigious Journal of Molecular and Cellular Cardiology in January 2016, attracted a special editorial in the February issue of the same journal, which stressed the translational potential of the findings in targeting cardiac fibrosis.
- Many important events were organized:

a. The SCTIMST-TIMed Technology Business Incubator for medical technologies was introduced to the Indian medical device industry and other important stakeholders such as NHSRC, ICMR, DST, DBT, NHHID at a meeting held at the India Habitat Centre on 6th November 2015.

b. The Institute show-cased its activities at the India International Science Festival 2015, held from 4-8 December 2015 at IIT, Delhi. Prof Ashutosh Sharma, Secretary, DST and Dr Praveer Asthana, Adviser, DST, visited the exhibition stall of SCTIMST.

c. The 3rd G Parthasarathi Oration was delivered by Prof M S Valiathan, National Research Professor and Founder of SCTIMST, on November 30, 2015.

d. Hindi Fortnight Celebrations of the Institute were held from 14th September 2015. A conversational Hindi Workshop for the employees of the Institute was also organized as part of the celebrations.

- The Institute had many distinguished visitors who contributed in different ways to the ongoing programmes. A list of important visitors is provided in this Report separately.

Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, and Earth Sciences, Government of India, inaugurating the new Medical Devices Engineering Block, named after Dr M S Valiathan in the Satelmond Palace Campus of SCTIMST on 16 May 2015

Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, and Earth Sciences, Government of India, launching the Technology Business Incubator SCTIMST-TIMed in the Biomedical Technology Wing on 16 May 2015

Dr Harsh Vardhan, Hon'ble Union Minister of Science and Technology, and Earth Sciences, Government of India, delivering the convocation address

Prof M S Valiathan, National Research Professor and Founder of SCTIMST, delivering the 3rd G Parthasarathi Oration on 30 November 2015

The Principal Investigators of the Technical Research Centre for Biomedical Devices along with the Research Council members during the flag off function

Meeting of the representatives of the Association of Indian Medical Device Industry and SCTIMST on 6 November 2015

The National Science Day celebration on 25 February 2016 in the Biomedical Technology Wing of SCTIMST, hosting school students. The program included lectures by the faculty, science quiz and lab visit.

HOSPITAL WING

HOSPITAL ADMINISTRATION

The annual statistics of hospital services for the year is shown in Figures 1-6. During the year, various services in Cardiology, Neurology, Cardiac Surgery, Neurosurgery and Imaging Sciences & Interventional Radiology registered 17,523 new patients (Figure 1). A total of 11,236 patients were admitted during the year for treatment, including surgical and interventional procedures (Figure 1). OPD services registered 1,61,990 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 4% and subsidized treatment to 60% of the patients based on socio-economic background. The bed occupancy rate and the bed turnover increased while keeping the average length of stay at 7, which indicated the stretching of the facility to accommodate increasing patient load in the hospital.

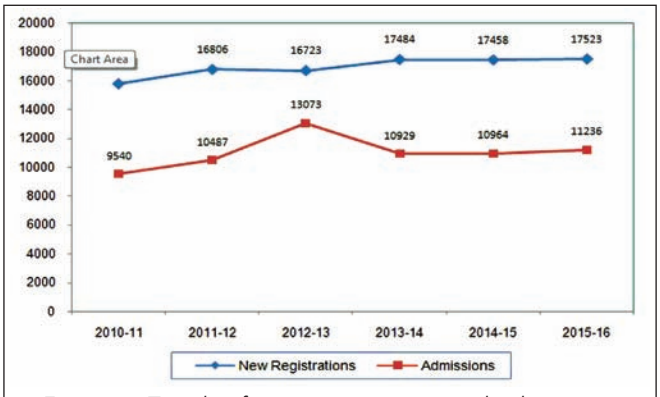


Figure 1. Trends of new registrations and admissions

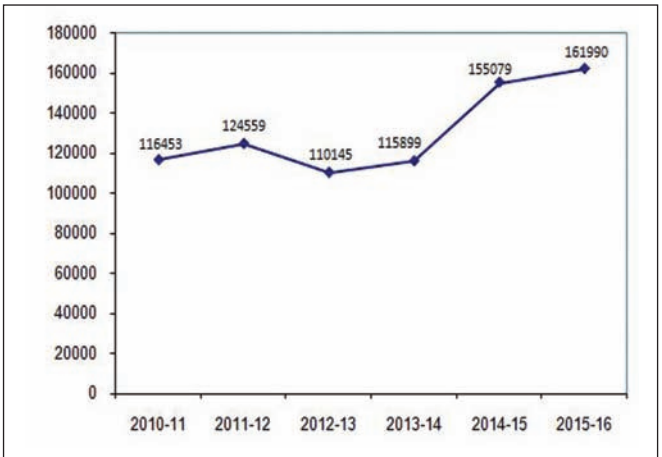


Figure 2. Trend of review out patient visits

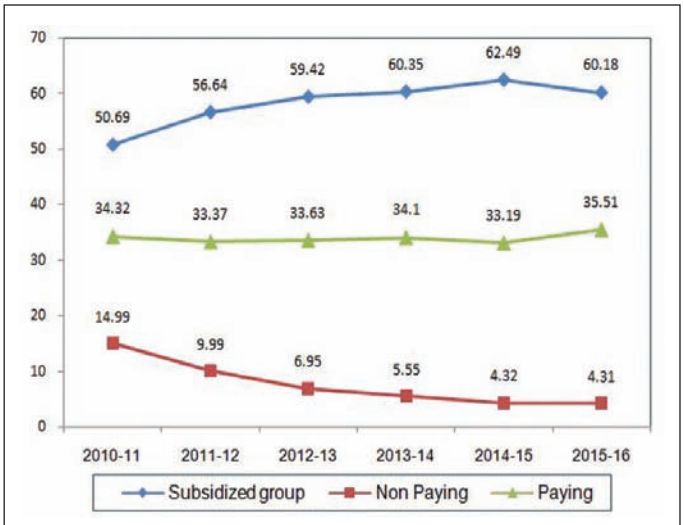


Figure 3. Trends of paying, non-paying and subsidized treatment groups

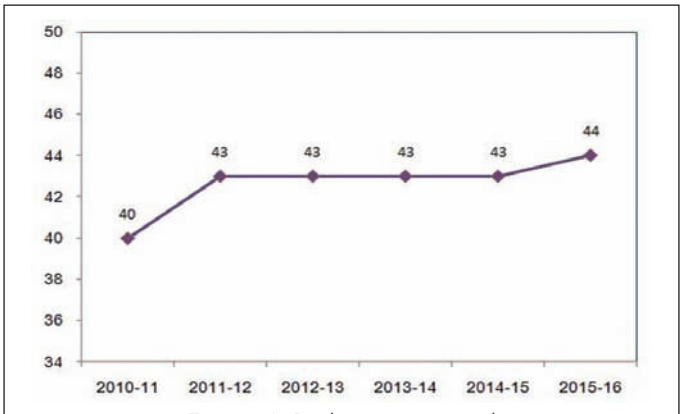


Figure 4. Bed turnover trend

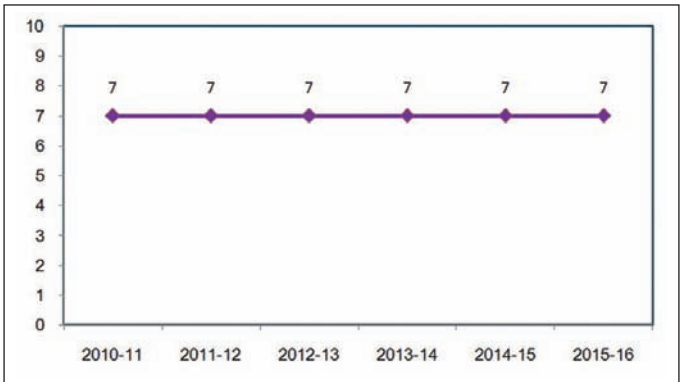


Figure 5. Average length of hospital stay

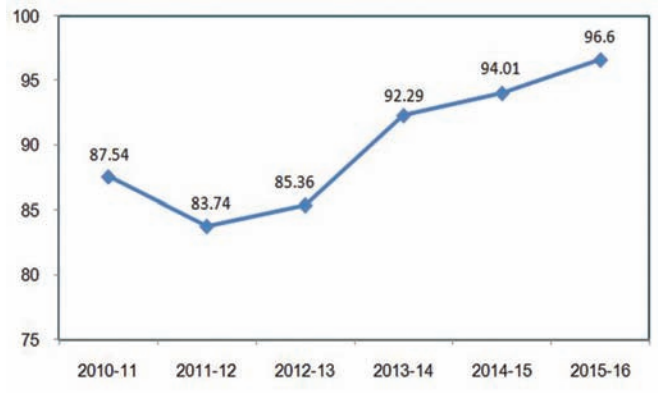


Figure 6. Bed occupancy rate

Activities

The Institute was able to utilize the following sources of financial support to patients:

Scheme	Number of Patients	
	IP	OP
Karunya	24484	0
RBSK	1689	36700
Thalolam	1036	0
CHIS PLUS	1319	0
Other Schemes	242	4064
Total	28770	40764

Infection Control Programme

The Infection Control Unit, along with the infection control nurse, carried out surveillance in the hospital regularly and facilitated infection control activities. The Institute deputed an infection control nurse to Tata Memorial Hospital, Mumbai, for training in hospital infection control programme.

Staff Welfare Programmes

A building to accommodate the hospital canteen, gymnasium, convention hall, co-operative society office and yoga centre was ready for inauguration.

National Knowledge Network

The Institute, which is connected to the National Knowledge Network, participated in 16 CMEs, 8 tele-education sessions, 10 meetings/discussions, 3 PhD programmes and 1 international software demonstration organized by other national institutions like AIIMS New Delhi, ISRO Ahmedabad, IIT Kharagpur, CMC Vellore, Research Institute Hyderabad, IIT Chennai, GE Healthcare and NIMS Hyderabad.

Institute Day Celebrations

Institute Day was celebrated on 18 April 2015. The competition among the staff and residents for the best paper was organized and prizes were distributed. Dr Suresh Das, Executive Vice-President, Kerala State Council for Science, Technology and Environment, delivered the keynote address at the function. A walkathon by staff and students was also organized in connection with the celebrations.

New Initiatives

The imageology complex was renovated with the addition of 3T MRI. The facility was inaugurated on 14 December 2015 by Shri K M Chandrasekhar, President of the Institute and Vice-Chairman, Kerala State Planning Board.

There was progress towards initiation of the heart transplantation programme.

The Institute implemented the e-gateway for receiving the payment for hospital services, which was inaugurated on 16 May 2015 by Dr Harsh Vardhan, Honorable Minister for Science and Technology and Earth Sciences, Government of India.

A guesthouse was inaugurated in the Staff Quarters campus for guests and officials of the Institute.

A crèche was started for the children of employees on 9 April 2015 in the hostel campus of the Institute.

Events organized by the Department

Hand Hygiene Day was observed on 5 May 2015 with TV displays on the importance of hand hygiene, ward visits, distribution of badges and education programmes for the staff.

The Institute undertook activities related to the Swatch Bharat Mission on 2 October 2015. The staff of the Institute read out the pledge, and tree saplings were planted in the Institute. A cleaning drive was also initiated.

Staff

Hospital Administration

Dr Sarada C, Medical Superintendent

Dr Kavita Raja, Associate Medical Superintendent

Dr S K Jawahar, Deputy Medical Superintendent

Nursing Services

Dr Sudhamani Amma S, Nursing Officer - A

Ms Valsala Kumari C, Senior Nursing Supervisor

Ms Saraswathy Amma C, Senior Nursing Supervisor

Ms Padmaja Devi S S, 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

Computer Division

Dr Geetha G, Scientist G

Construction Wing

Col Vijayan Pillai K (Retd), Construction Engineer

Mr Gopinathakurup G, Assistant Executive Engineer

Security & Safety

Mr Hemanth Kumar RP, Assistant Security & Safety Officer-B

Dietary

Ms Leena Thomas, Senior Dietician

Ms Jyothi Lekshmy S, Assistant Dietician

Laundry

Mr Umesh Sankar S, Laundry Supervisor

Medical Social Services

Dr Jayachandran D, Scientific Officer

Dr Usha Kandaswamy, Scientific Officer

Ms Rosamma Manuel, Junior Scientific Officer

Medical Records

Mr Thampi N G, Senior Medical Records Officer

Pharmacy

Ms Rosily Joseph, Pharmacist (Gr.I)

Transport

Mr Saji M S, Transport-in-Charge

Medical Records Department

The Medical Records Department continued to play a role in advanced health care, academic and research activities, maintaining confidentiality of health information and efficient management of hospital services.

Activities

Documenting and updating patient data and maintenance of a staggered appointment system.

Processing and maintenance of Electronic Medical Records.

Performing deficiency check, ICD-coding and indexing of diseases and procedures.

Providing hospital-related statistics for administrative, academic and research activities.

Handling patient care-related correspondence, including issue of certificates.

Reporting hospitalized overseas patients to Foreigners' Regional Registration Officer and deaths to Corporation of Thiruvananthapuram.

Conducting academic programme in Medical Records Science.

New Initiatives

The Electronic Medical Records system was extended to all clinical services.

Staff

Mr N G Thampi, Senior Medical Records Officer & Assistant PIO (patient care)

Mr Jesudin M Arul Radjvy, Medical Records Officer

The statistics for the year 2015-16 are summarized in the Table below.

Category	Number
Reviews	161990
Records analysed, coded and indexed	28727
Electronic Medical Records processed	23294
Records scanned and uploaded	21000
New Registration	17523
Admissions	11236
Certificates processed/issued	8745
Records retrieved for study/research	8218
Bed turnover	44 patients
Average length of stay	7 days
Bed occupancy	96%

Nursing Service Division

Nursing Service Division is committed to providing high quality patient care and ensuring patient safety. Its important mission is to bring innovation through evidence-based practice, and to impart care with efficiency, devotion, compassion and empathy. The Division mentors about 200 observers every year from nearly thirty institutions all over India.

Activities

Providing high standards of holistic care to patients to meet realistic goals and care needs.

Mentor and evaluate the performance of students and observers.

Carry out patient and family education for effective home care management.

Conduct structured short-term training programmes for staff development.

Events organized by the Department

The International Nurses' Week was celebrated on 12 May 2015 at the Institute.

A State level nursing education programme on 'Comprehensive Nursing Management in Stroke' was organised on 24 October 2015 at the Diamond Jubilee Auditorium, Medical College, Trivandrum.

A CNE on 'Cardiac Nursing - a Review' was conducted on 28 June 2016 at SCTIMST with over 130 participants.

Staff

Dr Sudhamani Amma S, Nursing Officer - A

Ms Valsala Kumari C, Senior Nursing Supervisor

Ms Saraswathy Amma C, Senior Nursing Supervisor

Ms Padmaja Devi S S, Senior Nursing Supervisor

Physical Medicine and Rehabilitation

The Department of Physical Medicine and Rehabilitation plays a seminal role in the rehabilitation of inpatients and outpatients with physical disabilities and patients in the ICU. It actively supports neurocare by offering neuro-rehabilitation services to patients and participates in the multi-disciplinary Pain Clinic Facility.

Activities

The Department is well-equipped with exercise equipment, posturography system equipment and virtual reality system. At present, it functions with a team of one physiatrist and five physiotherapists.

Faculty

Dr U Nandakumaran Nair, Visiting Professor

Technical

Ms Deepa, Senior Physiotherapist
Dr Vijesh P V, Physiotherapist - B
Mr Aji, Physiotherapist - A
Mr Rahool, Physiotherapist - A
Ms Jijimol George, Physiotherapist - A

DEPARTMENT OF ANAESTHESIOLOGY

NEUROANAESTHESIOLOGY

Neuroanaesthesia Division was actively involved in patient care at operation theatres, and radiological intervention suite. It provided anaesthesia services ranging from general anaesthesia, regional blocks, and total intravenous anaesthesia to monitored awake surgeries.

Activities

The Department was actively involved in managing intensive care of patients of neurosurgical and radiological intervention procedures, stroke and various neuroinvestigational procedures as indicated in the Table below. The outpatient services for investigational procedures and pre-operative clinics for assessment of patients for surgery were also undertaken.

Location	Number
Neurosurgery operation theatre	1629
Neurosurgery ICU	1400
MRI	456
Digital Subtraction Angiography	270
Intervention Radiology ICU	170
Neuromedical ICU	138
Stroke ICU	53

One of the major challenges in patient management is treatment of post-operative pain, especially in neurosurgical patients. A new 'Acute Pain Relief' programme was initiated to alleviate pain in these patients. The programme includes novel methods of pain relief, like patient-controlled analgesia (PCA) by dedicated PCA pumps bought this year.

Academic activities consisted of didactic lectures, pros and cons sessions, and research activities that included postgraduate resident thesis work. Faculty and senior residents participated in various conferences related to neuroanaesthesia and got recognition for their contributions. The academic schedule and teaching programmes were modified, and morning academic classes were introduced to keep pace with the expanding scientific research happening around the world.

New Initiatives

The development of a flexible ultrasound probe holder for central venous cannulation is under way. This would facilitate the handling of ultrasound probes during central venous cannulation to improve success rates and avoid complications.

Awards and Honours

Dr Ajayprasad Hrishi secured the Kop's Award for the best scientific paper in Neuroanaesthesia at ISACON, Jaipur, and first prize for the poster titled "TEE in Neuroanaesthesia" at the 10th Annual Perioperative and Critical Care Transesophageal Echocardiography Workshop, Chandigarh.

Faculty

Dr S Manikandan, Additional Professor

Dr Smita Vimala, Assistant Professor

Dr Arulvelan A, Assistant Professor

Dr Ajayprasad Hrishi, Assistant Professor

Dr Unnikrishnan P, Assistant Professor

CARDIOTHORACIC & VASCULAR ANAESTHESIOLOGY

The Department continued to focus on cardiothoracic and vascular anaesthesia and intensive care, providing high quality anaesthesia and peri-procedural care. The Department conducts quality resident training programmes in cardiothoracic and vascular anaesthesia and promotes clinical and biomedical technology research.

During the last year, the Department aimed to have structured initiatives like Anesthesia Critical Care programme and Minimally Invasive Cardiac Surgical programme (in collaboration with the Department of Cardiaothoracic Surgery); Comprehensive Heart Failure programme (in collaboration with the Department of Cardiology), and acute pain services. Other initiatives included transesophageal echocardiography (TEE) for surgical patients, fellowship courses in TEE and a new programme on hybrid procedures (in collaboration with Vascular Surgery and Interventional Radiology).

Activities

Anaesthesia was provided for the following surgeries and procedures:

Location/Procedure	Number
Adult cardiac surgery operation theatre	1275
Paediatric cardiac surgery operation theatre	663
Cardiac Catheterization Laboratory	535
Electrophysiology Laboratory	36
Cardiac MRI	44
Cardiac CT/aortogram/pulmonary angiogram	93
Digital Subtraction Angiography	39
Cardiac medical and paediatric surgical ICU	50
Percutaneous Tracheostomy	10
Transesophageal Echocardiography	18

New Initiatives

Use of ultrasound-guided paravertebral block in paediatric patients undergoing open-heart surgery resulted in a shorter period of post-operative ventilation.

Transthoracic echocardiography was used extensively in post-operative cardiac surgical intensive care units.

Commencement of round-the-clock duty in paediatric surgical ICU for anaesthesia residents followed by case presentation during morning rounds.

Events organized by the Department

The Department organized a 'Focused Basic Transesophageal Echocardiography-cum- Live Workshop' on 6 August 2015 at SCTIMST.

Awards and Honours

Dr Rupa Sreedhar received the Dr Kop's Award for the best paper at the Annual National Conference of Indian Society of Anaesthesiology ISACON, 25-29 December 2015, Jaipur.

Dr Suddhadeb Roy, DM resident was awarded the first prize for his presentation on "Echocardiographic Anatomy of Tricuspid Valve" at the 9th National Transesophageal Echocardiography Workshop, 21-23 August 2015, Bengaluru.

The DM cardiac anaesthesia residents, Dr Manjusha Pillai and Dr Saravana Babu, were the recipients of second and third prizes, respectively, for posters at the 10th Annual Perioperative and Critical Care Transesophageal Echocardiography Workshop, 26-28 February 2016, Chandigarh.

The DM cardiac anaesthesia residents, Dr Keerthi Chigurupati and Dr Kirubanand S, won first and second prizes, respectively, for their papers at the Science Fete, April 2015 at SCTIMST.

Faculty

Dr Rupa Sreedhar, Professor & Head of the Department
Dr Thomas Koshy, Professor
Dr Shrinivas V Gadhinglajkar, Professor
Dr Prasanta Kumar Dash, Additional Professor
Dr P R Suneel, Additional Professor
Dr K P Unnikrishnan, Associate Professor
Dr Subin Sukesan, Assistant Professor

DEPARTMENT OF BIOCHEMISTRY

The Department focuses on two important areas: laboratory services for patient care and research on disease biology. The Central Clinical Laboratory undertakes diagnostic laboratory services comprising biochemistry, haematology and clinical pathology. The research activities pursue the molecular basis of disease processes operating through multiple systems leading to neurological and cardiovascular disorders. The three areas of investigation are: a) identifying macromolecules involved in carbohydrate-dependent biological recognition events and elucidating the basis of their vascular inflammatory potential, b) study of dysfunctional and structurally modified high-density lipoprotein and their contribution to atherosclerotic cardiovascular diseases, and c) the role of mitochondrial dysfunction in complications of diabetic heart and progression of Alzheimer's disease.

Activities

The Central Clinical Laboratory performed 912101 tests during the year, an 11% increase from the previous year. Fully automated, state-of-the-art equipments used for clinical services include Dade-Behring / Siemens RXL, Olympus AU 400 clinical chemistry analysers, Beckman 5 part and IRIS I-COUNT differential haematology analysers, Roche U 411 urine analyser and Amax coagulation analyser. The category- wise break-up of the tests is as below:

Category	Number
General Chemistry	378685
Haematology and coagulation tests	353836
Urine analysis	144149
Automated blood gas analysis	27740
CSF analysis	7555
Stool examination	128
Neurochemistry	8
Total	912101

Research Programmes

1. Serum antibody-mediated uptake of lipoprotein (a) into macrophages

Previously, the Division had reported presence in circulation of human-specific anti-αgalactoside antibody (anti-Gal) immune complex (IC) with free form of lipoprotein(a) [Lp(a)], the most atherogenic of lipoproteins. This year, the results showed that unoccupied binding sites of anti-Gal in the above ICs enable their anchoring on specific receptors on macrophages, thereby offering a route for Lp(a) uptake.

2. Novel plasma glycoproteins that link albumin with anti-carbohydrate antibodies

All samples of anti-Gal and anti-αglucan antibody isolated from normal plasma by affinity chromatography contained albumin as well as heavily O-glycosylated glycoproteins GP1 or GP2. Each glycoprotein was simultaneously bound to both the antigen-binding site of the antibody and albumin to form a triplet with the glycoprotein acting as linker. Close to 50% of normal plasma albumin was bound to either GP1 or GP2.

3. Smaller Lp(a) molecules form immune complex with anti-Gal

Small Lp(a) phenotype predisposes to atherosclerosis though the underlying molecular mechanisms are unclear. The laboratory recently reported that large Lp(a) molecules with vast serine and threonine-rich peptide sequences carry non-covalently attached extra LDL molecules. It was also demonstrated that this occupation is the reason for protection of large Lp(a) molecules from IC formation with anti-Gal, thus explaining the relatively increased atherogenicity in small Lp(a) individuals.

4. Dysfunctional high-density lipoprotein (HDL) and atherosclerotic coronary artery disease (CAD)

Modified or 'dysfunctional' HDL from patients with established CAD, in contrast to HDL from healthy subjects, was found to be pro-atherogenic. It promoted oxidative stress and cholesterol influx in human macrophages via a mechanism that involves macrophage scavenger receptor CD36 and ERK1/2 MAPK pathway, thereby favouring lipid accumulation and foam cell formation (Figure 7). HDL functional capacity might provide an alternative mechanism for therapeutic modulation of the HDL pathway beyond HDL concentration to help reduce risk of coronary heart disease.

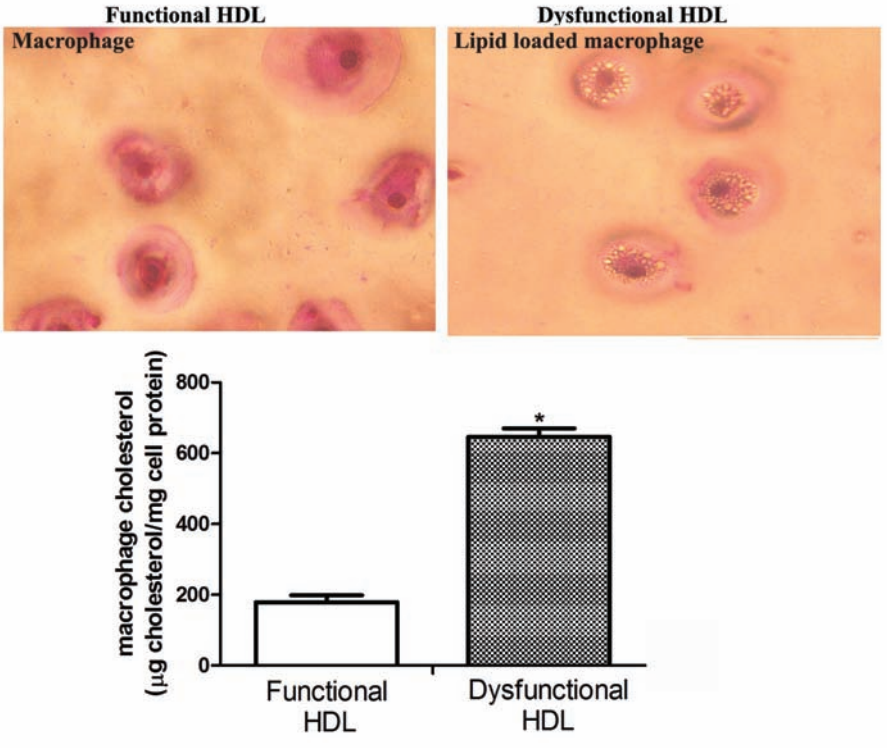


Figure 7. Dysfunctional HDL induces cholesterol accumulation and foam cell formation in human macrophages

5. Monocyte phenotypes and inflammatory markers in young patients with coronary artery disease (CAD): A case-control study (in collaboration with the Department of Cardiology)

Elevated levels of blood myeloperoxidase, a leukocyte enzyme that promotes oxidation of lipoproteins in atheroma, is associated with the presence of CAD, thereby suggesting its potential role as an inflammatory marker. Characterization of surface expression of markers, CD14 and CD16, in blood monocytes showed an enhancement in the non-classical monocyte subset (both CD14 and CD16 expressed) with a concomitant decrease in the classical monocyte subset (only CD14 expression) in patients presenting mainly with acute coronary syndrome. Non-classical monocytes might be triggering adverse coronary events or driving the myocardium to salvage, which needs more evidence.

6. Amino acid analysis in blood

Standardization of the quantitative analysis of different amino acids and their derivatives was initiated for detection and monitoring of metabolic diseases and inborn errors of metabolism.

7. Impairment of autophagy during hyperglycemia mediates alterations in cardiac mitochondrial respiration

Impairment of autophagic process was observed in H9c2 cells under high glucose condition. Addition of an autophagy inhibitor, chloroquine, significantly reduced the basal cell respiration that was restored by the autophagy activator, resveratrol. Hence, in diabetes, the role of autophagy, especially mitophagy, in the control of mitochondrial respiration in cardiomyocytes has gained much importance.

8. Mitochondrial fatty acid oxidation and oxidative phosphorylation complex activity in diabetic mice heart

Cardiac expression of long chain acyl CoA dehydrogenase (ACADL) was elevated in early phase of diabetes and reduced in later phases. However, the expression of CD36, the facilitator of fatty acid uptake, was unchanged in the latter, indicating lowered fatty acid oxidation in late phase of diabetes, irrespective of fatty acid uptake (Figure 8). Another finding was higher succinate dehydrogenase (SDH) activity in late phase of diabetes than in the corresponding control.

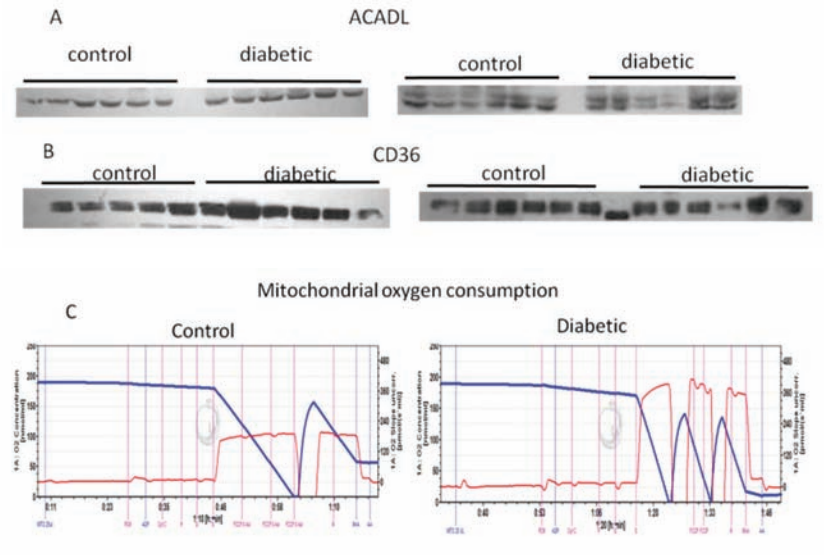


Figure 8. Cardiac expression of ACADL and CD36 in early and late phases of untreated diabetes (A, B). Mitochondrial oxygen flux in late stage of diabetic heart with corresponding control (C).

9. Effect of oxidative stress on the phagocytic efficiency of amyloid-beta (Aβ in macrophages

Aging is associated with increased oxidative stress and this might play an important role in the phagocytic inefficiency of peripheral macrophages in Alzheimer's disease (AD). Macrophages from AD, Mild Cognitive Impairment and age-matched control samples were analysed for their efficiency of FITC-Aαuptake. Differentiated THP-1 cells were used to standardize the Aαuptake efficiency after inducing oxidative stress (Figure 9).

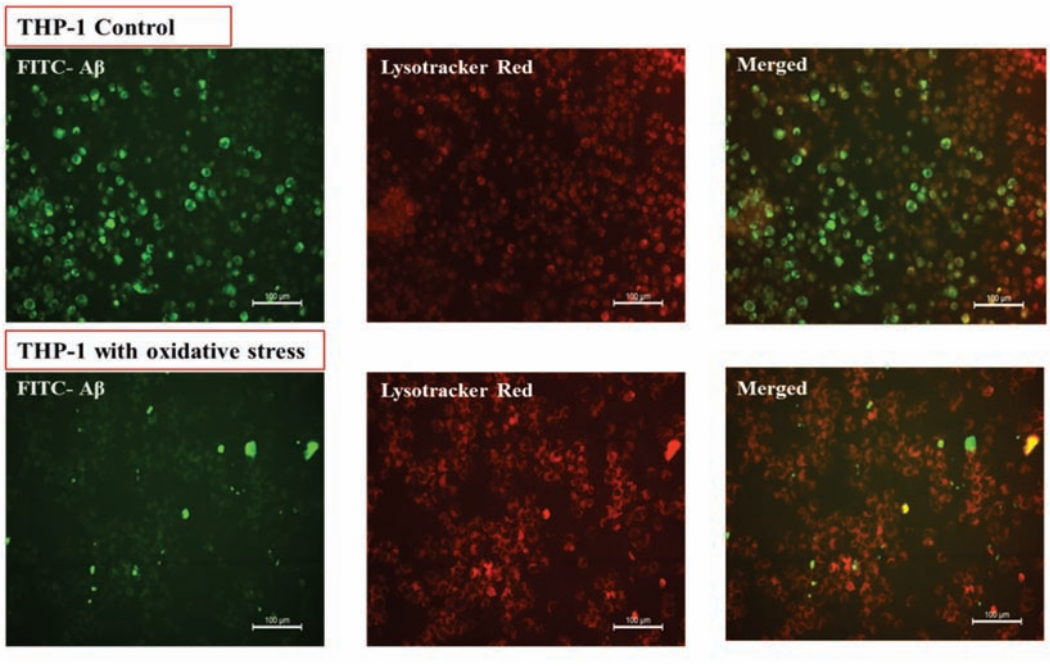


Figure 9. Effect of oxidative stress on the phagocytic efficiency of amyloid-beta in macrophages

New Initiatives

An MoU was signed between SCTIMST and Regional Cancer Centre, Trivandrum, to work jointly on a project titled, "Can increased anti-galactoside antibody activity observed in small lipoprotein (a) phenotype individuals protect against cancer?". The investigators from SCTIMST are Dr P S Appukuttan and Ms Jessy John and are Dr Kurian Cherian (Surgical Oncology) and Dr Abraham Thomas (Clinical Biochemistry) from RCC.

Awards and Honours

Ms Sini S, INSPIRE Fellow, Department of Biochemistry, won the second prize for the paper titled "Dysfunctional high-density lipoprotein induces foam cell formation and oxidative stress in macrophages via CD36-ERK1/2-MAPK pathway" at the National Seminar BIOSPARK '15 on 12 August 2015, M G University, Kottayam.

Faculty

Dr Appukuttan P S, Professor (Senior Grade) & Head of the Department

Dr Jayakumari N, Professor

Dr Srinivas G, Scientist E

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

Ms 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 continued to provide state-of-the art patient care, along with research and academic programmes during this period. Apart from the ongoing training programmes (6 DM trainees, 3 post-DM trainees and 3 cath-lab technical trainees/year), the Department conducted various Workshops, initiated new research programmes, and published the research work in indexed medical journals.

DIVISION OF ADULT CARDIOLOGY AND INTERVENTION

The section mainly dealt with interventions for coronary artery disease and structural and valvular heart disease. The Division performed about 700 coronary interventions during this period, in keeping with its position as a major interventional centre. Left main interventions and rotablations were done routinely. The state-of-the-art technologies such as Intravascular Ultrasound (IVUS), Optical Coherence Tomography (OCT) and Fractional Flow Reserve (FFR) estimation guided these interventions. Structural heart disease interventions, including device closure of paravalvular leaks, and percutaneous closure of congenital and acquired defects were executed. The section continued to be a large volume centre for balloon mitral valvotomy that was performed in 100 patients, including high-risk cases.

DIVISION OF CARDIAC ELECTROPHYSIOLOGY

The Division maintained its reputation as one of the best interventional electrophysiology centres in the country for the management of cardiac arrhythmias. The Division focused on expanding its expertise in ventricular tachycardia (VT) ablation, performing more than 400 radiofrequency ablations and electrophysiology procedures. Use of 3D electro anatomical mapping systems, CARTO 3 and Ensite velocity (Figure 10) aided the complex ablation procedures. In addition, the device clinic performed about 280 device implantations (including ICDs and cardiac resynchronization therapy devices) and followed-up nearly two thousand cases. This is also the most sought after training facility in the country for post-doctoral training in cardiac electrophysiology. The request by Asia Pacific Heart Rhythm Society for an additional seat in Post-doctoral Fellowship in Electrophysiology is under process.

Figure 10. 3D Ensite image from EP Lab

Regular electro-anatomical ablation sessions were organized for electrophysiologists interested in developing these programmes in their institutions. The Division is also the co-ordinating centre for a nation-wide channelopathy registry, which catalogues various causes of inherited abnormalities of cardiac ion channel functions that predispose to sudden cardiac death at a young age. The editorial office of the indexed medical journal, Indian Pacing and Electrophysiology (Elsevier Publishers), is housed in the Division.

DIVISION OF PAEDIATRIC CARDIOLOGY

The Division caters to the entire spectrum of congenital heart diseases from "fetus to adult". The range of device closure cases broadened from simple defects like atrial septal defect and patent ductus arteriosus to complex procedures, including closure of ventricular septal defect, coronary arterio-venous fistula and ruptured sinus of Valsalva aneurysms. There was an increase in the number of procedures for critically ill newborns with congenital heart diseases, including emergency balloon atrial septostomy, ductal stenting and balloon valvotomy. Besides providing diagnostic echocardiography and interventions round the clock, a comprehensive neonate outpatient clinic was also started. The Department continued to offer advanced training to residents and fellows in various diagnostic and therapeutic interventions.

The procedures performed by the Department during 2015-16 are listed below:

Procedure	Number
Diagnostic Procedures	
Coronary angiogram	1521
Catheterisation	144
EPS	85
Total	1750
Interventional Procedures	
Coronary intervention (PCI)	632
EPS+ RF ablation	332
ASD device closure	228
PDA device closure	128
Balloon mitral valve	97
Balloon atrial septostomy	33
Balloon pulmonary valve	30
PDA stenting	13
Pericardial aspiration	12
Balloon aortic valve	11
CoA stenting	8
VSD device closure	7
IVC filter	6
PDA coil closure	4
MAPCA coil closure	2
Alcohol septal ablation	2
Biopsy	2
VSD + PDA device closure	1
DTA balloon	1
AV fistula closure	1
Total	1550
FFR	106
OCT	20
IVUS	35
ROTA	9
Pacemaker Implantation	
Pacemaker	207
ICD implantation	66
CRT implantation	40
Others	12
TPI	10
Total	335
Grand Total	3635

Comprehensive Heart Failure Intervention Programme

This is dedicated to the evaluation and management of heart failure patients and to provide impetus to the heart transplant programme. The heart failure clinic has registered more than 450 patients, providing us with valuable information on optimization of their management. Besides providing quality care for these patients, the programme is poised to make the Institute a nodal centre for advanced heart failure care in this region. Supported by ICMR, the programme has completed the two year follow-up data collection of the first ever heart failure registry (Trivandrum Heart Failure Registry) in the country encompassing all admissions with heart failure in Trivandrum urban area and Athiyannoor block panchayat, a rural area in Trivandrum District. The 1205 patient cohort enrolled in the registry is in their third year of follow-up. The dedicated Heart Failure (HF) ICU (Figure 11) is functioning and will support the cardiac transplant programme. The TATA Trust was kind enough to allocate funds of 3.17 crores to the Institute's Heart Transplant Programme.

Figure 11. New Heart Failure ICU

New Initiatives

Use of percutaneous left atrial appendage occlusion to reduce the risk of stroke in patients with atrial fibrillation having contraindications for oral anticoagulants.

Percutaneous closure of atrial septal defects without fluoroscopy.

Paediatric ablation programme in children with refractory cardiac arrhythmias.

Events organized by the Department

"Back to Basics" - A simulator-based coronary intervention training programme for Fellows in Cardiology, organised on 20-21 December 2015 at SCTIMST, was attended by 70 DM and DNB trainees from various parts of India. The faculty comprised experts in Interventional Cardiology, mostly SCTIMST alumni.

Dr Ranjan Shetty, Kasturba Medical College, Manipal, conducted a Workshop on left atrial appendage device closure in patients with atrial fibrillation in November 2015.

Dr Neeraj Verma, Consultant Electrophysiologist, Mayo Clinic, conducted a Workshop on cardiac resynchronisation therapy.

Dr Roy John, Consultant Electrophysiologist, Boston Medical School, participated in a Workshop on complex arrhythmia.

Dr Sang Wook Kim from South Korea visited the Department on July 11, 2015 and performed OCT imaging-guided coronary interventions. Two members of the core-lab team from Korea also visited the Department and imparted training in IVUS to the cath lab staff.

Dr R Yoshikawa, Sapporo Cardiovascular Clinic and Dr Y Noguchi, Tsukuba University, Japan, visited the hospital and shared their experiences in coronary angioplasty in chronic total occlusions.

The first national 'Coronary Imaging and Physiology Conference' was organised by SCTIMST on 11-12 July 2015. Drs Ajith Kumar and Harikrishnan were the organising Chairperson and Secretary, respectively. Experts from abroad and India, and 200 delegates attended the meeting and took part in the discussions. The demonstration of imaging-guided coronary interventions was transmitted live from SCTIMST to the venue

The Annual Fellows Programme of the Cardiological Society of India was organised by the Department on 20-21 June 2015. It was a well-attended event with reputed cardiologists from all over the country as faculty.

The Division of Cardiac Electrophysiology organized the 7th annual conference of Indian Heart Rhythm Society between 30 October and 1 November 2015 at Trivandrum.

Awards and Honours

Dr Ajit Kumar V K was co-opted as Member of Research Committee, Asia Pacific Heart Rhythm Society and Devices Advisory Committee, Government of India.

Dr Narayanan Namboodiri was appointed Editor-in-Chief of Indian Pacing and Electrophysiology Journal and Member of 'Guidelines and Writing Group' of Asia Pacific Heart Rhythm Society in January 2016.

Faculty

Dr Jaganmohan A Tharakan, Professor (Senior Grade) & Head of the Department

Dr Ajit Kumar V K, Professor

Dr Sivasankaran S, Professor

Dr Krishna Moorthy K M, Additional Professor

Dr Harikrishnan S, Additional Professor

Dr Narayanan Namboodiri K K, Additional Professor

Dr Bijulal S, Associate Professor

Dr Anees T, Associate Professor

Dr Sanjay G, Assistant Professor

Dr Venkateswaran S, Assistant Professor
(till December 2015)

Dr Abhilash S P, Assistant Professor

Dr Krishna Kumar M, Assistant Professor

Dr Deepa Kumar, Assistant Professor

Paramedical/Technical

Mr Suji K, Scientific Officer

Mr Subrahmoniam H R, Junior Technical Officer

Ms Resmy P V , Technical Assistant - B

Ms Sheeja S, Technical Assistant - A

Ms Sethu Parvathy, Technical Assistant - A

Ms Rasmi Mohan, Technical Assistant - A

Mr Midhun S V, Technical Assistant - A

DEPARTMENT OF CARDIOVASCULAR AND THORACIC SURGERY

The Department continued to provide general cardiac surgical services with renewed focus on new and emerging thrust areas. The heart failure and transplant programmes had major initiatives for infrastructure, work-up and listing of eligible candidates. The paediatric cardiac surgical programme received additional intensive care beds to cater to the ever-increasing number of neonatal operations. The Heart Team was established as part of initiation of transcatheter aortic valve implantation programme. The endovascular aneurysm programme continued to be one of the best in this part of the country with excellent clinical outcomes. The Department also collaborated with the Biomedical Technology Wing and initiated programmes for the development of left ventricular assist devices, centrifugal pumps and mitral annuloplasty rings.

Activities

During the year, 1838 cardiovascular and thoracic surgeries were performed, of which 1451 were open heart procedures. The details are furnished below:

Type	Number
Adult Cardiac Surgeries	
Open Heart	976
Closed Heart	261
Congenital Cardiac Surgeries	
Open Heart	475

Adult Cardiac Surgeries

The open heart surgeries performed included:

1. Coronary artery bypass surgery – On pump and Off pump
2. Mitral valve repair – simple and complex
3. Valve replacement surgery – mitral, aortic and double
4. Ascending aortic and root aneurysm repair
5. Adult congenital heart disease

The closed heart operations performed included:

1. Surgeries for complex aortic aneurysms and aorto-iliac occlusive diseases
2. Lung surgery including video-assisted thoracoscopic surgery (VATS)
3. Beating heart surgeries
4. Coarctation repair - adult and paediatric
5. Patent Ductus Arteriosus (PDA) division - adult and paediatric
6. Blalock-Taussig (BT) shunt operation
7. Carotid endarterectomies

Congenital Cardiac Surgeries

These included all simple and complicated cardiac surgeries of infants and children. Nearly 60% of cases were done on neonates. A novel mini-sternotomy approach for minimally invasive approach was adopted for simple procedures. The operations performed included:

1. Transposition of the Great Arteries (TGA) operations - Switch and Sennings
2. Norwood operation for Hypoplastic left heart syndrome (HLHS)
3. Surgeries for Tetralogy of Fallot (TOF)
4. Ventricular septal defect (VSD) and atrial septal defect (ASD) closures
5. Intra-cardiac repair (ICR) for atrioventricular (AV) canal defects
6. Rastelli operation
7. Single ventricular repair procedures like Glenn and Fontan

8. Neonatal arch repair

A new, paediatric intermediate care ICU was set up during the year. The Institute has one of the very few homograft heart valve banks in the country (Figure 12).

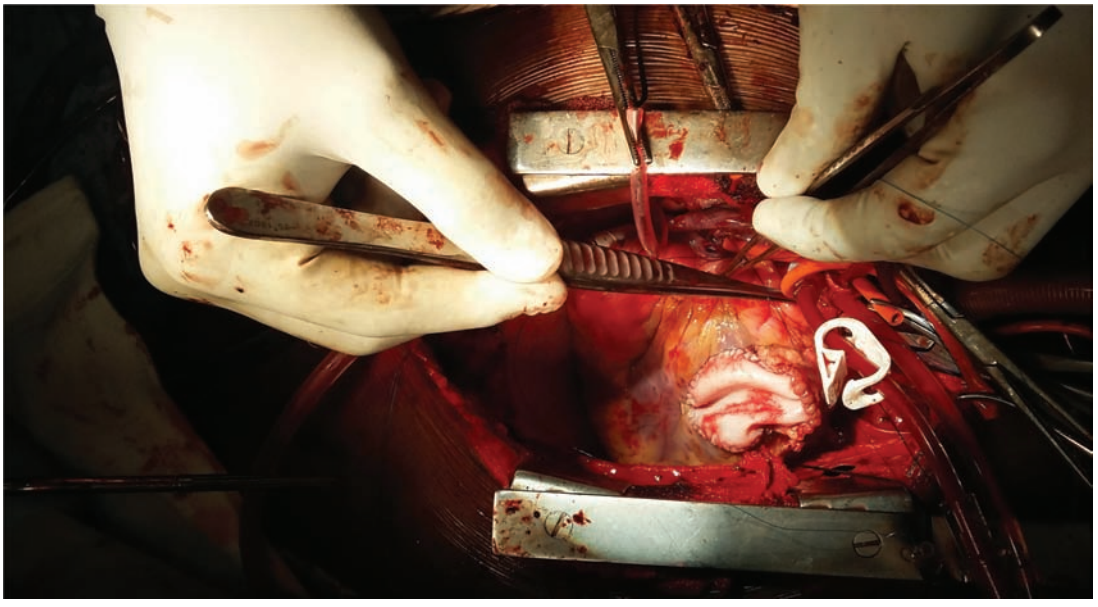


Figure 12. Homograft implantation

Awards and Honours

Dr Jayakumar K took over as President of the Indian Association of Cardiovascular and Thoracic Surgeons.

Dr Vivek V Pillai received the American Association of Thoracic Surgery 2015 Graham EHM Valve Fellowship and worked as a Fellow at Emory University, Atlanta, focusing on the transcatheter aortic valve replacement procedure.

Dr Sabarinath Menon underwent training as Fellow in Paediatric Cardiac Surgery at Westmead, Sydney.

Drs Saurabh Nanda and Neeraj Tapadia won top prizes for their posters at IACTSCON 2016, Lucknow.

VASCULAR AND THORACIC DIVISION

The Department of Vascular Surgery offers state-of-the-art diagnosis and comprehensive treatment of diseases of aorta and other arteries. The vascular surgery clinic works closely with other specialists in cardiovascular diseases and vascular medicine, neurology, and interventional radiology to treat patients with common vascular diseases and complicated vascular problems.

Activities

The Department carried out 353 procedures as indicated below. In addition, 12 procedures (vascular component) were also performed at RCC, Trivandrum.

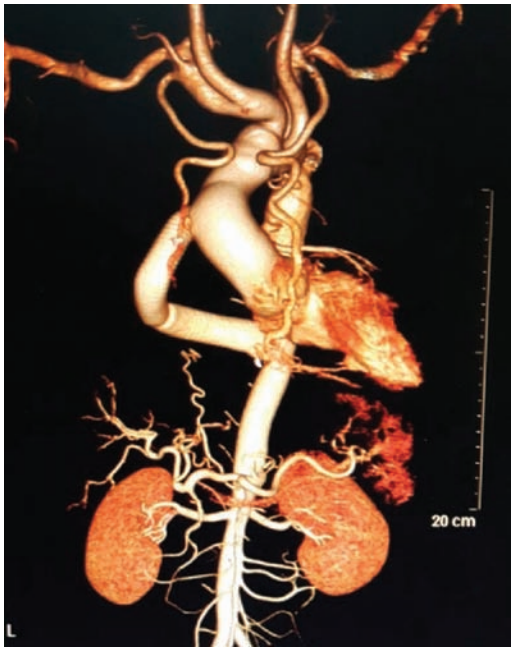
Type	Number
AV access procedures	151
Aortic and arterial procedures	128
Thoracic procedures	74
Total	353

The research on the tissue engineered small diameter vascular graft continued in collaboration with BMT Wing. The Division also hosted 10 vascular residents from across country as observers for 2-4 weeks.

Awards and Honours

Dr Ajay Savlania, DM resident Vascular Surgery, was awarded first prize as the Best Vascular Trainee in the Rolling Trophy Competition organized by the Vascular Society of India on July 3-5 2015 in Goa.

Pre operative image - Significant narrowing at the previously grafted site done 22 years back



Post operative image- Following ascending aorta to descending aorta bypass with 16mm coated Dacron graft via right thoracotomy

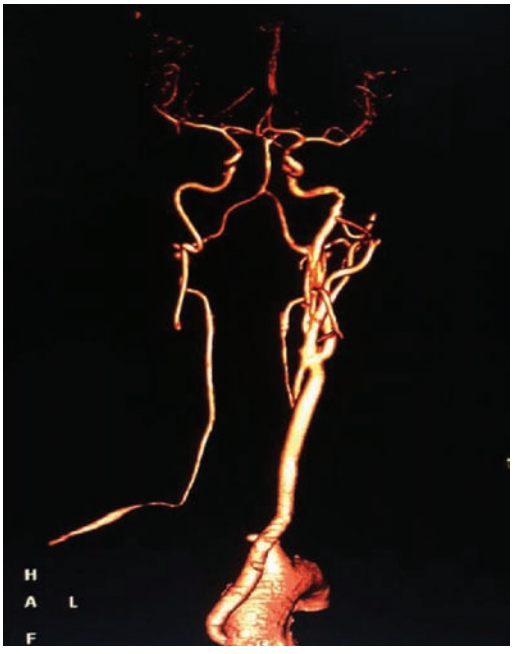
Figure 13. Case 1: Re-coarctation of Aorta

Preoperative image- Aneurysm involving distal aortic arch and full extent of DTA up to the origin of celiac axis

Postoperative image- Hybrid TEVAR- carotid-carotid and carotid- left SCA bypass with Chimney stent to celiac axis

Figure 14. Case 2: Extensive Aortic Arch and DTA Aneurysm

Preoperativeimage- Pan aortic arch vessel occlusion with distal cerebral flow maintained via collateral pathway



Postoperative image- Status post ascending aorta to left common carotid artery bypass

Figure 15. Case 3: Takayasu arteritis with global cerebral hypoperfusion

Faculty

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

Dr M Unnikrishnan, Professor (Senior Grade)

Dr Baiju S Dharan, Additional Professor

Dr Vivek V Pillai, Associate Professor

Dr Varghese T Panicker, Associate Professor

Dr Thomas Mathew, Assistant Professor

Dr Sabarinath Menon, Assistant Professor

Dr Bineesh K R, 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

DIVISION OF CLINICAL ENGINEERING

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

Activities

The Department ensured the safety of medical equipment used in the Institute. This involved multiple steps comprising routine inspection, testing, systems analysis, incident investigation: root cause, user error and risk analyses and management. An in-house program aided these activities. The data logging and monitoring of the maintenance activities were carried out with the help of the central desk and sub-division service call management system. The 'RV Inspection and Installation' entry program was used for inventory and data quality management.

The Department was responsible for ensuring the proper installation of the following equipments in 2015-16.

Name	No.	Department
Automated amino acid analyser	1	Biochemistry
Fluorescence and microplate reader	1	Biochemistry
X-Ray film processor	1	Cardiology
12 Channel ECG recorder	2	Cardiology
3 Tesla MRI	1	Imaging Sciences and Interventional Radiology
Laser camera	1	Imaging Sciences and Interventional Radiology
Micro electrode recording system	1	Movement Disorders Clinic
Star drive manual system	1	Movement Disorders Clinic

New Initiatives

1. A program for scheduling 'Preventive Maintenance' visits was developed in collaboration with the Computer Division.
2. The maintenance program was linked with store for smooth functioning of the inventory managing system. A program to upload the images of equipment and accessories during installation to aid future identification was initiated.
3. The program for uploading the images of work permit and service report was nearly completed.

Events organized by the Department

The Department also ensured training of personnel through a dedicated hands-on training programme, "Hospital Equipment Awareness and Training Series" (HEATS), which is ongoing since 2013. This was aimed at imparting advanced skills to deal with technical problems related to medical devices. The Department successfully organized five lecture series in 2015-16 as indicated below:

HEATS-11	Basics of Circuit Designing in Electronics	10 June 2015
HEATS-12	Engineering Principles and Application of MRI	8 August 2015
HEATS-13	Hands-on Training for Biomedical Technicians on Anaesthesia Machine	12 September 2015
HEATS-14	DCE Service Call Management	6 February 2016
HEATS-15	Advancement in ECG Recording	20 February 2016

The "Engineering Principles and Application of MRI" HEATS-12 was organized jointly with Imaging Sciences and Interventional Radiology Department and Kerala Chapter of IEEE Engineering in Medicine and Biology Society on 8 August 2015. Prof N R Jagannathan, Head of the Department, NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, delivered the keynote address (Figure 16). Technical experts from Wipro and GE conducted the training sessions and over 100 delegates from all over India took part in the meeting.

Figure 16. Keynote address at HEATS-12 by Prof N R Jagannathan, Head of NMR and MRI Facility, AIIMS, New Delhi

Staff

Mr Koruthu P Varughese, Engineer G & Head of the Department (Acting)

Mr Mohanlal G, Engineer G

Mr Madhusoodanan Pillai B, Scientist Engineer F

Mr Manoj G S, Engineer B

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 the molecular mechanisms in pathological cardiac remodeling and identifying strategies for modifying myocardial tissue response to injury using animal and cell culture models.

Research Programmes

1. Transition from left ventricular hypertrophy to cardiac failure mediated by decrease in functionally efficient resident cardiac stem cells

Left ventricular hypertrophy resulting from chronic pressure overload remains an important risk factor for cardiac failure. The cause of the transition from hypertrophy to failure remains an unanswered question. Oxidative stress and myocyte loss are relatively high in the hypertrophied myocardium compared to normal. Based on the premise that progressive cardiac remodeling is mediated by decrease in the number and efficiency of resident cardiac stem cells, either due to repeated cycling for replacement of lost myocytes and/or the adverse microenvironment, the number and functional characteristics of stem cells was assessed in the myocardium of Spontaneously Hypertensive Rat (SHR) and compared with Wistar rat. Compared to normotensive Wistar rat, migration and proliferative capacity of cardiac stem cells from SHR was significantly lower. Additionally, the total number of stem cells in the hypertensive heart was significantly lower (Figure 17). These findings led to the conclusion that stem cell-mediated tissue repair is compromised in the hypertensive heart, leading to cardiac failure. Maintenance of a healthy population of stem cells is, therefore, expected to prevent the transition from the compensatory to the decompensatory phase.

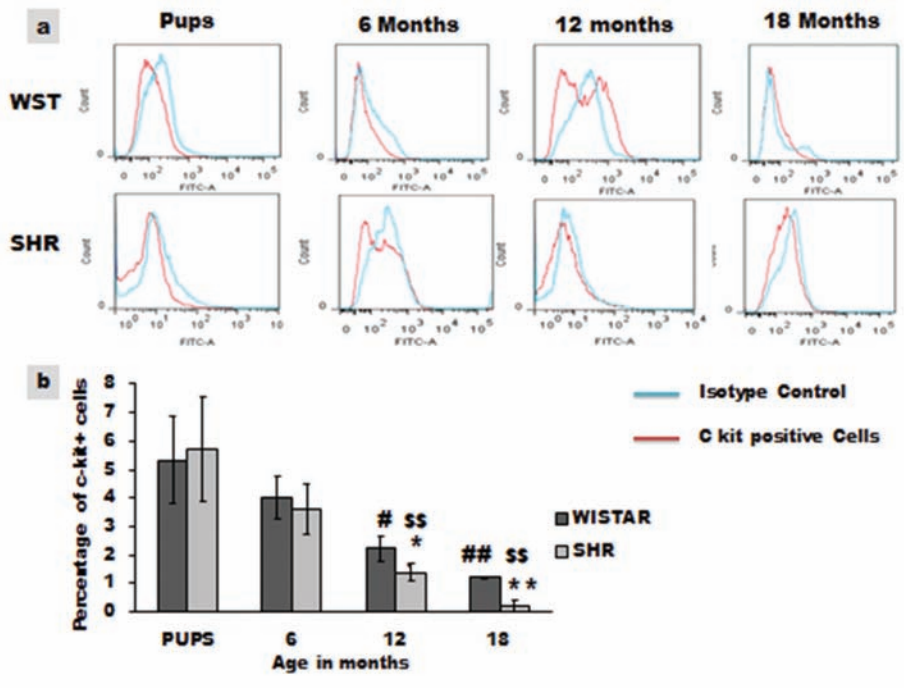


Figure 17. Distribution of cardiac stem cells in the myocardium of spontaneously hypertensive rat determined by FACS assay of tissue digest

(#,##p<<0.05 and 0.01 compared with Wistar rat pups; $$p< 0.01 compared to SHR pups,*, **p< 0.05 and 0.01 compared to age-matched Wistar rat)

2. Histamine 2 receptor antagonist-induced prevention of progressive cardiac remodelling is comparable with that of beta-blocker

Beta-blockers are conventionally used anti-hypertensive agents and are known to have a cardioprotective effect. Histamine 2 receptor (H2R) antagonists have recently been identified to have a protective role in ischemic heart disease. Our results indicated that histamine levels and the expression of H2R increase in hypertrophy. H2R are used in the treatment of gastrointestinal disorders. Treatment of SHR with H2R antagonist was found to prevent progressive cardiac remodelling. The cardiovascular response on treatment with famotidine was comparable with that of the beta-blocker, metaprolol (Figure 18). The observation paves the way for a novel approach to the treatment of hypertension and hypertensive heart disease.

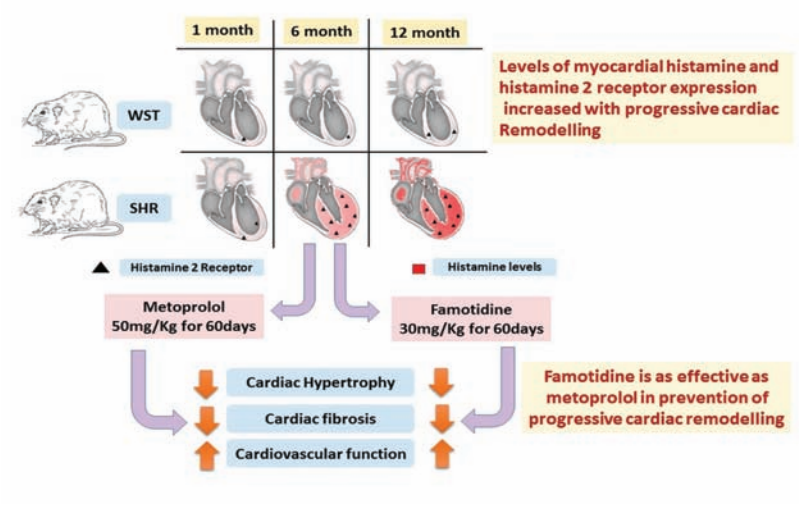


Figure 18. Histamine 2 receptor antagonist, famotidine, prevents left ventricular hypertrophy as effectively as the beta-blocker, metoprolol

3. Molecular basis of cardiac fibroblast growth

Investigations carried out during the year were focused on the regulation of cardiac fibroblast growth that is known to profoundly impact the structural and functional remodelling of the heart post injury. Specifically, the molecular regulation of two major collagen receptors, DDR2 and Integrin b1, and the Angiotensin II type 1 receptor, AT1, that impact the growth of these cells and, in turn, the cardiac stroma was probed during the year.

Novel observations in relation to the molecular basis and functional significance of Angiotenisin II-induced increase in DDR2 gene expression in cardiac fibroblasts were published in the prestigious Journal of Molecular and Cellular Cardiology. Notably, an exclusive editorial that stressed the importance and the translational value of the findings was published in the same journal soon after the publication of the original article.

Studies were initiated on the regulation of Integrin b1 gene expression in cardiac fibroblasts. Further, Dr Shivakumar spent a month in the Laboratory of Cardiovascular Science at the NIH, USA, to learn the protocol for the isolation and culture of vascular adventitial fibroblasts, which was set up in this laboratory immediately after his return. Investigations on the role of these cells in triggering vascular changes associated with diabetes were initiated in collaboration with the NIH.

Faculty

Dr R Renuka Nair, Scientist G (Senior Grade) & Head of the Division

Dr K Shivakumar, Scientist G

Technical

Ms J Remani, Junior Technical Officer

COMPUTER DIVISION

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

Activities

1. Website maintenance and updates; network management, maintenance and new cabling work.
2. Updation and maintenance of portals, DSpace and e-learning.
3. Training of staff and students.
4. Tender publishing, online recruitment of staff and students, and Optical Mark Recognition (OMR) evaluation.
5. Report generation for auditors and income tax committee.
6. Hardware and software maintenance of servers, storage, CPU, routers, switches, scanners, printers etc. (total 1225 devices) with a remarkable uptime of 99.98%.
7. Data backup and maintenance, and network security.

New Initiatives

Electronic Medical Records (EMR) for new and review outpatients in Cardiac Surgery and integration of ECG with EMR.

E-register for Neuroanaesthesia and log book for cath lab.

Software to enter Comprehensive Health Insurance Scheme (CHIS) details of patients at reception, implementation of Point-Of-Sale (POS) at hospital cash counters with E-payment integration.

Online preparation of inpatient charge account statement, and automatic journal preparation on closure of inpatient billing daily.

Software for stock monitoring in all Departments.

Online submission and review for Technical Advisory Committee (TAC).

File archiving for Biomedical Technology Wing.

Portal for vendor registration.

Preparation of management information system (MIS) reports for the Director, and development of software for the Director and senior administrative personnel to view the automatic bank balance.

Online vehicle request and transport management and gate pass system for security staff.

Provision of wireless internet access to ladies hostel.

Software for online requests by staff for loan and salary deduction from co-operative society, computer advance and festival allowance.

Staff

Dr Geetha G, Scientist G & Head of the Division

Mr Suresh Kumar B, Engineer C

Mr Rejith L R, Programmer - B

Mr Saji K S, Programmer - A

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

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

Mr Sakil Nag P S, Technical Assistant (Computer Programmer) - A

DEPARTMENT OF IMAGING SCIENCES AND INTERVENTIONAL RADIOLOGY

The Imaging Sciences and Interventional Radiology (ISIR) Department provides state-of-the-art imaging facilities for neurological and cardiac diseases. The highlights of the current year include the acquisition of a new 3 Tesla MRI machine and inauguration of the new processing laboratory.

The Neuro-intervention centre (NIC) is a tertiary care facility for the comprehensive management of patients suffering from various neurovascular disorders. Since its inception in 2013, there has been a steady increase in the number of neurovascular and peripheral interventions. This year, the combination of quality management practices and strong multidisciplinary teamwork contributed significantly towards achievement of zero procedure-related morbidity or mortality and less than 1% overall morbidity and mortality. These figures were attained despite a 15% increase in the number of procedures performed as compared to the previous year.

Activities

The imaging procedures performed in 2015-16 are summarized below.

Procedure	Number
X-ray	30289
Ultrasound & Doppler	3641
Computed Tomography Scans	6662
Magnetic Resonance Imaging	4277
Digital Subtraction Angiography	1091

The details of patient statistics and neuro-intervention procedures are shown in figures 19-26.

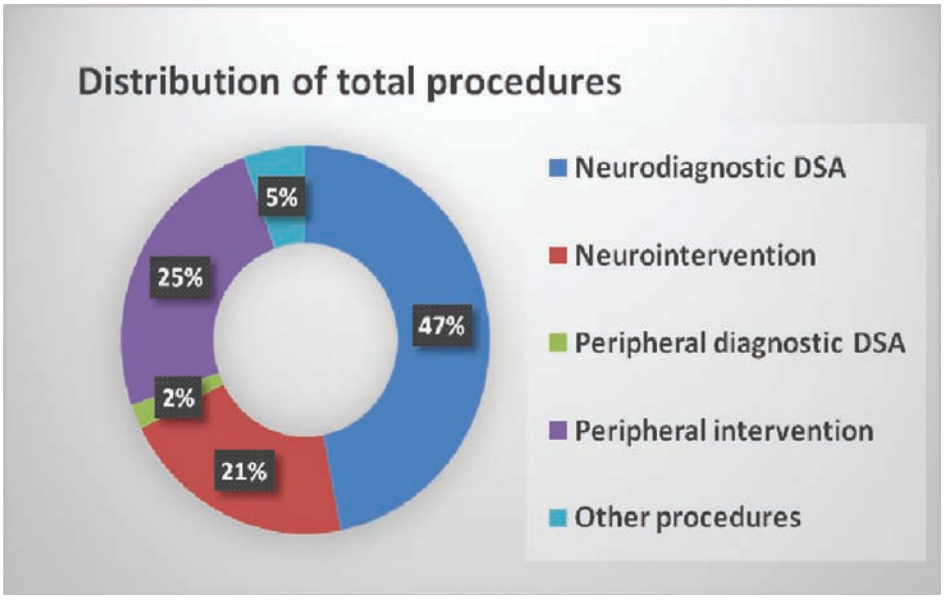


Figure 19. Distribution of neurovascular and peripheral intervention procedures

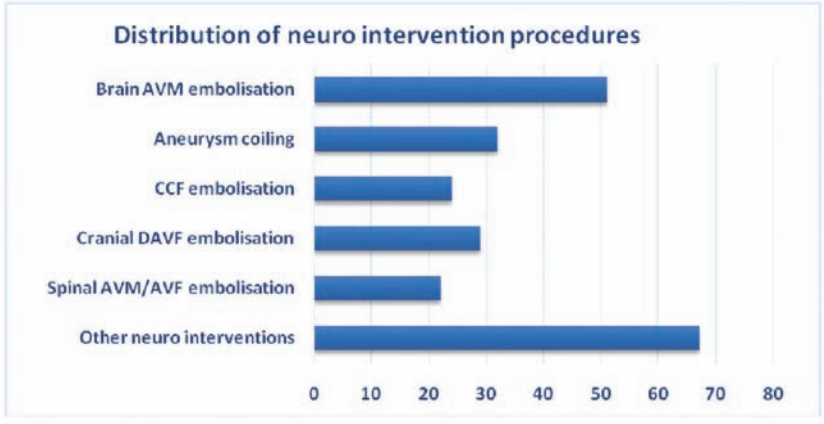


Figure 20. Distribution of neuro-intervention procedures

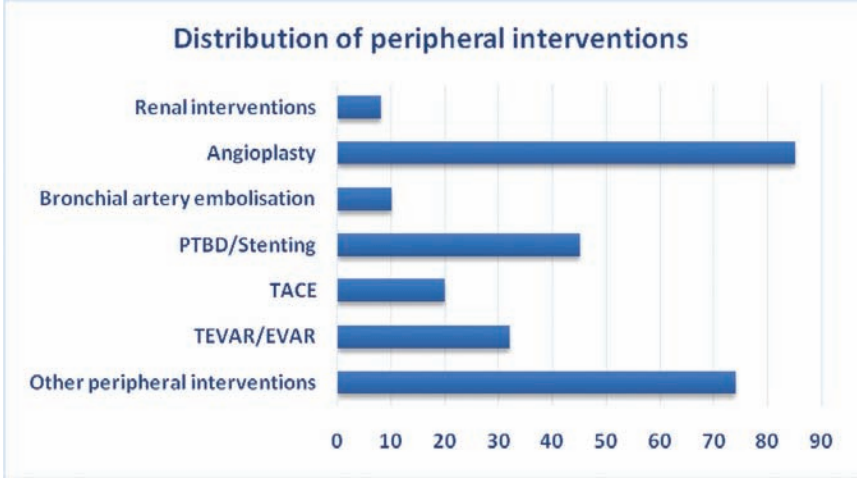


Figure 21. Distribution of peripheral intervention procedures

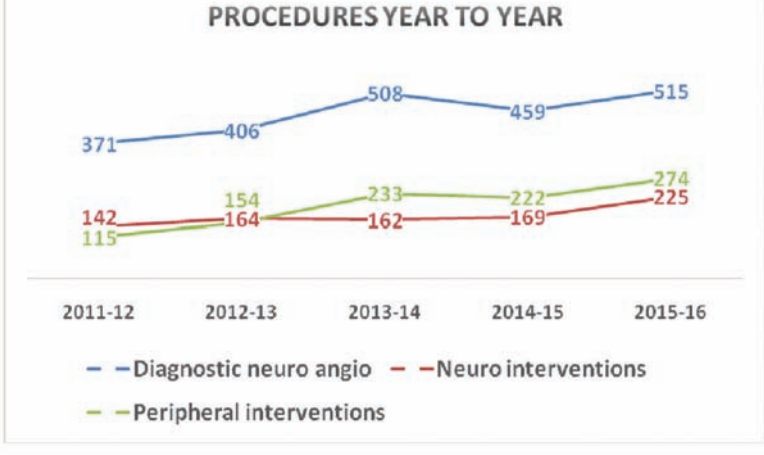


Figure 22. Intervention procedures over the last five years

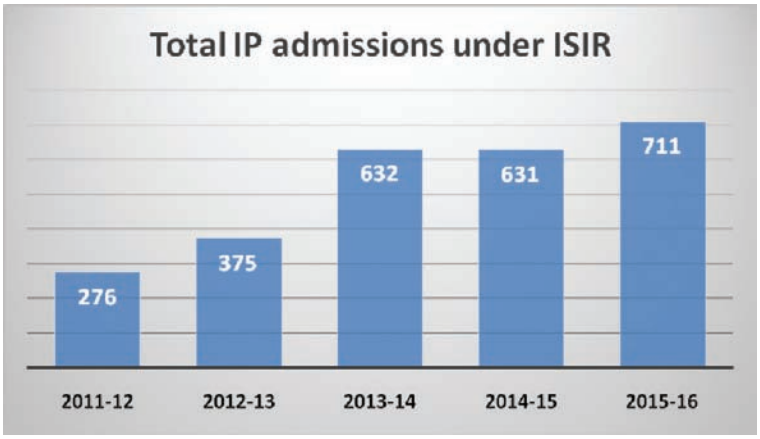


Figure 23. Year-wise distribution of inpatient admissions in ISIR

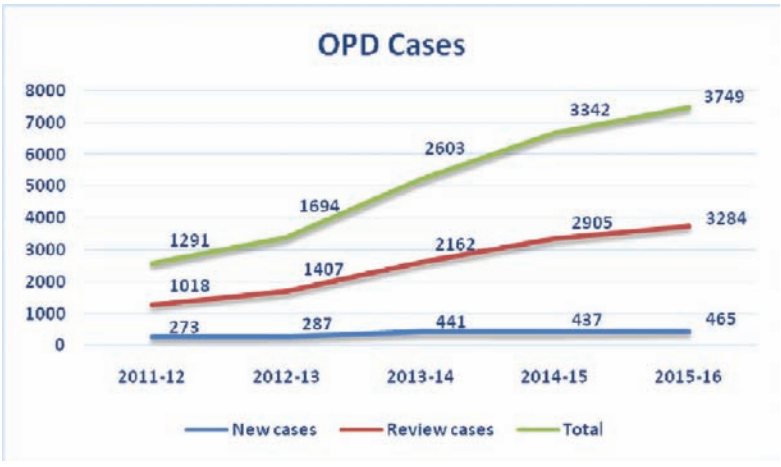


Figure 24. Year-wise distribution of outpatients in ISIR

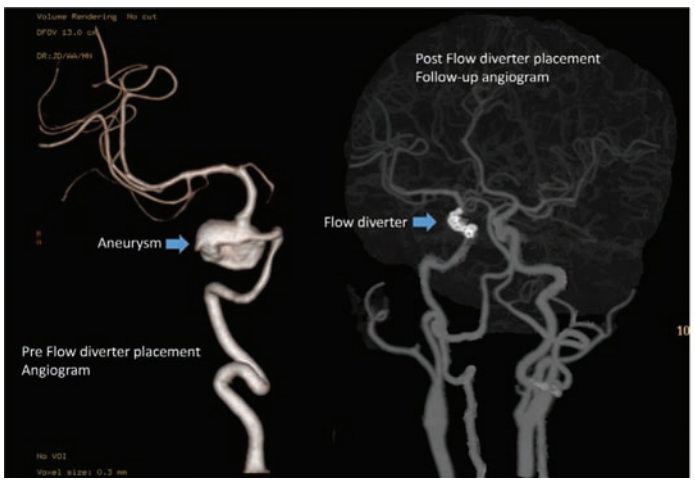


Figure 25. Flow diversion for complex wide neck intracranial aneurysm

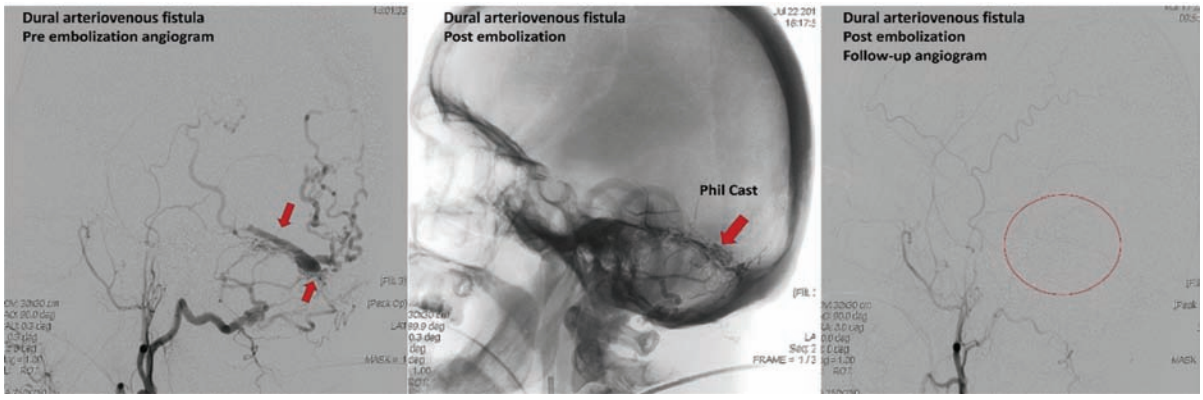


Figure 26. Dural arteriovenous fistula embolization with liquid embolization agent

New Initiatives

- The new 3 Tesla MRI (Discovery 750w from GE healthcare) was inaugurated on 14 December 2016. A research agreement was signed between the Institute and GE Healthcare in the area of MRI research. The new processing lab inaugurated along with the MRI machine is capable of advanced image processing techniques in the diagnosis of cardiovascular and neurological diseases.

- The new interventional procedures started were:

Peripheral angioplasty using drug-eluting balloon

Flow diversion in complex intracranial aneurysm with P64 flow diverter

Vascular plug-aided intracranial vessel trapping

Chimney treatment for complex aortic aneurysms

Cranial dural AV fistula management using Phil liquid embolization agent

Management of scalp and peripheral AVM using ethylene vinyl alcohol co-polymer

Awards and Honours

Drs Rahul K R and Anoop A, PDCC, Cardiovascular Imaging and Interventional Radiology, secured first and second prizes, respectively, in the 'Lobby Quiz' at the 5th Annual Conference of Indian Association of Cardiac Imaging, 23-24 October 2015 at the Christian Medical College, Vellore.

Faculty

Dr T R Kapilamoorthy, Professor & Head of the Department

Dr C Kesavadas, Professor

Dr Bejoy Thomas, Additional Professor

Dr Jayadevan E R, Associate Professor

Dr Santhosh Kumar K, Assistant Professor

Technical staff

Mr Alex Jose D, Technical Assistant - B

Mr Johnson C, Technical Assistant - B

Mr Joyi K, Technical Assistant - B

Mr Krishnakumar N, Technical Assistant - B

Mr Mahesh P S, Technical Assistant - B

Ms Sandhya V S, Technical Assistant - B

Ms Sheebakumari R, Technical Assistant - B

Mr Vikas K N, Technical Assistant - B

Mr Babunath B, Technical Assistant - A

Ms Githakumari V, Junior Scientific Officer

DEPARTMENT OF MICROBIOLOGY

The Mission of the Department is to provide accurate and quick reports, offer consultant clinical microbiology services, one component of which is antibiotic stewardship, develop molecular diagnostic services to encompass a broader spectrum of infectious diseases, and enhance research activities.

Activities

Bacteriology

a. There were 24 cases of infective endocarditis, half of them caused by alpha lytic Streptococci, and others by Enterococcus spp, Staphylococcus aureus (Figure 27a) and Gram-negative bacteria. Advice was offered for the appropriate antimicrobial therapy.

b. The control of hospital-acquired infections is an important aspect of the departmental service with periodic assessment by the infection control team. A new infection control nurse (Mrs Shiny Biju) took charge and was responsible for systematic data collection on health care-associated infections. Mrs Biju also completed a certificate course on health care-associated infections at the Tata Memorial Hospital, Mumbai.

Molecular Diagnostics

The trial run of the new RT-PCR machine was successful and facilitated the detection of HSV-2 in one case. TB-PCR for tuberculous meningitis performed on 161cases showed no positives.

Mycology

In 49 cases, yeasts of both Candida albicans and non-Candidial species were identified, with Candida parapsilosis and Candida pelliculosa (Figure 27b) being the causative organisms in infective endocarditis.

Serology

The ARCHITECT analyzer by Abbott improved the accuracy and turnaround time for the serology tests. There were more HBsAg-positive cases (101), than HCV (33) and HIV (12).

Tests for procalcitonin and CRP were used to assess bacterial infection. In fact, more tests for procalcitonin were performed this year than in previous years.

Homograft Valve Bank

The programme continued its successful run with harvesting and storage of 32 heart valves. The Department played a pivotal role in ensuring the sterility and preservation of the valve tissue following cadaveric harvestation from the Forensic Department, Trivandrum Medical College. During this process, the departmental Medical Sociologist supported the donors' families through interactions and

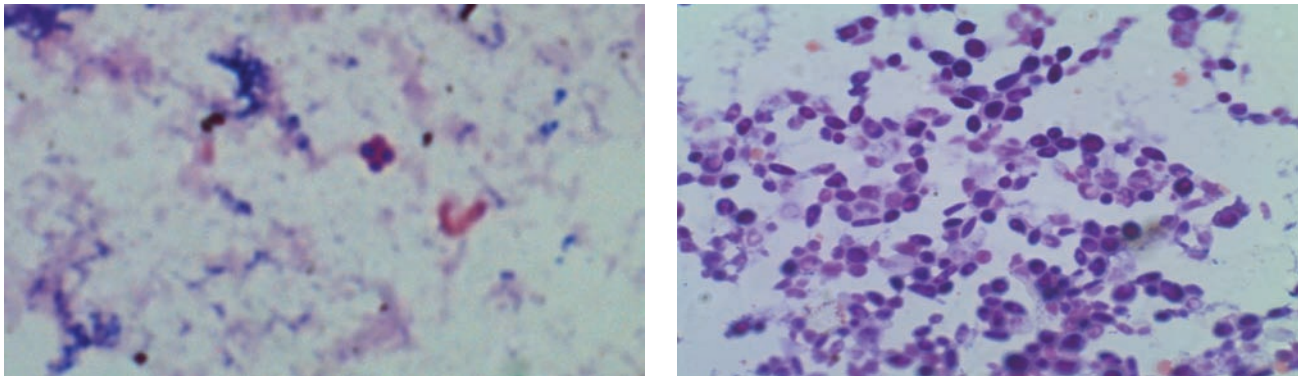


Figure 27. Gram-positive cocci (a) and yeast (b) in infective endocarditis vegetations

counselling. These activities led to 20 successful implants in patients with congenital heart disease.

Research Programmes

The completion of internal faculty project on drug resistance in nosocomial infections resulted in a proposal for the molecular level identification of a few isolates.

A collaborative pilot programme on Pseudomonas infections in bronchiectatic lungs is ongoing with Microbial Technology Division, BMT Wing.

New initiatives

The new RT-PCR became functional under the supervision of Dr Molly Antony and Mrs Sujatha (Figure 28).

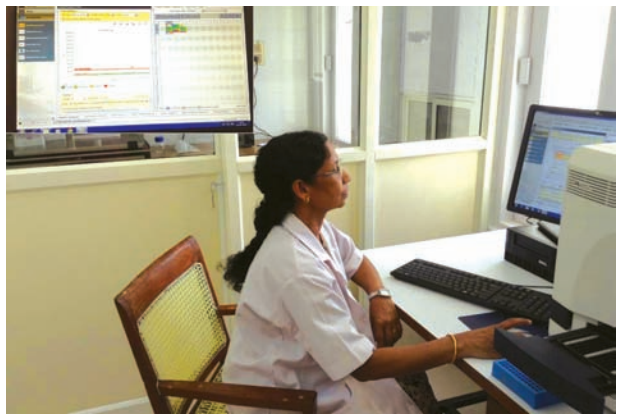


Figure 28. Molecular diagnostics laboratory

Figure 29. Workshop on article writing for microbiologists

Events organized by the Department

The Department organized a Workshop on article writing for medical microbiologists on 17-18 September 2015 (Figure 29).

Awards and Honours

Ms Beena Pillai, MSW, Homograft Section, received the best paper award at the conference of Indian Society for Organ Transplantation, Chennai (Figure 30).

Figure 30. Ms Beena Pillai receiving the award for best paper at the Indian Society for Organ Transplantation Conference, Chennai

Faculty

Dr Kavita Raja, Professor & 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 (Lab) - A

DEPARTMENT OF NEUROLOGY

The Department of Neurology comprises multiple subsections, which provide specialized and comprehensive care to patients with various neurological disorders. The Department conducts daily general and speciality neurology outpatient clinics.

A total of 19616 outpatients were seen in the general and speciality outpatient clinics and 3244 inpatient admissions were made in 2015-16. There was a 10% increase in inpatient admissions this year.

The average length of inpatient stay was 6 days, with a bed occupancy rate of 94.7% and bed turnover of 54, and the bed strength was 60 beds. The mortality rate was 1.1 %. The departmental statistics for the year 2015-16 and the trend in the last 5 years are shown in Figures 31 & 32.

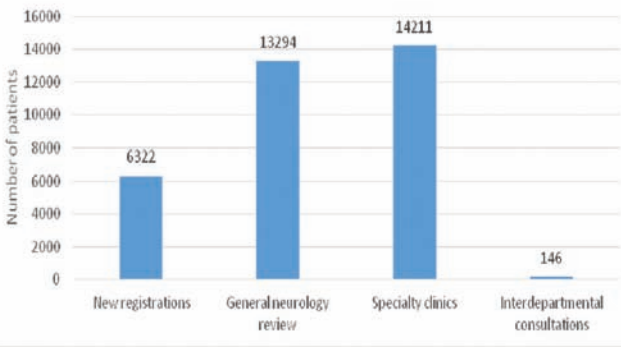


Figure 31. Outpatient statistics of Neurology Department

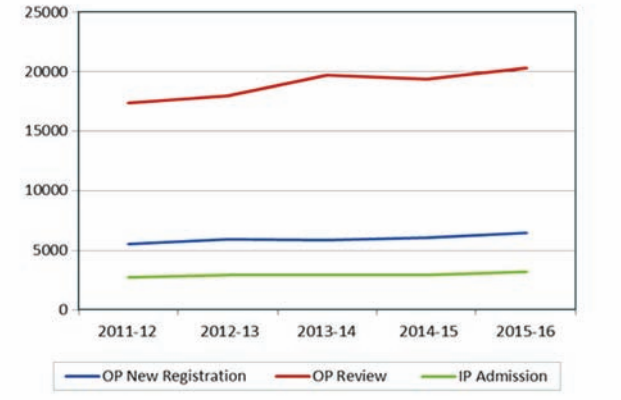


Figure 32. Trend in outpatient and inpatient services in Neurology – last 5 years

In 2015-16, the Department organized Paediatric Epilepsy and Clinical Neuropsychology Workshops. The year was marked by the commencement of a dedicated Paediatric Neurology subdivision. The 'Autism Clinic' for management of autism spectrum and other neurodevelopmental disorders, and the 'Multiple Sclerosis Clinic' for streamlined management of multiple sclerosis were inaugurated in 2015. The faculty and students also took part in many national and international conferences and received several prestigious awards during this period. The Department continued to pursue major research projects and produce notable publications. The faculty also participated in many outreach programmes and camps.

COGNITIVE AND BEHAVIOURAL NEUROLOGY SECTION

The Cognitive and Behavioural Neurology Section (CNBS) provides clinical services to children and adults with cognitive problems in disorders like dementia, epilepsy, stroke and childhood developmental disorders. It also offers 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 conducts clinical and basic science research in the field of dementia, cognition and behaviour that include structural and functional neuroimaging besides development and validation of neuropsychological batteries.

Activity	Number
Speech and Language evaluation	1410
Neuropsychological testing	1376
Memory and Neurobehavioral clinic attendance	431
Audiometric evaluation	348
Speech therapy	225
IQ assessment	97
New patients with dementia	81
Counselling session	73

Activities

The Unit conducts a Memory and Neurobehavioural Clinic every week, catering to patients with mild cognitive impairment and dementias. Other services include comprehensive assessment of inpatients with cognitive problems, counselling and psychosocial support to caregivers of dementia patients.

The clinical activities for the year 2015-16 are summarized in the Table above.

Research Programmes

A research project on 'Resting state functional MRI in patients with minimal cognitive impairment and healthy controls- development of new technology' with a grant from Cognitive Science Research Initiative (CSRI), Department of Science and Technology, was initiated.

Events organized by the Department

The Cognitive and Behavioural Neurology Section (CNBS) organized a Workshop on Clinical Neuropsychology on 19 September 2015 in collaboration with ARDSI, Trivandrum, during World Alzheimer's Month that was attended by more than 130 delegates. Dr Shobini L Rao, renowned Neuropsychologist, delivered a guest lecture on "Brain dysfunction in Autism" on 18 September 2015 at SCTIMST.

COMPREHENSIVE CARE CENTRE FOR MOVEMENT DISORDERS

The Comprehensive Care Centre for Movement Disorders provides state-of-the-art medical and surgical treatments to patients referred from all over the country. The outpatient services and the number of Deep Brain Stimulation (DBS) procedures performed for movement disorders, for which the Centre is a pioneer in India, showed a steady increase compared to previous years. Our academic activities included training senior residents in Neurology in the diagnosis and treatment of movement disorders, conducting Postdoctoral Fellowship course in Movement Disorders and PhD programmes in related areas. The Centre was actively involved in international collaborative and in-house research projects on clinical, genetic and neurophysiological aspects of movement disorders and has received sanctions for two new collaborative projects, one international and another national.

Activities

The Centre received more than 500 new referrals for advanced Parkinson's Disease (PD) and various other complex movement disorders from all over the country. This was in addition to the Movement Disorders Clinic attendance of around 1800 patient visits for review consultations this year. Nearly 300 sessions of Botulinum toxin therapy were conducted for patients with focal and segmental dystonia, spasticity and hemifacial spasm. Forty DBS surgeries and DBS neurostimulator replacement procedures and 70 programming sessions for patients implanted with Deep Brain Stimulators were performed during the year.

Research Programmes

The Centre is actively involved in several research projects with special focus on the genetics and molecular pathogenesis of PD.

Genetic research in PD had a great leap forward in the year. The Indo-German international collaborative project with Dr Manu Sharma, University of Tubingen, Germany, on "Genomic variations in Parkinson's disease in Indian population" was awarded $ 299,992 by the Michael J Fox Foundation, USA.

Genetic variability in the *LRRK2* gene is recognized as one of the most common causes of PD, but there is a complete lack of knowledge regarding its role in the Indian population. The research project "Deciphering the genetic architecture of *LRRK2* gene for Parkinson's disease (PD) in Indian population'' funded by the Michael J Fox Foundation, USA, addresses the question whether genetic variants in *LRRK2* gene confer risk upon the Indian population. It will define the clinical relevance of the *LRRK2* gene in the Indian population and can provide a comprehensive catalogue of genetic variants of the *LRRK2* gene for PD from the Indian subcontinent.

Another related project focused on the elucidation of molecular interactions between alpha synuclein and autophagy in an endogenous cell model with relevance to sporadic Parkinson's Disease. Misfolded / aggregated alpha-synuclein is a key component in PD pathogenesis with perturbations in its clearance mechanisms contributing to the disease process. This project studied the factors promoting aggregation of alpha-synuclein and their influence on the clearance mechanisms in an endogenous cell model. The results highlighted the role of abnormalities in autophagy underlying PD and the need to evaluate the efficacy of autophagy-based therapeutic strategies (Figure 33).

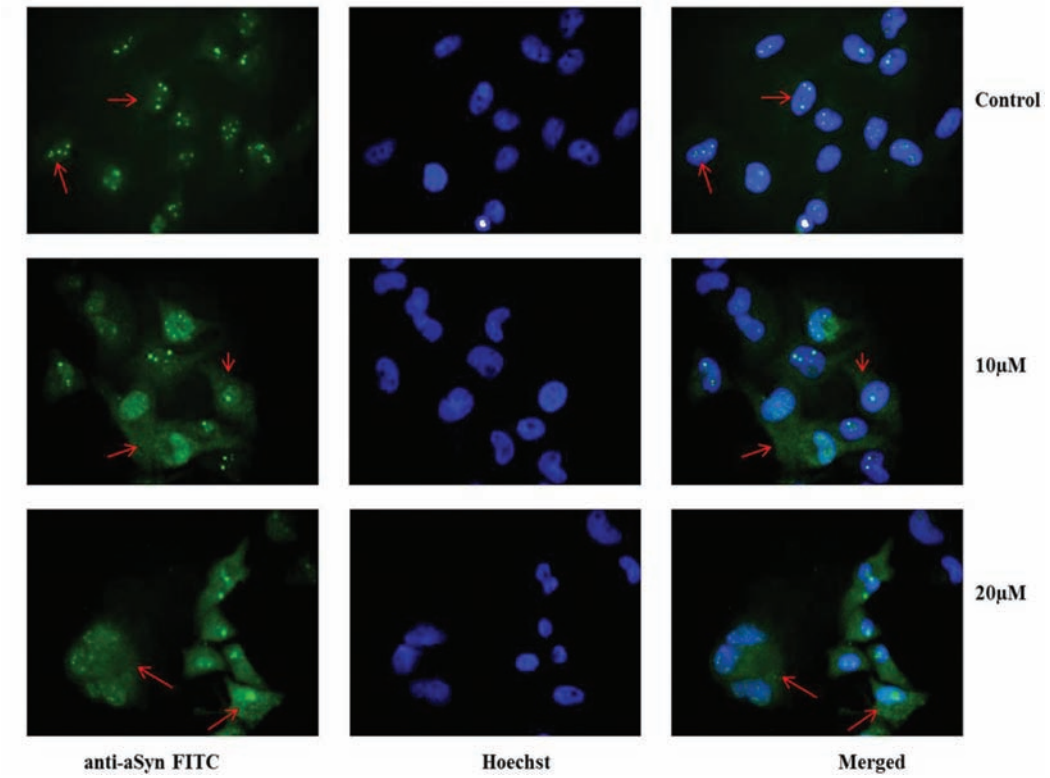


Figure 33. Change in alpha-synuclein sub-cellular distribution upon autophagy inhibition. Alpha-synuclein (aSyn) is localized to both nucleus and cytoplasm in SK-MEL-28 melanoma cells. Increase in the cytoplasmic localization of a Syn in autophagy-inhibited cells compared to control cells was observed.

Manganese and polyamines are proposed as two factors influencing alpha-synuclein aggregation, with the former leading to aggregation of alpha-synuclein and a PD-like state. In another ongoing project, it was observed that cells expressing alpha-synuclein are protected from manganese toxicity by spermine.

Motor physiology perturbations in motor abnormalities of PD were a focus of research in the previous year. The interaction of cerebellum with basal ganglia structures and the role of cerebellum in the pathophysiology of PD and other movement disorders are increasingly being recognized. The ongoing Transcranial Magnetic Stimulation (TMS)-based research project (Figure 34), "Cerebellar control of synaptic depotentiation at the primary motor cortex and implications for levodopa-induced dyskinesias" examines whether the loss of depotentiation of motor cortex synapses that occurs in dyskinetic PD patients can be restored by cerebellar stimulation. The study marks a step forward in understanding the role of cerebellum in the genesis of levodopa-induced dyskinesias in PD.

In the study entitled "Encoding interhemispheric interactions: a window to the pathophysiology of dystonia", funded by the Dystonia Medical Research Foundation, USA, the investigators explore whether inhibitory interactions of right premotor cortex (the action selection area) and right motor cortex with the left motor cortex are impaired in patients with focal hand dystonia. This study will also examine if such abnormalities underlie the phenomenon of mirror dystonia.

In the study examining the "Effect of cerebellar stimulation on motor adaptation and motor sequence learning through changes in motor cortex plasticity", the possibility of using cerebellar non-invasive stimulation as a strategy to facilitate motor learning in patients with disabilities such as PD or stroke was explored.

The team also addressed the alterations in the cerebellum-basal ganglia connectivity, using functional MRI, 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". The aim is to compare the effective

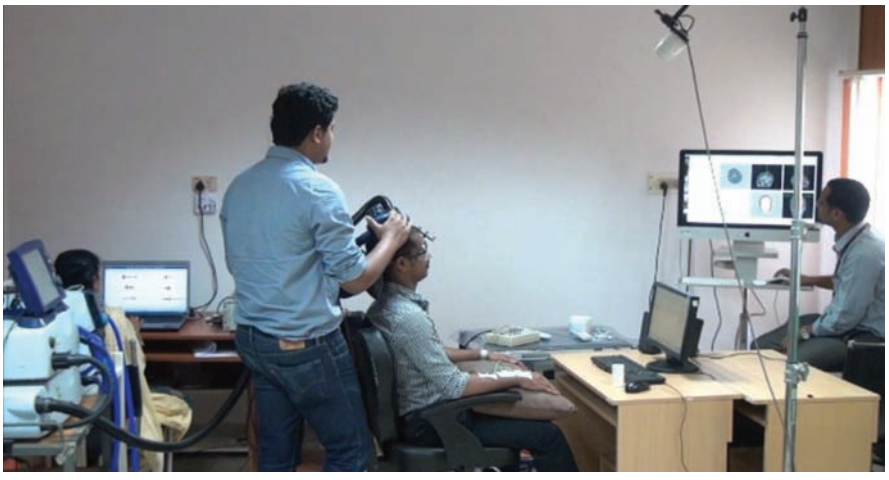


Figure 34. Transcranial Magnetic Stimulation

connectivity between the striatum, subthalamic, pontine and dentate nuclei, cerebellar hemisphere, thalamus and motor cortex using resting state functional MRI in PD patients and age-matched healthy controls.

Impulse control disorders (ICDs) form an important non-motor manifestation of PD, particularly related to treatment with dopaminergic drugs, and genetic mechanisms are among the proposed causative factors. The association of dopamine receptor (*DRD2, DRD3*), glutamate receptor (*GRIN2B*) and serotonin transporter (*5HTTLPR*) gene polymorphisms in PD patients with ICD while on dopamine agonist therapy was examined using a prospective case-control study design. A specific *DRD3* genotype was found to be associated with ICD in Indian PD patients, which was novel. Whether specific genotype/s have an increased risk of cognitive and motor impulsivity (behavioural trait underlying ICDs) is currently being assessed using computerized tasks of decision making. Being one of the leading centres in India for subthalamic nucleus DBS for PD, the effect of subthalamic nucleus DBS on impulsivity in PD patients is currently being investigated.

The role of hearing impairment as a non-motor symptom in PD is being examined in another prospective cross-sectional study. Pure-tone audiometry and brainstem auditory evoked potential testing will assess the hearing in patients and healthy volunteers. The relation between hearing impairment and stage of PD, and other non-motor symptoms will be analysed.

Figure 35. Deep Brain Stimulation surgery for Parkinson's disease using MRI- based stereotactic and microelectrode recording guidance

New Initiatives

A new Microdrive Targeting System for accurate positioning of DBS electrode was purchased during the year (Figure 35).

A project involving the clinical team of the Centre and the engineering and scientific teams of the Biomedical Technology Wing was initiated to develop the DBS technology. The Bhabha Atomic Research Centre will be a technical collaborator and partner in the programme. The proof of concept phase of the project was commenced.

Events organized by the Department

The Centre conducted a patient awareness programme on PD in connection with the World Parkinson's Day on 28 April 2015, with more than 50 patients and their caregivers participating (Figure 36).

Figure 36. Patients attending the awareness class on Parkinson's disease, in connection with the World Parkinson's Day 2015

Awards and Honours

Dr Roopa Rajan received the American Academy of Neurology (AAN) International Scholarship Award 2016 to present the poster "A gene for risk taking: effect of genotypic variants on decision making, response inhibition and impulsivity in Parkinson's disease" at the AAN Annual Conference, April 2016, Vancouver BC, Canada.

COMPREHENSIVE CENTRE FOR SLEEP DISORDERS

The Centre caters to patients with varying sleep disorders referred from within and outside the Department, including cardiac and respiratory patients. The Section runs an outpatient clinic once a week, where new patients and interdepartmental consultations are evaluated. In addition, the clinicians also review patients on follow-up, recommend adjustments to positive airway pressure therapy and counselling. A fully equipped polysomnography laboratory with facilities for performing day and night studies is functional under the Centre.

Activities

The Section initiated patient education classes on sleep hygiene, obstructive sleep apnea (OSA), continuous positive airway pressure therapy and insomnia, with distribution of brochures. The classes were conducted once a week by a medical social worker with educational aids. The Centre performed regular polysomnography and positive airway pressure titration wherever indicated and also planned home positive airway pressure therapy. The statistics for the Comprehensive Centre for Sleep Disorders for the year is given in the next page:

Activity	Number
Sleep Clinic attendance	629
Polysomnography	148
CPAP titrations	52
Multiple sleep latency test	10

A public education article was published in the Kerala Kaumudi Sunday section about sleep disorders with special emphasis on diagnosis and management of obstructive sleep apnea.

Research Programmes

Two IEC-approved non-funded studies: 'Clinical and polysomnographic predictors of severe OSA in South Indian population' and 'Predictors of high CPAP requirement in patients with moderate to severe OSA' were completed last year.

COMPREHENSIVE STROKE CARE CENTRE

The Comprehensive Stroke Care Centre was established in March 2011 with the aims of providing speedy and comprehensive care to acute stroke patients and establishment of a multidisciplinary team for management of stroke. Since its inception, this subdivision has pioneered patient care, academic and research activities in the field of stroke in India.

Last year, the Centre hosted international faculty and organised continuing medical education programmes in stroke, in addition to providing high quality patient care and conducting research activities.

Activities

The routine activities are summarized in the Table below:

Activities	Number
Stroke patients seen in the clinic	2328
Patients admitted in stroke ICU	392
Carotid Endarterectomies	40
Thrombolysis and Mechanical Thrombectomies	38
Hematoma evacuation	2
Decompressive Hemicraniectomy	6
Moya Moya revascularization	9

Research Programmes

1. A Clinical Trial Agreement was signed for the study titled "Head position in stroke-(HeadPost)" on March 2016, which is an international trial evaluating the head position in acute stroke patients.

2. An MoU was signed in January 2016 with the Centre for Chronic Disease Control for the study titled: "Evaluating barriers and facilitators to stroke prevention to guide implementation research". Dr Rizwan Kalyani, Stroke Neurologist from Emory University and Co-Principal investigator of the project, visited the Centre from 1-14 March 2016.

Events organized by the Department

1. Prof Richard Lindley (Professor of Geriatric Medicine, Sydney Medical School, Australia), Prof Anne Forster (University of Leeds, UK), and Prof Marion Walker (University

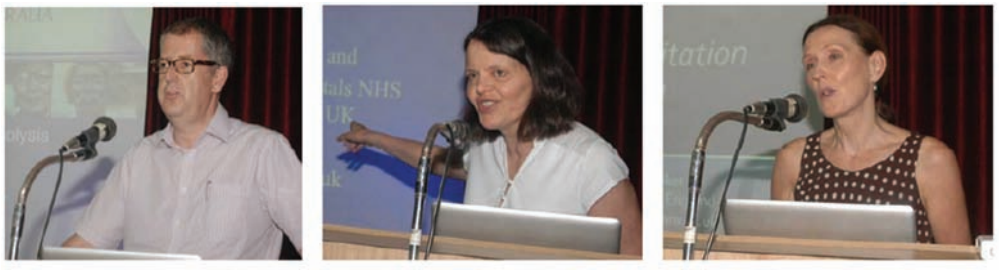


Figure 37. Talks by international faculty on 1 December 2015 at SCTIMSTon acute stroke care and stroke rehabilitation

of Nottingham, UK) visited the Stroke Unit on 1 December 2015. They lectured on acute stroke care and thrombolysis and advances in stroke rehabilitation (Figure 37).

2. In connection with the World Stroke Day 2015, the Comprehensive Stroke Care Centre along with the Nursing Division of SCTIMST organised a state level conference on nursing management in stroke on 24 October. Around 300 nurses from all over Kerala attended the meeting.

Awards and Honours

Dr P N Sylaja received the National Lifetime Achievement Award for teaching from the Indian Medical Association in 2016.

Dr P N Sylaja was awarded the Dr Eapen Samuel Memorial Award for the best research paper in 2015 from the Indian Medical Association and Allied Medical Specialities.

NEUROMUSCULAR DIVISION

The Neuromuscular Division caters to two broad groups of disorders: (a) Neuromuscular disorders, which include anterior horn cell diseases, neuropathies, myopathies, and neuromuscular junction disorders (b) Acquired central nervous system demyelinating disorders including multiple sclerosis and neuromyelitis optica spectrum disorders. The Division conducts a weekly neuromuscular clinic in addition to the routine management of patients admitted in the wards and intensive care unit. The Division had one Postdoctoral Fellow in the academic year 2016 and participated in the training of DM Neurology and Diploma in Neurotechnology students. In 2015-16, 1366 nerve conduction (NCS) and electromyography (EMG) procedures were performed in the electrophysiology laboratory and new techniques of NCS and EMG were standardized. The faculty also participated in various national and international conferences.

Activities

The neuromuscular clinic functions on Tuesday of every week. In 2015-16, 1690 patients attended the clinic. In order to streamline the rehabilitation and management of patients with motor neuron disease attending the clinic, these patients were allocated a specific day of the week for review. A patient management conference focussing on rehabilitation of patients with significant physical disability was organised in the afternoon on all Tuesdays. The session was attended by neurologists, physiatrist and therapists.

The routine studies conducted in the electrophysiology laboratory are summarized in the Table below:

Study	Number
Nerve conduction studies	1220
Electromyography	738
Repetitive nerve stimulation	111
Blink reflex studies	35
Single-fibre EMG	18

The therapies and procedures performed in 2015-16 are indicated below:

Procedure/ treatment	Number
Thymectomy	6
Intravenous immunoglobulin	32
Plasma exchange	24
Interferon α1a	17
Glatiramer acetate	5
Muscle biopsy	5
Nerve biopsy	16

The Multiple Sclerosis (MS) Clinic was inaugurated by the Director on 22 September 2015 (Figure 38). The Clinic focuses on the management of patients with multiple sclerosis and related acquired demyelinating disorders of the central nervous system. This dedicated Clinic will help address the unique problems faced by these patients and streamlining their management. The Clinic is held on all second Tuesdays of the month in the Neurology outpatient block. Since its inception, 38 patients have attended the MS Clinic.

Research Programmes

The Department is presently conducting a drug trial in relapsing remitting MS as per GCP guidelines.

New Initiatives

1. New EMG procedures were standardized in the laboratory: (a) surface and axonal stimulation single-fibre EMG (b) paired blink reflex study, and (c) dorsal sural nerve conduction study.

2. Dr Ajay Asranna, second year resident of Neurology,

conceived the idea of an android-based application for communication assistance of Motor Neuron disease (MND) patients with significant impairment of speech. The application was created in conjunction with CDAC (Centre for Development of Advanced Computing), Trivandrum, under the supervision of Prof M D Nair.

Events organized by the Department

A Workshop on the functional scores and expanded disability status scale in multiple sclerosis was held on 22 September 2015 by Dr Harshal Chaudhari, Consultant with Merck Serono, for the senior residents in Neurology. This score is widely used in drug trials and prospective studies for the assessment and follow up of MS-related disability.

Awards and Honours

Prof M D Nair was co-opted member of Institutional Ethics Committee, IISST, Trivandrum, from February 2016-18.

Dr Abraham Kuruvilla, Professor of Neurology, was awarded FRCP by Prof Derek Bell, President of the Royal College of Physicians of Edinburgh, on 26 June 2015 at the Royal College of Edinburgh, United Kingdom.

Dr Deepak Menon, Postdoctoral Fellow, Neuromuscular Disorders, cleared the MRCP examination in March 2016.

Dr Sruthi S Nair, Assistant Professor, obtained a grant of USD 500 from the Japanese Society of Clinical Electrophysiology for attending the Super EMG Workshop in July 2015 at Tokyo, Japan.

Figure 38. Inauguration of the Multiple Sclerosis Clinic by Dr Asha Kishore

PAEDIATRIC NEUROLOGY SECTION

The Paediatric Neurology subdivision started functioning as a separate Section from July 2015. The first activity was the inauguration of "Autism Clinic" by the Director, Dr Asha Kishore, on 7 August 2015 (Figure 39). Children with neurodevelopmental disorders such as autism spectrum disorders, attention-deficit hyperactivity disorder, learning disability, intellectual disability and social communication disorders are given comprehensive evaluation and management in the Autism Clinic. A multidisciplinary team consisting of speech language pathologist, neuropsychologist and occupational therapist is involved in the management of children with neurological disorders, especially neurodevelopmental disorders.

Activities

The speciality clinic was conducted on two Saturdays a month. 175 paediatric neurology cases admitted as inpatients and 58 new cases were registered in the Autism Clinic, indicated in the Table below:

Diagnosis	Number
Autism Spectrum Disorder – ASD	27
Intellectual Developmental Disorder- IDD	21
Social Communication Disorder- SCD	2
Cerebral Palsy- CP	3
Typically developing child	1
Learning Disorder- LD	4

A patient management conference along with Autism Clinic was organised twice a month for discussing complicated cases and management issues, and Paediatric Neurology meet was held every Monday. All team members contributed to the discussion by presenting their findings and formulating a proper cognitive rehabilitation plan.

Figure 39. Inauguration of the Autism Clinic by Dr Asha Kishore

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 over India and the neighbouring countries. It is the main centre for epilepsy surgery in India and South-East Asia and offers excellent yet affordable comprehensive epilepsy care, comparable to any other Centre in the world.

The Mission of the RMNC is as follows: (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 primary care physicians and general public, and (4) to address issues pertaining to epilepsy in women, under the Kerala Registry for Epilepsy in Pregnancy (KREP).

Activities

The procedures performed at RMNC this year are summarized in the Table below:

Procedures	Number
Video EEG monitoring	1556
Epilepsy surgery	123
Intra-operative ECoG	91
WADA test	14
Intracranial monitoring	10
Cortical stimulation & mapping	05

Events organized by the Department

RMNC conducted a Workshop on Paediatric Epilepsy on 14-15 November 2015 at Mascot Hotel, Trivandrum, that was attended by 110 delegates.

Twelve epilepsy clinics were conducted at PHC Changaramkulam in collaboration with Alamcode Panchayat Committee, and more than 125 patients attended the epilepsy camp organized in February 2016 at Thodupuzha, Idukki.

Awards and Honours

Dr Ashalatha Radhakrishnan, Additional Professor, was awarded the BMJ Award for "Medical Team of South Asia, 2015". Dr Ashalatha Radhakrishnan also received the best scientific original research paper for the work "Mapping and volumetry of Heschl's gyrus by VBM aids in planning temporal lobe resection in patients with TLE with auditory aura" at the 31st International Epilepsy Congress (IEC), Istanbul.

Dr Ramshekhar Menon received the travel bursary award of Indian Epilepsy Society for paper presentation at the 31st IEC, Istanbul, for the work "Electroclinical predictors of outcome in West syndrome and its relationship to tractographic abnormalities".

Dr Deepak Menon, Postdoctoral Fellow, won the best paper award for "Factors affecting seizure outcome following resective surgery in malformations of cortical development" at IANCON 2015, Agra, and the second best free paper award for "Status epilepticus, predictors of outcome" at the Kerala Association of Neurologists Meeting, October 2015, Trivandrum.

Dr Ajay Asranna, senior resident, won the travel bursary award by International League Against Epilepsy to attend the 11th Asian & Oceanian Epilepsy Congress 2016, Hong Kong, for his paper "Referral pattern for epilepsy surgery after evidence-based recommendations in India: a developing country perspective".

Faculty

Dr Muralidharan Nair, Professor & Head of the Department
Dr Sarada C, Professor (till 30.11.2015)
Dr Sanjeev V Thomas, Professor
Dr Abraham Kuruvilla, Professor
Dr Sylaja P N, Additional Professor
Dr Ashalatha R, Additional Professor
Dr Sajith S, Associate Professor
Dr Syam K, Associate Professor
Dr Ramsekhar N Menon, Associate Professor
Dr Sapna Erat Sreedharan, Assistant Professor
Dr Ajith Cherian, Assistant Professor
Dr Sruthi S Nair, Assistant Professor
Dr Soumya Sundaram, Assistant Professor
Dr Roopa Rajan, Assistant Professor

Technical

Ms Nandini V S, Senior Scientific Assistant
Ms Preetha Govind G, Technical Assistant - B
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

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 surged ahead in the year 2015-16 with new initiatives, better surgical care for the ever-increasing patient load and quality teaching programmes for residents, observers and PhD students. The faculty and students actively participated in various academic forums and surgical Workshops displaying the diverse and extremely precise neurosurgical protocols of the Institute. The year also saw collaborations with prestigious centres abroad that will pave the way for mutual exchange of knowledge and skills.

Procedure	Number
Intracranial aneurysms	143
Gliomas	128
Epilepsy surgeries	116
Meningiomas	86
Endoscope assisted procedures	66
Vestibular schwannomas and other cerebellopontine angle tumours	52
Pituitary tumours	43
Movement disorders related: Deep Brain Stimulation and Neurostimulator re-implantations	40
Paediatric and adolescent posterior fossa tumours	28
Spinal tumours	26
Craniopharyngiomas	22
Chiari malformations	22
Arteriovenous malformations	11
Cervical degenerative disease	10
Colloid cysts	10
Cavernomas	09
Atlantoaxial dislocations	07
Others	501
Total	1320

Activities

The three major arms of patient care in the Department, viz., the outpatient clinics, inpatient wards and intensive care unit, and operating theatre services together ensured the delivery of quality service to patients seeking tertiary neurosurgical care. Total 1320 surgeries were performed last year, including complex neurovascular, skullbase, endoscopic and functional surgeries. The Department continued to pursue global standards of superior medical care through qualified consultants, judicious use of technology integrated with continuous learning and development, and patient-centric interactions.

The operative procedures performed during the year are summarized in the Table :

Dr Kenji Ohata, Professor and Chairman of Neurosurgery, Osaka City University School of Medicine, was Visiting Professor in the Department in October 2015. The Director of the Institute and Prof Ohata signed an MoU between Osaka City University School of Medicine and SCTIMST.

The Department is participating in a TDF project to derive a biologically potent agent to prevent CSF leaks by providing dural cover. Pre-clinical animal studies with decellularised bovine pericardium as a dural substitute are ongoing.

Awards and Honours

Prof Suresh Nair, Head of the Department, was awarded the prestigious National Lifetime Achievement Award on Teachers' Day at the 90th National Annual Conference of the Indian Medical Association, 27-29 December 2015, Delhi.

Prof Suresh Nair served as President of the Skullbase Surgery Society of India in 2015. As a pioneer in the field of complex skullbase surgery and for his role in popularizing safe techniques for resection of vestibular schwannomas, Prof Suresh Nair was appointed executive committee member of the Asian Oceanian International Skull Base Society (AOISBS).

Faculty

Dr Suresh Nair, Professor & Head of the Department
Dr Mathew Abraham, Professor
Dr H V Easwer, Additional Professor
Dr K Krishnakumar, Additional Professor
Dr George C Vilanilam, Associate Professor
Dr Jayanand Sudhir B, Assistant Professor
Dr Prakash Nair, Assistant Professor

DEPARTMENT OF PATHOLOGY

The Department has a central role at the Institute, providing round-the-clock laboratory and autopsy services, participating in academic activities and carrying out research on the diagnosis and causation 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. Dr S Sandhyamani carried out the diagnostic work with the help of an Ad hoc consultant (Drs Amita or Jalaja). The clinical services provided by the Department this year are summarized in the Table below:

Category	Number
Neurosurgical biopsies	746
Cardiothoracic biopsies	486
Frozen sections	285
Cytology	64
Paraffin blocks	3543
Immunohistochemistry	1400
Immunopathology	3658

Research Programmes

1. The Department provided support to a number of projects by students (clinical residents and PhD scholars from BMT Wing). Dr S Sandhyamani was a co-supervisor for dissertations by clinical residents and was advisor for PhD students in the following research projects:

Histopathological evaluation of survival of neural progenitor cells in experimental spinal cord injury and fibrin-based niche for spinal cord injury regeneration. The study showed improved viability of implanted cells in the presence of a medium developed by the student, Ms Tara and her guide, Dr Lissy Kalliyanakrishnan. The medium itself may have a protective role in acute spinal cord injuries before transplantation of the stem cells by limiting the extent of injury and damage to tissues.

Evaluation of the histopathological changes in liver in experimental CCl4-induced hepatotoxicity carried out by Dr Shaiju Nazeer, PhD scholar, BMT Wing.

A collaborative study on epidermoids of the brain was carried out with Dr Srinivasan, DM resident, Department of Imaging Sciences and Interventional Radiology. The changes seen in diffusion tensor imaging indicated the presence of water molecules held by the proteoglycan compartment, possibly consisting of keratan sulphate lying between layers of keratinized epidermal cells in the tumour.

In a study on myasthenia gravis with thymomas, Dr Sreedhara, DM Neurology resident, found MuSK antibodies to be a useful predictor of prognosis.

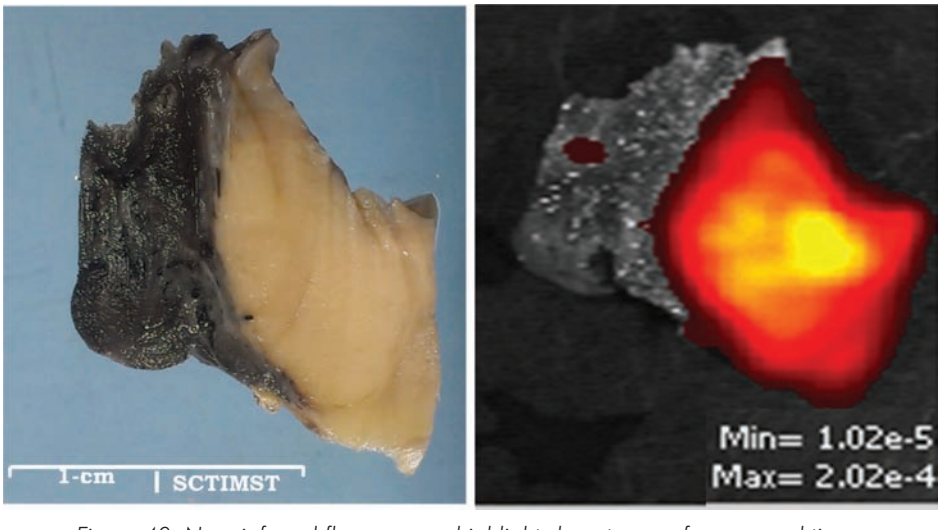


Figure 40. Near-infrared fluorescence highlights lung tumour from normal tissue

2. Rheumatic heart disease

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

3. Autofluorescence of chest tumours

Dr Santhosh Kumar, a DST Fast Track Fellow, under the mentorship of Dr S Sandhyamani, completed a 3-year study that produced significant results. Distinct differences were noticed in the fluorescence emitted by different types of lung tumours, particularly, carcinoid tumours (Figure 40). This will help in better characterization of tumours and possibly obviate the need for costly immunohistochemical reagents for diagnosis of some of these tumours. The work has the potential for development of devices to distinguish tumour from normal tissues, intra-operative tumour characterization, and diagnosis of metastases in lymph nodes/distant organs. The work also has the potential for developing devices to guide selection of lesional tissue during fine-needle aspiration biopsies. This work resulted in important publications and filing of one national patent.

Faculty

Dr S Sandhyamani, Professor & Head of the Department

Dr Amita R, Assistant Professor (till 26 May 2015)

Dr Jalaja Mary George, Assistant Professor (till 4 February 2016)

Dr Deepti A N, Associate Professor (from 7 December 2015)

Technical

Ms Sushama Kumari P, Scientific Officer (Lab)

Mr James T, Junior Scientific Officer

Ms Neena Issac, Technical Assistant (Lab) - A

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

COMPREHENSIVE PAIN CLINIC

The Comprehensive multidisciplinary Pain Clinic completed four successful years on 31st March 2016. A multidisciplinary team comprising consultants from the Departments of Physical Medicine and Rehabilitation, Anaesthesiology, Neurosurgery, Radiology and Neurology, and a Pain Nurse are involved in patient care. The patient management decisions are taken on a broad multidisciplinary-based consensus.

Activities

Persons presenting with chronic non-cancer pain syndromes like low back pain, neck pain, musculoskeletal pain, facial pain, shoulder and arm pain, painful digits, complex regional pain syndrome and post-herpetic neuralgia constituted the bulk of referrals to this Clinic. Many patients had poor response and tolerance to medications and poor surgical fitness or unwillingness for surgery. The Clinic is also equipped to treat patients with intractable cancer pain.

The team provided 'Intervention Pain Management' procedures to patients with acute and chronic pain conditions not responding to conventional treatment (Figure 41).

The services provided included trigger point injections, musculoskeletal infiltrations, transforaminal injections, sacroiliac joint interventions, selective dorsal root ganglia radiofrequency ablation, facet joint interventions, epidural steroid injections, radiofrequency ablation in trigeminal neuralgia, stellate ganglion block and ozone therapy.

Figure 41. Interventions performed at the Pain Clinic

The services provided by the pain clinic in 2015-16 were:

Total patients catered to in OPD and interventions: 554

Major interventions performed (under fluoroscopy - transforaminal, sacroiliac and facet joint injections; Gasserian ganglion and stellate ganglion RF ablations; intra-discal ozone injection): 13 patients

Minor interventions performed (nerve and plexus blocks; musculoskeletal injections/infiltrations, trigger point injections): 28 patients

The complete details of services provided are indicated in the Table below:

Service	Number
New registrations	44
Review patients	443
Minor interventions atientsnoror, Neurosurgeryne and Rehabilitationin Sukesan of intractable pain.	15
Major interventions	12
High risk interventions	1
Trigger point injections	20
Musculoskeletal infiltrations	17
Musculoskeletal anaesthetic + steroid	1
Referral appointments	27

The faculty also participated in several national Workshops and conferences in pain management.

New Initiatives

An innovative procedure was introduced last year by the team who performed intercostal nerve pulsed radiofrequency in patients with chest wall pain due to infiltrating carcinoma and in those with post-herpetic neuralgia.

Faculty

Dr Rupa Sreedhar, Professor, Anaesthesiology

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

Dr Easwar H V, Additional Professor, Neurosurgery

Dr Subin Sukesan, Assistant Professor, Anaesthesiology

DEPARTMENT OF TRANSFUSION MEDICINE

The Department broadened its service and academic activities during the year. The voluntary blood donation reached close to 100 percent by increasing the number of outreach blood mobile camps. This will enhance blood safety and reduce the burden of arranging donors. The Department continued to extend technical support in resolving immunohaematological problems to other blood banks. The Department functioned as NACO training centre, imparting training to personnel in Blood Banks across the state. Collaboration with the Thrombosis Research Unit of BMT Wing for production of fibrin glue continued.

Activities

The Department supported 1520 cardiac surgeries, 789 paediatric surgeries and 1668 neurosurgeries patients for their transfusion needs. Total 12,171 units of blood components were issued to our patients, while 2846 units of blood components were issued to outside hospitals. Total 6928 units of blood were collected, of which 80% came from voluntary blood donors. The Department has reached a stage where the replacement donations arranged by the patients can be stopped. In addition, the Department offers bedside consultation to our patients with haematological problems.

The Department also carried out special red cell serological investigations on problematic samples referred from other hospitals and issued reports. Counselling services are also offered to blood donors detected to be reactive for hepatitis markers before referring them to Medical Gastroenterology Department.

Research Programmes

Study of the effectiveness of therapeutic plasma exchange on outcome of patients with Guillain-Barré syndrome. The aim of this work was to study the various techniques of therapeutic plasma exchange and neurological outcome of patients with Guillain-Barré syndrome.

Study on the effectiveness of platelet rich plasma prolotherapy (local administration) in management of pain-related disorders.

Training

As a National AIDS Control Organisation (NACO) training centre, the Department trained 32 medical officers, 40 blood bank technicians and 22 nursing staff working in blood banks across the state. One MD and two diploma students joined in the current year making a total of 2 MD and 4 diploma students.

Events organized by the Department

The Department conducted a CME on "Hemotherapy-Recent Trends and Developments" on 21 February 2016 at Hotel Chaithram, Trivandrum with Dr Sathyabhama S as the Organising Secretary. More than 100 doctors and postgraduate students from various medical colleges in the state attended it. Four invited speakers lectured on various topics and 10 postgraduate students presented free papers (Figure 42).

The National Blood Donation Day was celebrated with felicitation of our regular blood donors and organisers. The function was inaugurated by Dr Asha Kishore, and certificates were distributed (Figure 43).

Faculty

Dr Jaisy Mathai, Scientist G (Senior Grade) & Head of the Department

Dr P V Sulochana, Scientist G

Dr Sathyabhama, Scientist G

Dr Debasish Gupta, Professor

Technical

Ms Sheeladevi S, Scientific Officer

Ms Sindhu P N, Junior Scientific Officer

BIOMEDICAL TECHNOLOGY WING

DEPARTMENT OF APPLIED BIOLOGY

The Department of Applied Biology was formed during the re-structuring of the BMT Wing on 1st January 2016 by merger of the following Divisions:

1. Experimental Pathology and Histopathology Laboratory
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
10. Transmission Electron Microscopy

The Department plays a major role in providing testing services that form the backbone of all product development activities of the Institute. A large number of tests performed by the different Divisions are accredited by Comité français d'accréditation (COFRAC) of France and essential for technology transfer of the specialized medical products of the Institute. These tests have also been availed by external customers from Indian and international industry and academia to strengthen their portfolio for obtaining CE mark. Further, the Divisions offer several non-accredited tests that are important in product development activities. The faculty, MPhil and PhD students, and post-docs of the Divisions are engaged in research on various aspects of applied biology as detailed below under the individual Divisions.

DIVISION OF EXPERIMENTAL PATHOLOGY

The Division of Experimental Pathology performs histological evaluation of samples for research and evaluation purposes. The dedicated histopathology laboratory employs specialized techniques for evaluation of biocompatibility of various materials as per international standards and pre-clinical evaluation of medical devices as per approved protocols. The laboratory has maintained the quality system for past 11 years and has retained the COFRAC accreditation for selected tests. The COFRAC external audit was completed on 15-16 October 2015.

In the past year, the Division developed an innovative non-detergent/enzymatic method for preparing implantable grade scaffolds from porcine cholecyst (gall bladder). Its potential for various applications is being explored.

Four DNB (Pathology) students visited the histopathology laboratory for training.

Product Development

Prototypes of skin substitutes were prepared using decellularised porcine gall bladder and subjected to pre-clinical safety evaluation. A biphasic hydroxyapatite-based keratoprosthesis was designed using in-house bioceramics facility and implanted in an animal model.

Research Programmes

1. Bioartificial Skin

The Division fabricated a prototype of provisional bioartificial skin by seeding human keratinocytes/fibroblasts on porcine cholecystic extracellular matrix (Figure 1) and demonstrated its use for treating burn wound in a rabbit model. Wound healing potential of scaffolds prepared from porcine jejunum and urinary bladder by a non-detergent/enzymatic method was also explored.

2. Titanium porous structures for osteogenesis

Under a multi-institutional project, titanium (Ti) porous structures, prepared by LAM, RRCAT, Indore, using Laser Rapid Manufacturing technique, were found to be noncytotoxic by in vitro cytotoxicity tests and haemocompatible. The Ti porous structures also induced osteogenesis in rat bone marrow mesenchymal stem cells.

Testing and Evaluation

A total of 216 specimens were received from internal and external customers for histological evaluation, which included muscle and bone with implant for biocompatibility evaluation as per ISO 10993-6 and preclinical evaluation specimens such as tissue-engineered scaffolds, right ventricular outflow tract (RVOT) (Figure 2), vascular grafts, brain tissue and wound healing studies. Requests for evaluation in large, preclinical studies from both Indian industry and research groups, and international research

groups were also addressed. They included studies on bare and drug-coated stents (Figure 3), mechanical heart valves, small and large diameter vascular grafts and surfacemodified bone implants. Student-based studies from international Institutes involving histopathological studies on bone grafts, orthodontic screws, de-cellularised tissue as conduits and corneal substitutes were also carried out. Twenty-seven accredited and non-accredited reports were issued.

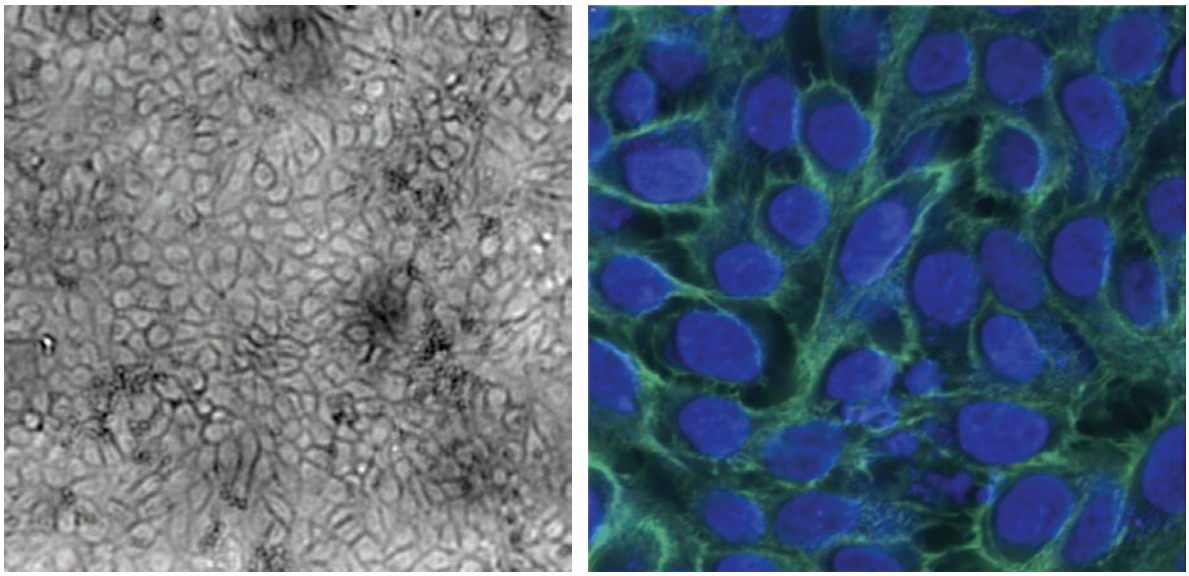


Figure 1. Bioartificial skin under Phase contrast microscopy 10x (a) and Confocal microscopy DAPI /Phalloidin-FITC 40x (b)

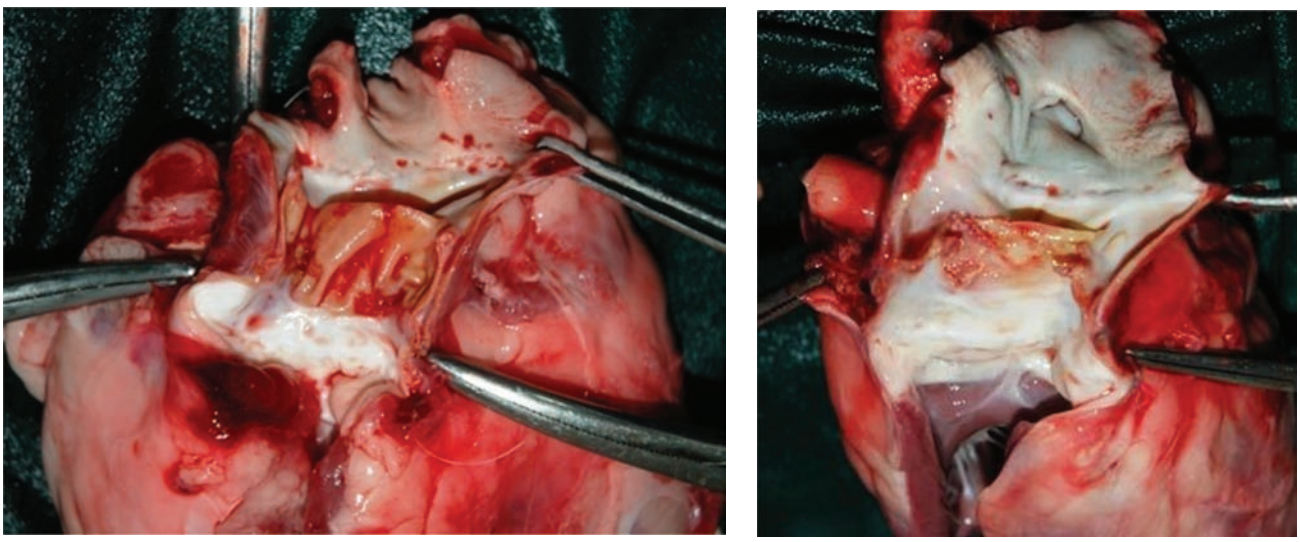


Figure 2. RVOT graft in sheep heart

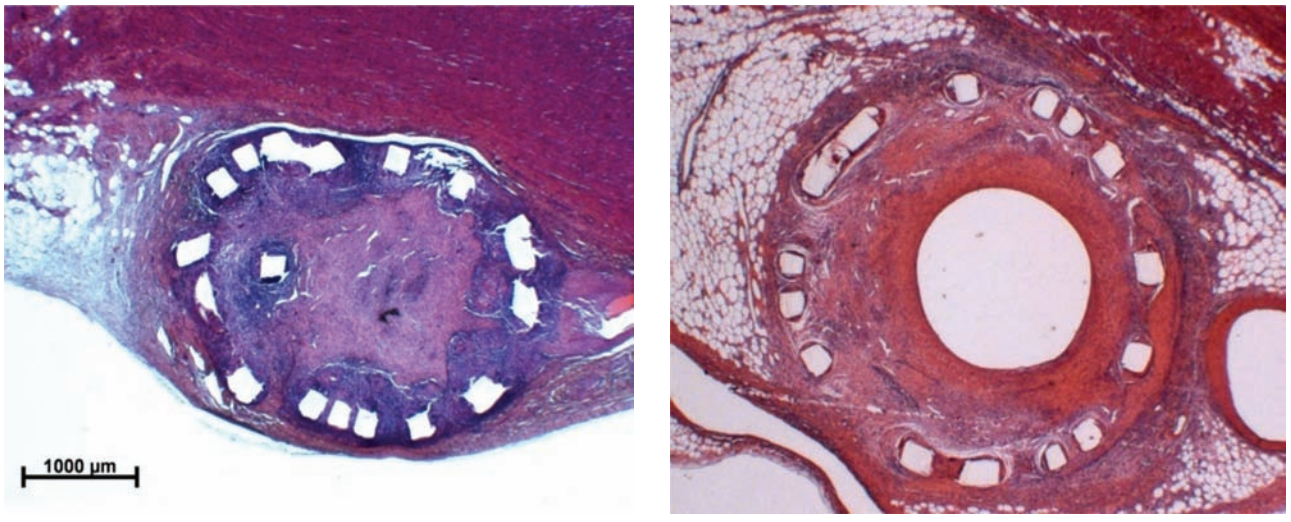


Figure 3. Degradable coronary stent in coronary vessel with complete occlusion of lumen (a) and neointimal hyperplasia (b) (H&E stain)

DIVISION OF LABORATORY ANIMAL SCIENCE

The Division facilitates research and testing using small laboratory animals by imparting care, welfare and management of small laboratory rodents and rabbits. It is effected as per ISO 10993 Part-II for testing facility of which the quality system is based on ISO/IEC 17025. The Division is under the surveillance of COFRAC for the quality system and registered under the CPCSEA. Periodic quality assurance and compliance with ISO 10993 Part II guidelines was ensured during the year.

The Division has a state-of-the-art experimental animal facility and developed several animal models for biomedical research. As a new initiative, the Division started inbreeding BALB/c mice.

Research Programmes

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

1. Development of a non-invasive stress assessment technique in New Zealand white rabbits using enzyme immunoassay.
2. Calvarial defect repair in osteoporotic rat model to study the efficacy of bone implant.
3. Study of carbamazepine embryotoxicity in relation to MDR1 polymorphisms and Pgp expression in mice.
4. A hybrid tissue-engineered skin substitute to treat burn wounds.

Testing and Evaluation

Animals bred and supplied from the Division for testing and research during 2015-16:

Rabbits NZW: Sctb -138; Rats Wi:Sctb/SD:Sctb/SHR - 687; Mice BALB/c /SA:Sctb - 529; and Guinea Pigs (HA:Sctb) -180.

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 12 participants (MSc students and PhD scholars) from all over the country.

The staff in the Division were trained in Refinement of Euthanizing methods based on "Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010" on the protection of animals used for scientific purposes on 19 March 2016. The "Techniques to be applied in Rodents, Rabbits" were dealt with in detail.

DIVISION OF MICROBIAL TECHNOLOGY

The Division of Microbial Technology is involved in medical device/biomaterial evaluation, facility monitoring of controlled environments, research into understanding molecular mechanism of medical device-related infections and its prevention by surface modification of devices or materials.

Product Development

1. The Division developed a rapid urinary tract infection diagnostic kit with antibiogram (Rapidogram) for which evaluation of shelf life is ongoing.

2. An antibiotic active predominantly against Methicillin-Resistant Staphyloccus aureus (MRSA) was discovered. The bacillus strain producing it was characterised and the fermentation parameters for its production and purification are being addressed.

Research Programmes

1. *Immunomodulation by Pseudomonas biofilms*

P. aeruginosa is a Gram-negative, opportunistic pathogen capable of infecting a wide range of host and can invade different tissues, including respiratory tract, damaged or burnt skin or injured cornea. The ability of P. aeruginosa to adapt to inhospitable environments, minimal nutritional requirements and their inherent resistance to antibiotics allows them to survive in different hosts, leading to the formation of biofilms on the adapted surfaces. Biofilm forming ability by different strains in response to temperature, pH, iron concentration and antibiotics were analysed and interesting leads obtained. Maximum biofilm was produced at body temperature of 37ºC, while alkalinity reduced biofilm formation. Study of the role of siderophores and iron sequestration in biofilm formation demonstrated that ferric chloride promoted biofilm formation. Curli is a bacterial cell wall structure that plays a role in initiation and maturation of biofilm; and work on dynamics of curli expression is progressing.

2. *Pulmonary fibrosis - Role of micro to nanosized particles, a common constituent of air*

Pulmonary fibrosis is a chronic lung disease characterized by excessive accumulation of extracellular matrix (ECM) and remodelling of the lung architecture. To understand the fibrotic changes in alveolar epithelial cells, the hydroxyapatite (HA) microparticle-driven changes were compared to a known fibrosis-inducer bleomycin, an anticancer antibiotic. HA toxicity to alveolar epithelial cells increased in a dose-dependent manner as seen by LDH assay, which was substantiated by microscopy.

3. *Study the modulations in molecular mechanisms of Klebsiella pneumoniae infection*

Klebsiella pneumoniae is a common pathogen causing a number of infections like pneumonia, septicaemia, wound and nosocomial infections. Epithelial cells are the first line of defence against infection in any organ or tissue, and in the lung it is Type I and II pneumocytes. The molecular pathology of alveolar epithelial cell infection was addressed during the year. For this, the in vitro effects of Klebsiella virulence factors on A549 cell monolayers that are representative of Type II pneumocytes were studied. It was found that, in comparison to ATCC strain, Klebsiella 4352 strains from clinical isolates were capable of producing biofilms and actin modulation.

Testing and Evaluation

The Division of Microbial Technology is involved in evaluation of medical devices at various stages of development starting from facility monitoring. Three evaluation protocols are accredited by COFRAC. For preclinical and biocompatibility evaluation, the animals used are evaluated for presence of bacterial and viral pathogens in the sentinel animal health monitoring programme.

In the past year, 116 evaluations were done, with details as follows: Sterility test (16); In vitro genotoxicity assay (3); Bioburden analysis (1); Microbiological monitoring of air (27); Water analysis (12); Growth promotion test for Media validation (10); Antimicrobial activity test (5); Dynamic contact antimicrobial activity testing (6); Spore viability test (2); and, Screening for pathogens in experimental animals (30).

DIVISION OF MOLECULAR MEDICINE

Product Development

Recombinant growth factors VEGF and TGF-alpha have critical role in wound healing. The main aim of the project is to have controlled release of these growth factors in chronic wounds so that the healing process is augmented. The Division initiated the programme to incorporate the growth factors into bio-scaffolds to see how it helps in the healing

process. The growth factors were expressed as functional peptides to increase the stability and their bioactive level. The process also helped in reducing the cost of development of these growth factors. Assays showed high bioactivity.

Research Programmes

1. Interactome neuronal network variations and gene expression alterations in brain during physiological and pathological conditions

Learning and memory are two of the critical functions of brain and are maintained by neural plasticity and alterations in network of neuronal cells. Caenorhabditis elegans is an excellent model system to study the neuronal architecture and its variations because of its fewer number of neurons and the presence of all the neurotransmitters found in the human brain. Various learning paradigms like imprinting and learning were developed in these model organisms (both normal and specific mutants) to see the functional characteristics both at cellular and organismal levels. An important observation was the role of dopamine in behavioral variations. Besides, the neural circuits involving interneurons, AIY and RIM are critical in learning and memory. The gene, sra-2, was found to have a role in memory-forming pathways.

Human synuclein expressing C. elegans in dopamine neurons were found to have more sensitivity to metallic salts. This is similar to the reported role of heavy metals in development of Parkinson's disease. Synuclein protein was found to accumulate specifically in the cell bodies of dopamine neurons. The highly sensitive organisms showed axonal degeneration and high mortality.

2. Epileptogenesis and role of NMDA receptor subtypes in hippocampal neurons and astrocytes

NMDA receptors (NMDAR) are important for memory formation, synaptic plasticity and excitotoxicity. Using electrophysiology and NMDAR antagonist, the role of NMDAR in epileptic seizure was investigated. Pilocarpine rat models (in epilepsy) were generated and histopathology of rat brain sections was studied. Blocking NMDAR altered the signal spikes in the brain slice models.

DIVISION OF SLEEP RESEARCH

The Division evaluated the role of sleep during pregnancy and the development of early neural networks involved in different aspects of cognition and sleep-wakefulness in rat model. Scientific evaluation of herbal medicines on sleep was also carried out. Training was provided to international students in advanced neurophysiological techniques for sleep and sexual behaviour.

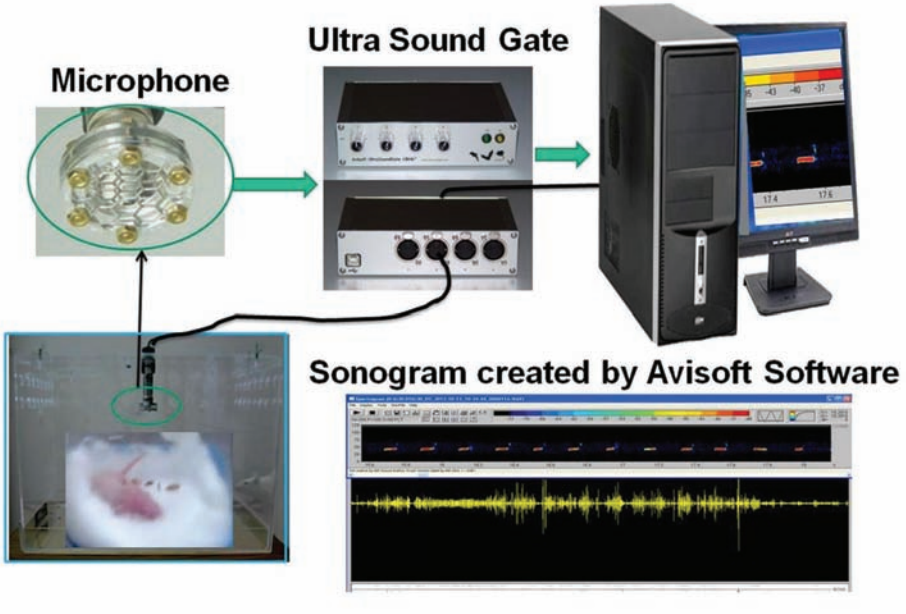


Figure 4. Ultrasonic vocalization (USV) recording set up for rats

Research Programmes

The Division is involved in Cognitive Science Research Initiative Programme to identify the role of sleep during pregnancy in shaping cognition in offspring in a mouse model (Figure 4). The study illustrated that significant sleep deprivation during the third trimester of pregnancy produced hyperactivity, emotional deficits and increased risk-taking behaviour during the entire peri-adolescence period. Increased crying during early postnatal days was observed in pups born to sleep-challenged mothers. The increased hyperactivity and risk-taking behaviour stressed the role of sleep during pregnancy, with deprivation leading to some phenotypic features of attention-deficit/ hyperactivity disorders. In addition, work to identify a safe herbal substitute for management of insomnia during pregnancy is ongoing.

DIVISION OF TISSUE CULTURE

The Division offers cell culture tests and studies to internal and external customers under the quality platform. The in vitro cytotoxicity test offered is accredited by COFRAC. The Division also offers technical support to product development and participates in research and development activities. Research areas include cell- material interaction, stem cells and tissue engineering, 3D tissue constructs and in vitro tissue models.

Product Development

A polymeric platform for translation from a flat 2D to a 3D culture model was proposed and initial studies were conducted.

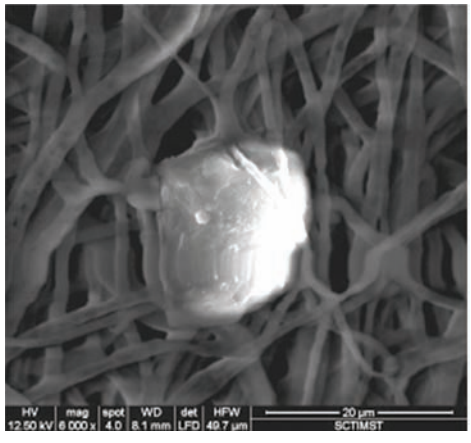


Figure 5. Bead entrapped electrospun PCL mat

Research Programmes

1. Electrospun matrix as wound dressing matrix

The electrospun synthetic non-woven fibrous matrix was proposed as a potential wound care device. Different modified versions of electrospun mats from polycaprolactone (PCL) were prepared for application in wound dressing. Surface-modified PCL mats showed improved in vitro degradation and enhanced cytocompatibility. Antibiotic-loaded chitosan microbead-entrapped PCL mats (Figure 5) were proposed as a novel wound dressing and results confirmed that the device is cytocompatible with mammalian cell lines with antimicrobial property.

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

Stem cells from human umbilical cord can differentiate into many lineages including cardiomyocytes. Commercially available Wharton's Jelly Mesenchymal Stem Cells (MSCs) were chemically differentiated to create a myocardial patch using in-house thermo-responsive Poly N-isopropylacrylamide-co-glycidylmethacrylate (NGMA) cell culture substrate. The stem cells were characterised for the markers CD90, Stro-1, CD105 (positive) and CD34 (negative) by immunostaining and flow cytometry; and differentiation was confirmed by analysing for cardiac markers like sarcomeric alpha-actinin, beta-myosin heavy chain, connexin 43 and cardiac Troponin T by immunostaining. The cell sheets could be detached from the culture surface by simple temperature variation.

3. Transdifferentiated Adipose-derived Mesenchymal Stem Cell (ASC) sheets for corneal surface reconstruction

Various stem cells were screened for their ability to differentiate into corneal lineage. Adipose-derived mesenchymal stem cells (ASCs) were transdifferentiated into corneal lineage (Figure 6) using limbal explant conditioned medium; and differentiation was confirmed using the corneal epithelial marker, cytokeratin 3/12. ASC cell sheets were retrieved

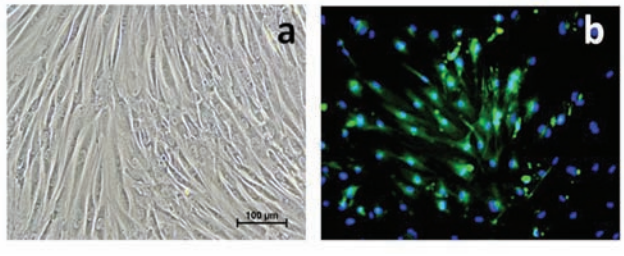


Figure 6. (a) Adipose derived MSCs differentiated to corneal lineage (b) Differentiated ASC expressing corneal epithelial cell marker cytokeratin 3/12

and transfer efficiency was evaluated in terms of viability and actin staining. Morphology and viability of the cell sheets before and after transfer were determined by actin cytoskeletal staining and Calcein AM staining, respectively.

4. *Hair follicle-derived stem cell sheets for corneal surface re-construction*

Isolation and culture conditions of hair follicular (HF) stem cells from rabbit vibrissae were optimized and characterization of the cells was initiated. HF-MSC and HF-epidermal stem cells were isolated. Positive staining for Oil red O confirmed the differentiation of HF-MSC cells into the adipogenic lineage. Differentiation into osteogenic lineage was confirmed via mineral deposition by positive staining with Alizarin red and von Kossa. Evaluation of the potential of these cells to differentiate into corneal epithelial lineage is ongoing.

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

Corneal stromal stem cells require proper extracellular matrix for their maintenance and differentiation under in vitro conditions. The themo-responsive NGMA culture substrate was modified by incorporating Type I collagen molecules and multipotent corneal stromal stem cells (CSSC) were successfully cultured. Conjugation of amniotic membrane-derived extracellular matrix proteins to NGMA was also studied for potential application in developing new stem cell source for ocular surface regeneration.

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

The study involves development of cost-effective biomaterial to regenerate dental pulp and periodontal ligament. Human dental pulp stem cells and periodontal ligament MSCs were isolated and differentiated in the presence of calcium-containing dental cements. Stem cells from periodontal ligament, exfoliated deciduous tooth, dental pulp and apical papilla were isolated and culture conditions standardized. The osteogenic differentiation property of the stem cells was analysed. Osteogenic differentiation of periodontal ligament cells on self-assembling peptide dendrimers was also evaluated.

Testing and Evaluation

Testing involved accredited tests of in vitro cytotoxicity for biomaterials and medical devices based on international standards. Cytocompatibiltiy studies were done for both internal and external customers.

DIVISION OF TISSUE ENGINEERING AND REGENERATIVE TECHNOLOGIES

The major thrust of the Division is the designing of suitable biological substitutes/ tissue-engineered constructs through the principles of tissue engineering. Current major research programmes of the Division are directed towards: (a) developing novel, biodegradable and biomimetic "designer" scaffolds (b) understanding the regeneration process using adult cells and directed stem cell differentiation, and (c) delineating the molecular pathways that regulate growth factors and other molecules to promote regeneration. Other areas of interest relate to usage of bioreactors wherein the in vivo environment is recapitulated and monitored in vitro, while exerting physiologically relevant mechanical and biochemical stimuli to guide neo-tissue development.

The Division contributes indigenously developed innovative scaffolds and biomaterials to other laboratories, institutional programmes, national and international collaborators. The scaffolds generated by the Division using conventional techniques, electrospinning, 3D printing, as well as regulator combinations find additional medical applications in drug delivery, wound healing and haemostats. Polymeric microneedles and injectable gels are other promising products from the Division.

Product Development

The Division focused on the development of different fabrication methods for scaffolding technologies like gels, freeze drying, gas foaming, electrospinning and 3D-printing. Preclinical evaluation of some of the scaffolds for cartilage and bone regeneration, a model for vascular regeneration and pancreatic substitute were started. Procedures for regulatory approval of injectable gel product for cartilage regeneration and a novel superabsorbent wound dressing material were also initiated.

Research Programmes

1. *Novel polysaccharide-protein cryogel scaffold for cartilage tissue regeneration and protein delivery*

The laboratory could develop a novel polysaccharide-protein cryogel, an injectable gel and 3D porous scaffold, which demonstrated higher biocompatibility with excellent chondrocyte interaction, cell infiltration and ECM deposition when seeded with chondrocytes in vitro. The scaffold was modified to incorporate additional proteins like H8 as a drug delivery matrix for de novo tissue regeneration. Further evaluation of the protein-releasing scaffold in vivo is under

way in the laboratories of collaborators in Copenhagen, Denmark.

2. *Development of hydrophilic electrospun fibrous scaffold for tissue engineering*

Scaffolds based on polycaprolactone (PCL), blended with a triblock co-polymer, polycaprolactone-polytetrahydrofuran-polycaprolactone (PCL-PTHF-PCL) at different ratios were fabricated by electrospinning. This generated a super hydrophilic scaffold, the mechanical and biological properties of which varied with the concentration of the triblock co-polymer. A variety of cell types could easily be grown on the scaffold without additional growth-promoting substances.

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

Synthetic 3D nanofibre scaffolds with hydrophilic-hydrophobic components were successfully developed through electrospinning. The synthetic polycaprolactone blend with polycaprolactone-polytetrahydrofuran-polycaprolactone block co-polymer (PCL/PCL-PTHF-PCL) in the ratio 90:10 was successfully electrospun to form hydrophilic scaffolds with large pore size that helps cell penetration and growth (Figure 7). This procedure helped overcome the major limitation of low pore size for a 3D nanofibre scaffold made by electrospinning. Rat mesenchymal stem cells were differentiated to form islet-like clusters on these scaffolds. These polymeric scaffolds were coated with natural and ECM molecules such as collagen IV, fibronectin, vitronectin and gelatin through EDC cross-linking to form surfaces that mimic the ECM surrounding islets during embryogenesis.

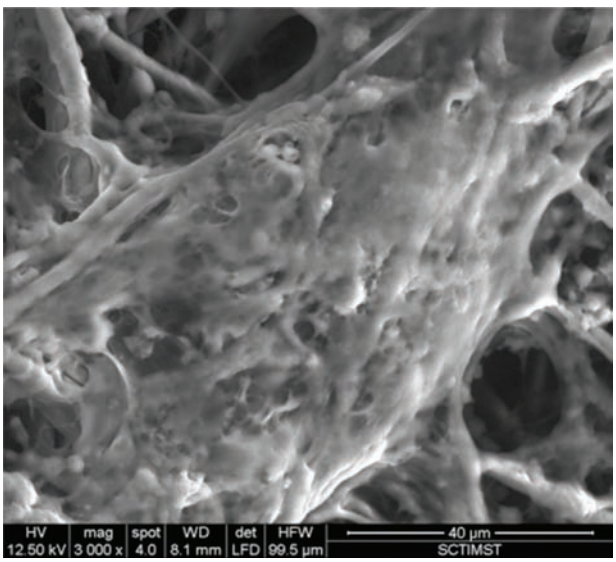


Figure 7. Rat mesenchymal stem cells growing on 3D electrospun scaffold

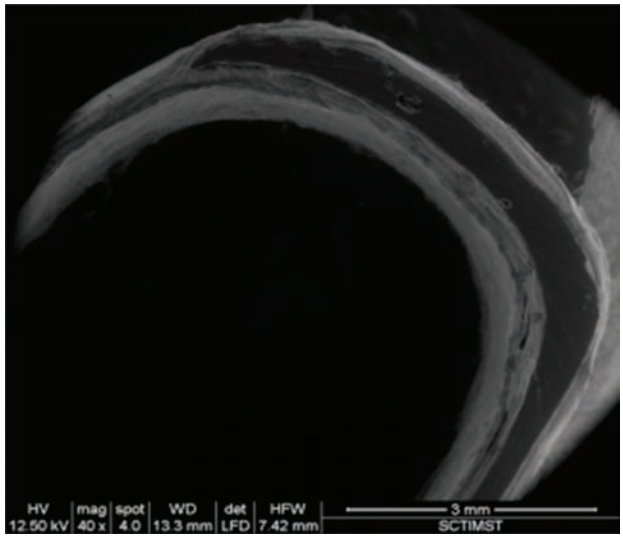


Figure 8. SEM images of cross-section of electrospun tubular scaffold with rings

4. *Tracheal tissue engineering*

A tubular scaffold for tissue engineering of trachea was fabricated by electrospinning of polycaprolactone (Figure 8). The mechanical characteristics of the scaffold at different polymer concentrations of 7%, 10% and 15% were compared. The scaffold made of 10% PCL was found to be most appropriate for tracheal tissue engineering. Live/dead staining of chondrocyte-seeded scaffold showed no dead cells and demonstrated secretion of ECM.

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 bypass the stratum corneum barrier and thus achieve enhanced transdermal drug delivery.

Polymeric microneedles for controlled delivery of biomolecules were developed and characterized. The MN were found to be sturdy enough to penetrate through full thickness skin and were capable of delivering embedded biomolecules in a controlled fashion. The MN showed good dimensional stability with minimal swelling when immersed in phosphate buffer saline for a period of 72 h at 32°C (Figure 9).

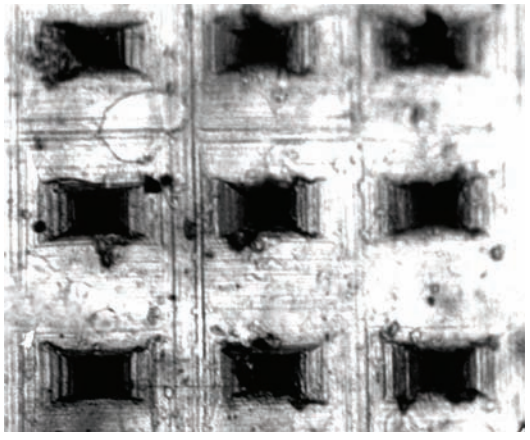


Figure 9. Impression of microneedles on skin model following insertion

6. *Basic studies on in vitro osteoarthritic model*

The study on in vitro osteoarthritic model was focused on developing a 3D platform to evaluate the success of tissue-engineered construct and MSCs for therapy or regeneration in osteoarthritis. For developing the osteoarthritic model, synoviocytes were cultured in vitro and they were found to be responsive to cytokine combinations in both 2D and 3D with production of catabolic enzymes and nitric oxide, thereby generating an osteoarthritic microenvironment.

7. *Electrospinning of Protein-PEG methacrylate blend to develop a layered skin construct*

A novel three-layered skin construct (named Ge3) was developed with electrospinning of 14w%, 17w% and 20w% over one another with the objective of avoiding the hassle of a sandwich model. The 20w% fibres fell on top of the construct, followed by 17w% and 14w% fibres, respectively. This decreasing inter-fibre gradient resulted in the first seeded fibroblasts percolating down to the lower layers. After two days, when HFSCs were seeded, they settled on top of the fibroblast layer. This was followed by seeding keratinocytes on top of HFSC layer, thus mimicking the structure of normal skin. SEM analysis clearly revealed three distinct layers of the construct.

8. *Tissue-engineered small diameter vascular graft*

Small diameter vascular graft with dimensions of 3.3 mm inner diameter, 6 cm length, 0.5 mm thickness was developed by dual opposite source electrospinning of Gelatin vinyl acetate copolymer and Poly-αcaprolactone. The tubular graft was optimised for its biomechanical parameters. Smooth muscle derived from rabbit adipose mesenchymal stem cells were seeded on to graft outer surface (Figure 10a). The graft was implanted interpositionally in the carotid artery of New Zealand white rabbits (Figure 10b). The suturability and ease of handling of the graft was excellent during implantation. Immediately after implantation, the graft showed pulsation and smooth blood flow. The study provided a stage to extend the application to larger animals.

Testing and Evaluation

The Division extended the laboratory facilities (Contact angle analysis, Extended UV and Fluorescence Spectrophotometer, Inverted and Upright fluorescence microscopes, Lyophiliser, Viscometer, Gel Doc and Rotovacs) to internal and external researchers.

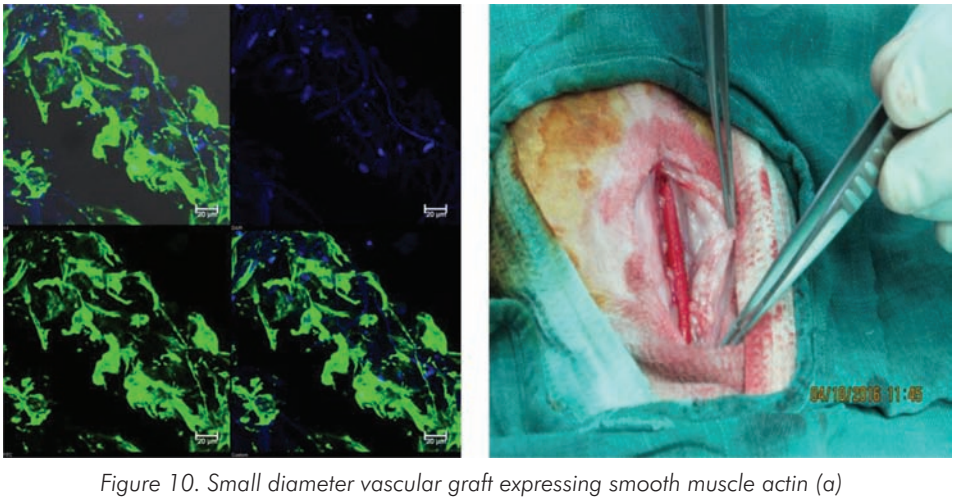


Figure 10. Small diameter vascular graft expressing smooth muscle actin (a) and implant in rabbit artery (b)

DIVISION OF THROMBOSIS RESEARCH

The Division focused on the development of biological products for various therapeutic applications. Fibrin glue components were tailored to use as cell and/or drug delivery vehicles and the initiatives resulted in three patent applications. For small-scale production of plasma proteins, the application for license is under consideration by the Drug Controller. Research activities continued to explore translational potential of adult human stem cells for neural, skin and cardiac regeneration.

A collaborative programme was initiated with IIT Guwahati for developing hybrid scaffolds by combining silk fibroin and human fibrin for applications in skin and cardiovascular tissue engineering with an MoU signed between SCTIMST and IITG. For development of point of care PT-INR monitor, collaboration with IIT Kharagpur was agreed upon and a concept note was submitted for funding.

Product Development

Isolation methods for two human plasma products, albumin and factor VIII (FVIII), were standardized during the year because of acute shortage of the products notified by the Hospital Transfusion Committee. They were validated to obtain virus-free, pharmacopoeia-grade products. In addition, a novel scaffold composed of fibrinogen and thrombin was identified for delivery of cells for regenerative applications. The porosity, cyto-compatibility and fibre strand thickness of this scaffold was compatible with cell survival, spreading and differentiation. Being an injectable composition, it is expected to be valuable in various cell-based therapies. In another aspect of the project, immobilization of albumin-conjugated curcumin in fibrin wafer increased the period of sustained release for >50 days when the wafers are suspended in tissue culture medium in the presence of serum. These activities resulted in filing of three patents during the year. Besides, the prototype of a 4x4 cm scaffold for use as skin graft in severe wounds was standardized with the help of precision fabrication team (Figure 11a) and experiments were carried out to standardize grafting of poly-lactide-glycolide-caprolactone and hemostatic fibrin scaffold in burn wounds of rabbits (Figure 11b).

Research Programmes

1. *Inflammatory proteins in diabetes*

Inflammatory proteins were identified in the circulation of diabetic subjects using 2D electrophoresis and mass spectroscopy analysis. Using bioinformatic tools, Peroxiredoxin-1, Peroxiredoxin-2, Ras-related protein Rab were identified in the platelet proteome of diabetic subjects, which probably play a major role in oxidative stress generation.

2. *Neural stem cells from adipose tissue*

Lipoaspirates from human subjects were processed to grow MSCs in culture. The MSCs were transformed in vitro to ectodermal lineage resulting in neurosphere formation (Figure 12) expressing nestin, the neural progenitor cell (NPC) marker. Moreover, induction of NPCs from circulating blood to neural lineage using a neural cell-specific fibrin niche resulted in activation of Wnt signal transduction. The neural lineage cells derived from adipose tissue and peripheral blood appeared to have a stable programmed biomimetic differentiation pathway, qualifying them as good candidates for cell transplantation therapy. The MSCs

Figure 11. Skin substitutes

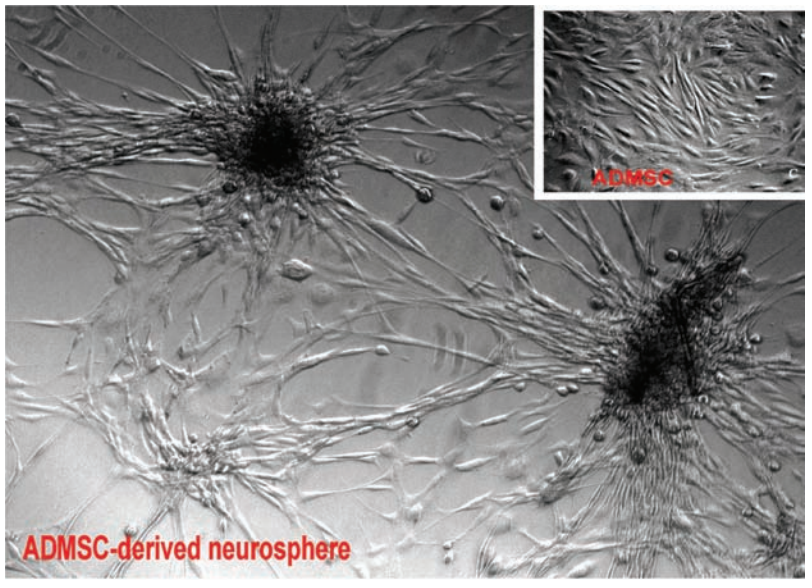


Figure 12. Neurospheres developed from human ADMSC

that differentiated into smooth muscle cells (SMCs) were suitable for small diameter vascular graft construction. The bioreactor chamber with ports for connecting 2.5 mm diameter graft was effective for seeding rabbit MSC-derived endothelial cells (ECs) and SMCs for evaluation in the same animal.

Testing and Evaluation

Quality system was maintained in the testing laboratory. Blood compatibility of materials developed internally as well as in external labs, was evaluated. A leukofilter developed within the Institute was evaluated by analysing nearly 300 samples before and after filtration. Coronary stents manufactured by various industries were evaluated for in vitro blood compatibility. Evaluation of drug-eluting stents was performed for efficacy of the eluted drug to induce apoptosis in vitro in endothelial cell cultures. Requests of customers from industry and academia were reviewed and suggestions were provided to them on various aspects of blood compatibility.

DIVISION OF TOXICOLOGY

The Division, which specialises in biomaterial toxicology, is accredited by COFRAC France as per ISO 17025. The Division is equipped with facilities for pre-clinical safety and toxicity/biocompatibility evaluation of various biomaterials, biomedical devices and tissue-engineered products as per International Standards such as ISO, USP and ASTM.

During the year, 60 materials were evaluated for toxicity with issue of 96 reports. The statistics of report generation is as follows: Closed patch test for delayed hypersensitivity - 3; Maximization test for delayed hypersensitivity - 10; Intracutaneous test - 15; Acute systemic toxicity test - 26; Implantation in muscle - 5; Pyrogen test - 1; Bone implantation - 2; Animal skin irritation test - 3; and, Physico-chemical analysis of potable water for various Divisions - 7 samples.

The Division also initiated support measures for the new TRC projects. An MoU was signed on 1 September 2015 between SCTIMST and Toyo University, Hakusan, Tokyo, Japan, for scientific collaboration.

Product Development

The proof-of-concept for the development of an ELISA-based in vitro pyrogen test kit for the evaluation of pyrogenicity using human whole blood was completed. This will be suitable to measure undetected non-endotoxin pyrogens of chemical or biological nature in a variety of applications.

Research Programmes

1. As part of the ICMR-supported project "Interfacing of nanographene with mouse bone marrow mesenchymal stem cells and its allied molecular toxicity using in vitro

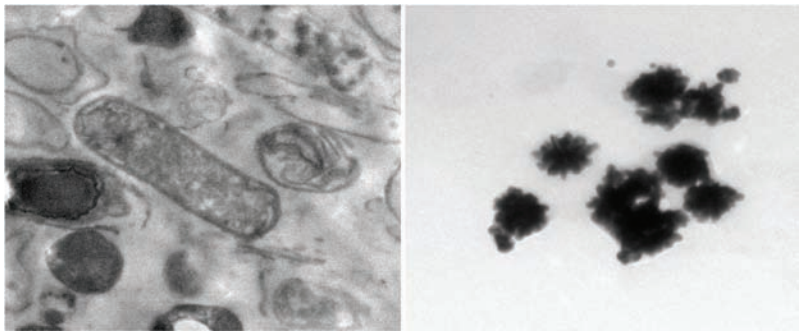


Figure 13. Ultrastructure of the bacterial culture and silver nanoparticle

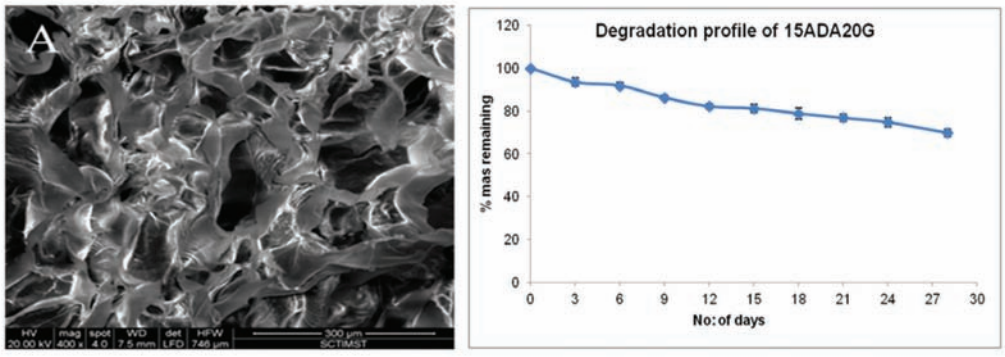


Figure 14. 3D suface topography and degradation profile of alginate dialdehyde - gelatin hydrogel

and in vivo methods", immunotoxicity, biodistribution and toxicokinetics of nanographene were monitored.

2. In another ICMR-supported project, "Integration of nanographene with rat neonatal cerebellar granule neurons and associated toxicity: an in vitro and in vivo approach", characterization of pleuronics-stabilized nanographene and granule neurons was carried out.

3. As part of a UGC-supported work on "Interaction of brain astrocytes with zinc oxide nanoparticles and related inflammatory, immuno and neurotoxicological response using rat model", standardization and characterization of astrocytes was achieved.

TRANSMISSION ELECTRON MICROSCOPY

The Laboratory has Transmission Electron Microscopy facility (Hitachi H-7650) for ultra-structural analysis of samples varying from animal and plant tissues, to cells to nanoparticles (morphology, size and distribution) (Figure 13). The facility is extended to researchers (internal and external) on payment basis. Activities of the Laboratory include transmission electron microscopic evaluation of samples by visualization of nanomaterials, sub-cellular structures and micron level scrutiny of all types of biological samples. In-house research focuses on the development and pre-clinical evaluation of hard tissue substitutes for orthopaedic applications. To facilitate repair and regeneration of the impaired tissue under pathological conditions, animal systems mimicking osteoporosis and intervertebral disc damage were generated and evaluated using in-house developed materials in combination with adult stem cells. Clinical trial of tissue-engineered bone, evaluated in this Laboratory was initiated at CMC, Vellore.

Research Programmes

1. *Evaluation of tissue-engineered Strontium-incorporated hydroxyapatite (SrHA) for the healing of osteoporotic bone defect in sheep model.*

Proof-of-concept studies of strontium hydroxyapatite (SrHA) scaffold for bone defects in osteoporosis were conducted in sheep osteoporotic models. It was observed that the incorporation of strontium in hydroxyapatite improves bone regeneration.

2. *Regeneration of intervertebral discs - a tissue engineering approach*

Regeneration of intervertebral disc is of high clinical significance in management of low back pain. Strontium (Sr) combined with alginate was evaluated in a rabbit model as a scaffold in combination with adult stem cells to address the issue. The radio-opacity of Sr was an added advantage.

3. *Role of microtubule-associated proteins and cross-linking proteins in maintaining cytoskeletal networking*

The work aims to understand the mechanisms of cytoskelatal cross-linking, which is critical for cell migration and processes such as wound healing. Migration of cells into the 3D scaffolds and adhesion of cells to the ceramic surface also depend on cytoskeleton and their interaction with different protein complexes. The study may help develop 3D in vitro model systems that can serve as pre-clinical platforms to study drug therapy, fracture healing and tissue regeneration.

4. *Meniscal tissue engineering*

Meniscal tear is the most common knee injury. A scaffold of alginate dialdehyde - gelatin hydrogel was developed to assist the repair of the injured meniscus after trauma. In vitro degradation of hydrogel showed 30% mass loss after one month (Figure 14). A 15:20 ratio material supported the proliferation of fibrochondrocyte cells of the meniscus.

AWARDS AND HONOURS

Dr A Maya Nandkumar received the prestigious Bridge Fellowship of the Japanese Society for Promotion of Science (JSPS). She visited 5 institutions and gave 3 invited talks of which one was a plenary lecture at the 13th International Symposium on Biosciences and Nanotechnology, 26-28 November 2015, Toyo University, Japan. She also delivered a talk at the 6th Indian Scientists' Association in Japan (ISAJ) Conference at the Indian Embassy in Tokyo, Japan.

Dr Kamalesh K Gulia received the 2nd prize for the poster 'Herbal Medicine: Drug Discovery from Herbs - Approaches, Innovations and Applications' at the International Training Workshop, 30 March-3 April 2015, Mysore & Ooty, India.

Prof V Mohan Kumar (Visiting Professor, SCTIMST) delivered the Prof R C Shukla Oration titled "Sleeping less is not a badge of honour" on 16 May 2015, at the King George's Medical University, Lucknow.

Prof V Mohan Kumar received the Lifetime Achievement Award in Sleep Medicine for the year 2015 from the American Association of Physicians of Indian Origin-Sleep (AAPIOS) on 7 June 2015, Seattle, USA.

Prof V Mohan Kumar received the Lifetime Achievement Award from the Association of Physiologists and Pharmacologists of India on 26 November 2015 at the Annual Conference of the Association, AIIMS-Jodhpur, Rajasthan.

Ms Sruthi S, PhD scholar, Toxicology Division, received the prestigious Raman-Charpak Fellowship 2015 of the Indo-French Centre for the Promotion of Advanced Research (Centre Franco-Indien pour la Promotion de la Recherche Avancée), New Delhi.

Ms Reshma S Cherian, PhD scholar, Toxicology Division, received the prestigious Commonwealth Split Fellowship-2015 of the Commonwealth Scholarship Plan Fellowship, United Kingdom.

Dr Prabha D Nair was awarded FRSC (UK) (Fellow of the Royal Society of Chemistry UK).

FACULTY

Dr Prabha D Nair, Head of the Department, Scientist G (Senior Grade) & Scientist-in-Charge, Division of Tissue Engineering and Regenerative Technologies

Dr T V Anilkumar, Scientist F & Scientist-in-Charge, Division of Experimental Pathology

Dr A Sabareeswaran, Scientist E, Division of Experimental Pathology

Dr V S Harikrishnan, Scientist D & Scientist-in-Charge, Division of Laboratory Animal Science

Dr A Maya Nandkumar, Scientist F & Scientist-in-Charge, Division of Microbial Technology

Dr Anoopkumar Thekkuveetil, Scientist F & Scientist-in-Charge, Division of Molecular Medicine

Dr Kamalesh K Gulia, Scientist D & Scientist-in-Charge, Division of Sleep Research

Dr T V Kumary, Scientist G & Scientist-in-Charge, Division of Tissue Culture

Dr Anil Kumar P R, Scientist D, Division of Tissue Culture

Dr Lynda V Thomas, Scientist D, Division of Tissue

Engineering and Regenerative Technologies

Dr Lissy K Krishnan, Scientist G & Scientist-in-Charge Division of Thrombosis Research

Dr Anugya Bhatt, Scientist D, Division of Thrombosis Research

Dr Mohanan P V, Scientist F & Scientist-in-Charge, Toxicology Division

Dr Remya N S, Scientist C, Toxicology Division

Dr Annie John, Scientist F & Scientist-in-Charge, Transmission Electron Microscopy (until 31-01-2016).

TECHNICAL

Ms Sulaikha Baby K L, Scientific Officer, Division of Experimental Pathology

Dr Geetha C S, Junior Scientific Officer, Division of Experimental Pathology

Mr Thulaseedharan N K, Junior Tech Officer, Division of Experimental Pathology

Mr Joseph Sebastian, Technical Assistant, Division of Experimental Pathology

Ms Sreeja K R, Technical Assistant (Lab) - A, Division of Laboratory Animal Science

Mr Sarath Kumar R S, Technical Assistant (Animal Lab) - A, Division of Laboratory Animal Science

Mr Pradeep Kumar B, Animal Handler, Division of Laboratory Animal Science

Mr Manoj M, Animal Handler, Division of Laboratory Animal Science

Mr Sunil Kumar M, Animal Handler, Division of Laboratory Animal Science

Mr Pradeep Kumar S S, Senior Scientific Assistant, Division of Microbial Technology

Mr Jose Jacob, Senior Scientific Officer, Division of Molecular Medicine

Ms Usha Vasudev, Scientific Officer (Lab), Division of Tissue Culture

Ms Deepa K Raj, Technical Assistant (Lab) - B, Division of Tissue Culture

Mr Vinod D, Technical Assistant (Lab) - A, Division of Tissue Culture

Ms Nimi N, Technical Assistant (Instruments) - A, Division of Tissue Engineering and Regenerative Technologies

Mr Anilkumar V, Scientific Assistant, Division of Thrombosis Research

Ms Priyanka A, Technical Assistant (Lab) - B, Division of Thrombosis Research

Mr Ranjith S, Technical Assistant (Lab) - A, Division of Thrombosis Research

Mr Shaji S, Animal Care Take, Toxicology Division

Mr Harikumar G, Animal Handler, Toxicology Division

Ms Amruthakumari, Unit Assistant, Toxicology Division

Ms Susan Mani, Technical Assistant, Transmission Electron Microscopy

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 following Divisions and Laboratories:

1. Division of Bioceramics
2. Division of Biophotonics and Imaging
3. Division of Dental Products
4. Division of Biosurface Technology
5. Polymer Analysis Laboratory
6. Polymer Division
7. Ceramic Coatings Facility

The Divisions under the Department have transferred and commercialized a large number of technologies to industry. The current emphasis is mainly on 3D bioprinting, tissue engineering, nanoparticles for biophotonic applications, synthesis and characterization of novel polymers and bioceramic materials for biomedical applications. The activities of each Division are described below.

DIVISION OF BIOCERAMICS

The Division is dedicated to the development of materials and strategies for bone substitution. This year, the bone graft design activity entered a new phase by producing bioceramic scaffolds for bone tissue engineering intended for human use. These cylindrical, porous scaffolds made of hydroxyapatite, tricalcium phosphate and calcium silicate are being used in human clinical trials at CMC Vellore, as a joint programme supported by DBT. The trial is on segmental defects in long bone wherein the scaffolds are cultured with patients' own (autologous) bone marrow cells and implanted. Special good manufacturing practice (GMP) facility for tissue engineering was set up at CMC Vellore for this work. The initial results are highly promising.

A new work of development of bioactive coating for dental implants was started as a part of the Centre of Excellence Programme of Department of Biotechnology, which is co-ordinated at IISc, Bangalore. Coatings of bioactive ceramics on the implant will provide osteointegration, which adds to the stability and longevity of the implant.

A team from M/s Surgiwear, one of the established bone graft dealers in India, visited the Division and expressed their interest in our expertise of manufacturing self-setting bone cements. Further discussions were initiated for technology transfer.

Product Development

New, bioactive, self-setting cement based on calcium sulphate was developed. The cement contains medical grade, low-dimensional calcium sulphate crystals modified with hydrogen orthophosphate ions synthesized through a patented 'drowning-out' technology. This product named 'BioCaS' (Figure 15) is a cost-effective bone filler cement useful for orthopaedic and dental applications.

The cement underwent biocompatibility studies as per the standard ISO10993 and following US FDA guidelines. It was found to be safe for human use. Pre-clinical bone implantation studies done in a rabbit model revealed BioCaS to be osteoconductive and its efficacy of healing the critical size bone defect is at par with that of hydroxyapatite ceramic.

Figure 15. BioCaS – the new bioactive cement

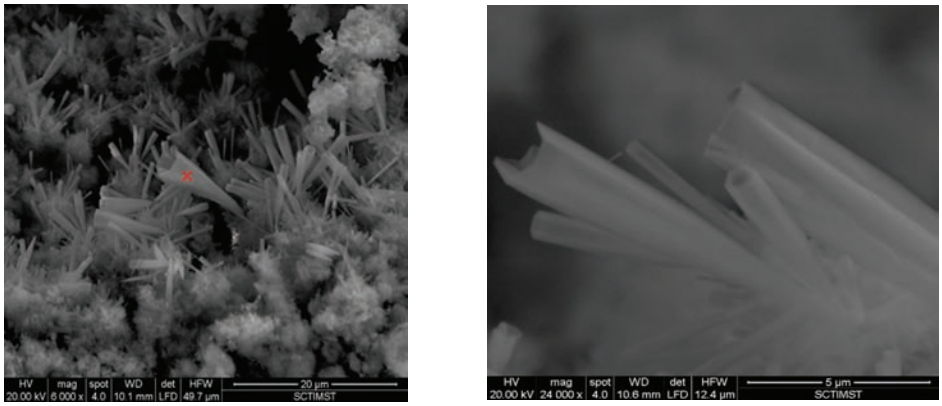


Figure 16a. Artificial nano sponges: ESEM image of the hydroxyapatite microfunnels after 24 hr hydrothermal reaction

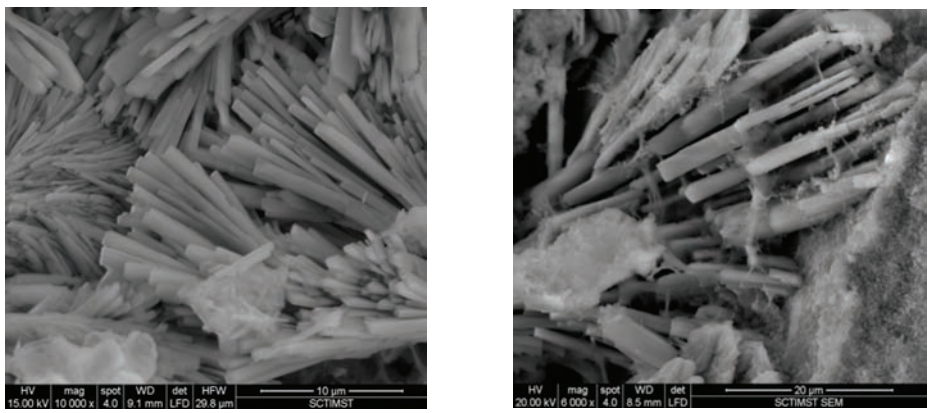


Figure 16b. ESEM image of calcite-derived calcium phosphate scaffold after 24 hr exchange reactions

Research Programmes

1. *Exotic bioceramic materials by hydrothermal synthesis*

Calcium-deficient phosphate was converted by hydrothermal synthesis to hydroxyapatite. In a similar way, calcium carbonate precursors were also hydrothermally converted to bioactive calcium phosphate scaffolds. Figure 16a shows a highly porous apatite scaffold having micron-sized funnels with diameter in the range of 200 nm. Figure 16b shows another apatitic bioceramic having nacre-like microstructure.

2. *Superparamagnetic nanoparticles for cell manipulation and theranostic applications*

Newly developed superparamagnetic iron oxide embedded hydroxyapatite nano-composite particles and its corresponding magnetic microspheres were studied for three dimensional cell cultures via magnetic levitation technique. The films of cells proliferated and formed a sheet-like structure (Figure 17). Moreover, the cellular structure, integrity and cell–cell interaction did not change with the presence of the nanoparticles. In the growth under magnetic levitation, the cells formed a spheroid shape with good cellular integrity.

3. *Safety and efficacy of injectable bioactive calcium sulphate bone cement*

A new bioactive composition of calcium sulphate (named 'BioCaS') was developed for bone filler applications. This is a self-setting cement, which is injectable with a needle when mixed as a paste. The safety and efficacy evaluation was done as per international standards, and it was found

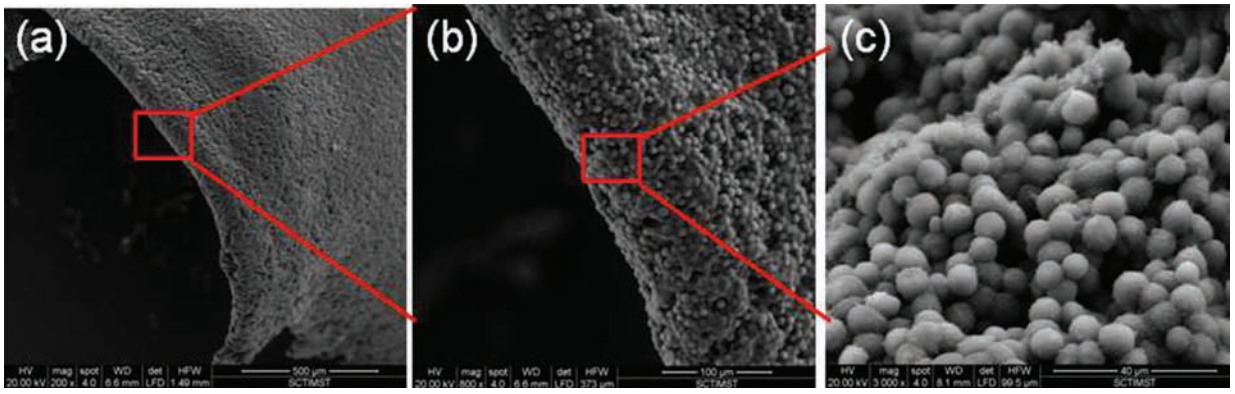


Figure 17. ESEM images of superparamagnetic iron oxide embedded hydroxyapatite nano-composite particles incorporated magnetically levitated three dimensionally cultured HeLa cells sheet

to be biocompatible. The efficacy of the material in healing bone defect was investigated by implanting in rabbit femur with hydroxyapatite porous ceramic as the control, and by analysing histologically at 12, 26 and 52 weeks (Figure 18).

Testing and Evaluation

1. The Laboratory offered various tests for internal and external customers, including:
2. X-Ray Powder Diffraction
3. Scanning Electron Microscopy (SEM), Environmental Scanning Electron Microscopy (ESEM) and Energy-dispersive X-ray spectroscopy (EDS) analysis
4. Atomic Emission Spectroscopy with Inductively Coupled Plasma (AES ICP) for elemental analysis

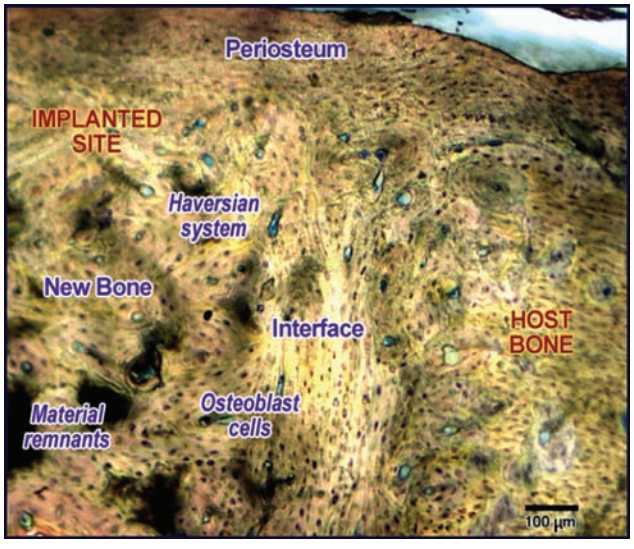


Figure 18. Histological section from the site of rabbit bone implanted with the cement at 52 weeks post-implantation. Formation of new bone and the interface with host bone are shown. The periosteum has completely healed. The new bone is characterized by osteoblast cells and the formation of Haversian system. Some remnants of the material are also seen.

DIVISION OF BIOPHOTONICS AND IMAGING

The Division focuses mainly on the development of light-sensitive and magnetic materials for imaging, sensing and therapy; and on photonics-based techniques for diagnosis and therapy. In this line, the Division has developed many nanomaterial-based contrast agents for optical and magnetic resonance imaging, and nanoprobes for biosensing. Additionally, a spectroscopy-based diagnostic tool for liver fibrosis was also developed.

A new multi-institutional project, in collaboration with NIIST, Trivandrum, titled: "Gold Nanorod Based Targeted Nanoprobe for Cancer Theranostics: Diagnosis By Surface Enhanced Raman Scattering (SERS) and Fluorescence Imaging and Therapy by PDT and PTT" was sanctioned for funding by DBT for a period of three years.

Product Development

1. Fluorescent gold cluster-based biomaterial for brain imaging and drug delivery was designed, pre-clinical evaluation was completed and a patent application was filed for the product.

2. Iron-based positive MRI contrast agent was designed and pre-clinical trials completed.

Research Programmes

1. Design of novel molecular probes

During the year, the Division undertook research to develop specific molecular probes to detect zinc release during epileptic condition by using ratiometric fluorescent detection. Gold nanorod-based probes were developed for targeted photodynamic therapy and fluorescence imaging. These probes were specifically modified to cross the blood-brain barrier and act as a carrier for drug delivery to the brain (Figure 19).

2. Vanadium nanoparticles in breast cancer

Vanadium (Vn) nanoparticles were developed and their effect on breast cancer was studied. It was observed that at a specific concentration, Vn nanoparticles induced cell cycle arrest and apoptosis.

3. Probe to track transplanted stem cells

A multi-functional probe was designed to track transplanted stem cells. Pro-survival and cardiac-specific signal was added to increase the number of stem cells that can repopulate the damaged heart. The work focused on the synthesis of a biocompatible and fluorescent material that can emit radiation in the near- infrared region.

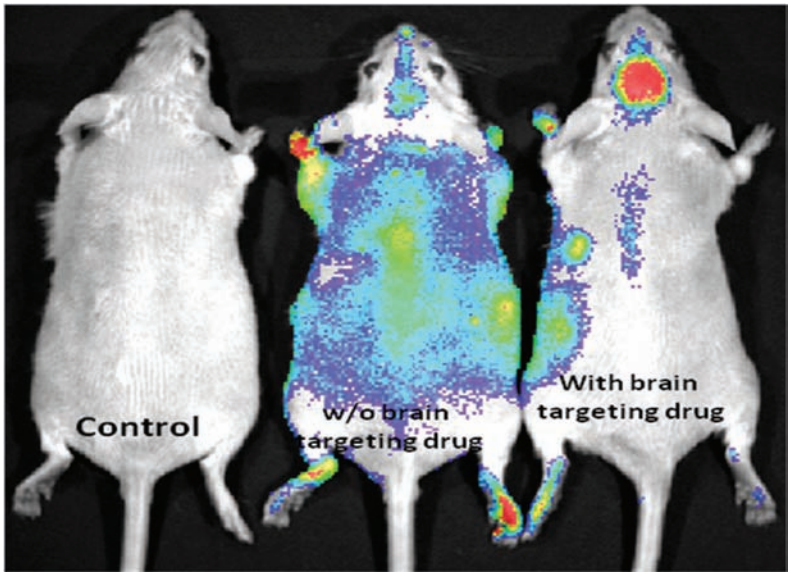


Figure 19. Nanoprobe for in vivo brain imaging and drug delivery - the red fluorescent probe modified with brain targeting drug enters the brain almost completely showing its potential for drug delivery and imaging

DIVISION OF DENTAL PRODUCTS

The Division is engaged in research on dental materials and development of dental products. The new initiatives of the year were:

1. A DRDO-funded project was approved for the development of a dental restorative based on inorganic-organic hybrid resin for the prevention of barodontalgia.
2. A new project on 3D bioprinting was started with Wake Forest Institute for Regenerative Medicine, North Carolina, USA, in February 2016. The Head of the Department and the Director, SCTIMST, visited the Wake Forest Institute for discussions.
3. A proposal for the development of bioactive bone cement based on novel inorganic-organic hybrid resins was approved for funding by the Kerala State Council for Science, Technology and Engineering.

Product Development

1. Development and characterization of a polymer-supported biological membrane scaffold for application to dermal burns wound was achieved during the year.
2. Novel amniotic membrane-based burn dressings were developed and characterised.
3. Discussions were held with industry regarding technology transfer of dental composites and burn dressings.
4. The award winning invention of intrauterine system (IUS) was presented before the Hon. Cabinet and Deputy Minister of Chemicals and Fertilizers and a panel of experts on April 23rd 2015 at New Delhi. The technology, already transferred to HLL Lifecare, is being marketed in the name 'EMILY' and a 300 lakh plant is currently being set up for its production.

Research Programmes

1. *Development of a bioactive radiopaque inorganic-organic hybrid resin for dental and orthopaedic applications*

The objective is to develop radiopaque hybrid resins that mimic the natural biomineralization process, and contain strong covalent bonds between the inorganic and organic components leading to synergistic properties of polymers and ceramics. They find application in dentistry as restorative material and in orthopaedics as bone graft material. Visible light-cured composites of dimetharcylate and tetra methacrylate- based hybrid resins were synthesized, and properties (like shrinkage, radiopacity and depth of cure) were evaluated. Cytotoxic evaluation is in progress.

2. *Development of smart dental composites with calcium-containing resins and fillers*

New composites were derived from multifunctional oligomers for fast in situ step-growth photopolymerization for medical application. They showed good physico-mechanical properties and low polymerisation shrinkage values, in addition to radio-opacity, bioactivity and non-cytotoxicity. The work resulted in three patent applications.

3. *Development of dental restorative based on inorganic-organic hybrid resins for prevention of barodontalgia*

This project is a joint programme with INMAS, New Delhi (DRDO), to develop smart composites with low shrinkage for use at high altitudes and depths. Development of formulations and cytotoxicity tests were completed. Animal experiments are due to start at INMAS facility. A joint patent on the formulation has been filed.

DIVISION OF BIOSURFACE TECHNOLOGY

The major activity in the Division is the research and development work on polymeric biomaterials for drug delivery, gene delivery and wound dressing applications. They are being synthesised using natural biopolymers approved for biomedical applications. The cationic vectors developed for anti-cancer gene delivery using pullulan were found to have low or no toxicity and good haemocompatibility. Another area is the development of antioxidant polymers for various biomedical applications with thrust on wound healing materials.

Research Programmes

1. *Development of Pullulan-based non-viral vectors for delivery of anti-cancer gene TP53*

Two major approaches for the delivery were evaluated, resulting in varying degrees of success: (a) by developing cationized pullulan-based thiomers and (b) by grafting molecules that improve blood compatibility without compromising the transfection efficiency.

(a) Thiomers for simultaneous gene delivery and P-glycoprotein (Pgp) inhibition: The study focused on disulphide-modified, pullulan-based cationic polymer

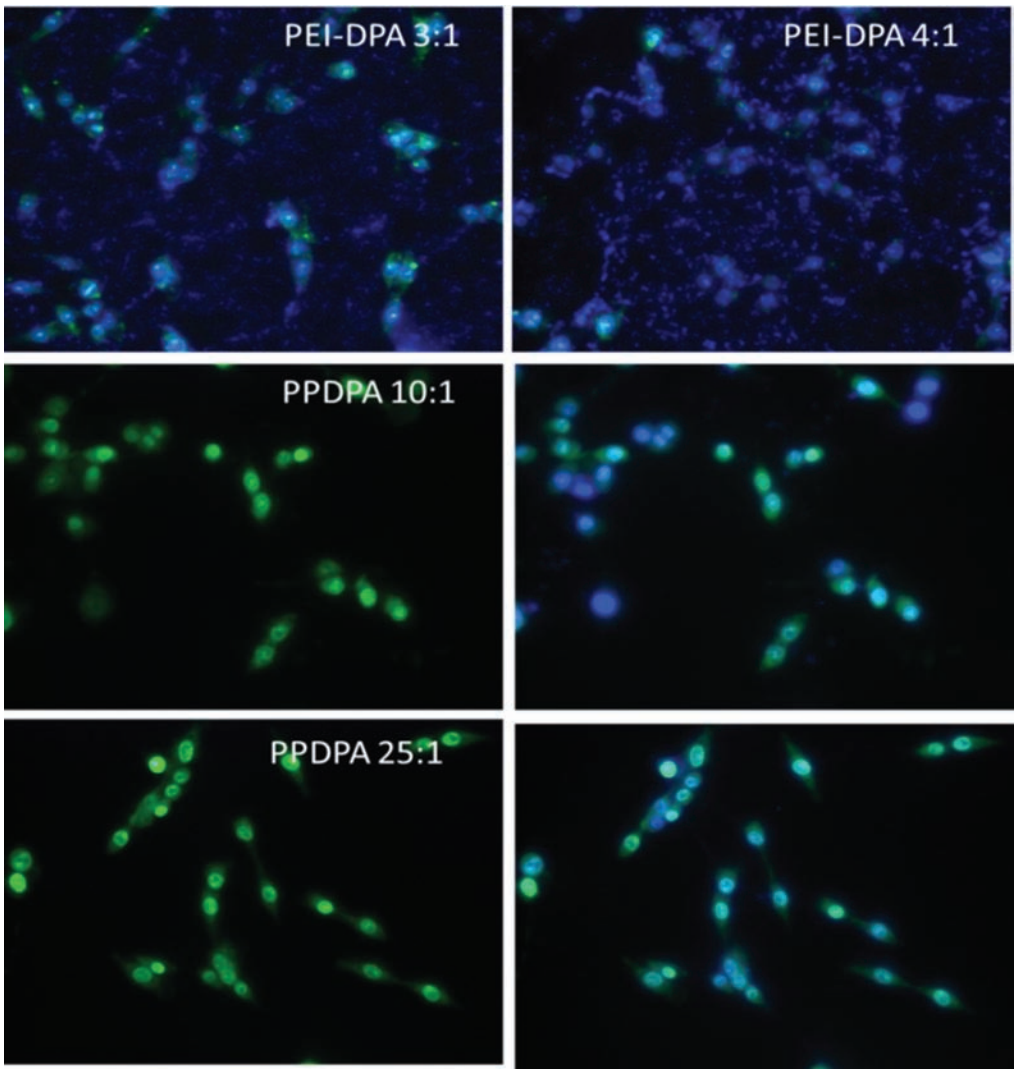


Figure 20. Uptake of the PPDPA nanoplex with polymer DNA ratio 10:1 and 25:1 and the control group PEI-DPA, indicating efficient uptake of YOYO-tagged DNA to the Hoechst-stained nucleus

to evaluate gene delivery efficacy, as well as efflux pump inhibiting property of the polymer. For this, pullulan was conjugated with the cationic polymer, Polyethylenimine (PEI), that was then combined with various thiol/disulphide-containing groups in varied composition. The polymers developed using various modifying groups showed a particle size of <200 nm and zeta potential value in the range +15 to +20 mV. The cell studies showed viability of >80% for all the polymers, excellent DNA uptake (Figure 20) and transfection efficiency, which was confirmed using fluorescence or confocal microscopy. The Pgp-inhibiting property of the polymer was also evaluated using the anti-cancer drug DOX that showed significant retention of DOX in the Pgp over-expressed cell line, indicating the potential application of polymers in efflux pump inhibition. Further studies in different cell lines such as HeLa and A549 are required.

(b) Monomer-grafted cationised pullulan for gene delivery purpose: The study was to analyse how the different monomers grafted to pullulan-PEI (PP) to influence its transfection efficiency. For this, 4 different monomers namely: 2-(Diethyl amino)ethyl methacrylate, ethylene glycol dimethacrylate, 2-[(Acryloyl oxy)ethyl] trimethyl ammonium chloride, 2-Methacryloyloxyethyl phosphorylcholine were grafted to pullulan-PEI at two different weight ratios by

Micheal addition reaction to form PPD, PPE, PPA, PPM, respectively. The optimum size and zeta potential were observed at the weight ratio 5:1 (polymer to ctDNA) for all polymers except PPM where the optimum weight ratio was 4:1. Smaller-sized nanoparticles were formed with the polymer PPM which was followed by PPE, PPD, and PPA. PPM and PPE showed almost similar zeta potential, which was higher than that of PPD and PPA. All grafted polymers except PPM showed >80% cell viability even at higher polymer concentration of 100 μg/ml. This toxic effect of PPM may have been due to its higher positive charge and buffering capacity causing cell membrane disruption and destabilisation. Of the four different polymers synthesised, excellent cellular internalisation and transfection efficiency in C6 cells was observed for PPD followed by PPE. Cellular internalisation was studied by tagging ctDNA with flourescent dye, YOYO and transfection efficiency by analysing the expression of p53 in C6 cells. Grafting percentage of PPM and PPA need to be further modified to make them suitable for gene delivery purpose.

POLYMER ANALYSIS LABORATORY

The Polymer Analysis Laboratory focuses mainly on three activities, namely, testing services, research and product-oriented missions. The Laboratory extends its testing services done on quality platform to internal and external customers. The research activities of the Laboratory are mainly on the development of multifunctional nanoscale materials for cellular imaging, drug delivery and biomolecular sensing. Last year, the focus was on the design of nanoprobes as theranostic agents.

Product Development

The collaborative ICMR-funded project for the development of glucose-sensing device, involving this laboratory and Vinvish Technologies, Trivandrum, entered the final phase. The methodology is devoid of enzymes and based on fluorescence measurements.

Research Programmes

1. *Multifunctionalized carbon dots as theranostic agents*

Carbon dots (CDs) have interesting applications in nanomedicine like cellular imaging, drug delivery and diagnosis. Digitonin (DG) is traditionally known as a cell membrane permeabilizing agent. Based on this fact, CDs were modified with DG (CDDG) and conjugated with methotrexate (MX). These probes (CDMX) were subjected to physico-chemical characterization, cytotoxic evaluation by MTT assay and cellular uptake studies using confocal laser microscopy. The drug release study indicated that at physiological pH release is less, indicating maximum drug retention in the probe during circulation. DG influenced the enhancement of cellular uptake and cytotoxic potential of the drug carriers. The internalisation of CDDG, CM (drug conjugate without DG) and CDMX was studied by incubating C6 glioma cells and the uptake visualised by confocal laser microscope (Figure 21). Fluorescent images indicated effective internalisation of CDMX. The uptake of CM also occurred, but the fluorescence intensity of the cells was less when compared to those incubated with CDMX. This suggests that the enhanced cytotoxicity of CDMX compared to CM is due to the improved internalisation of CDMX facilitated by DG. These results suggest DG can

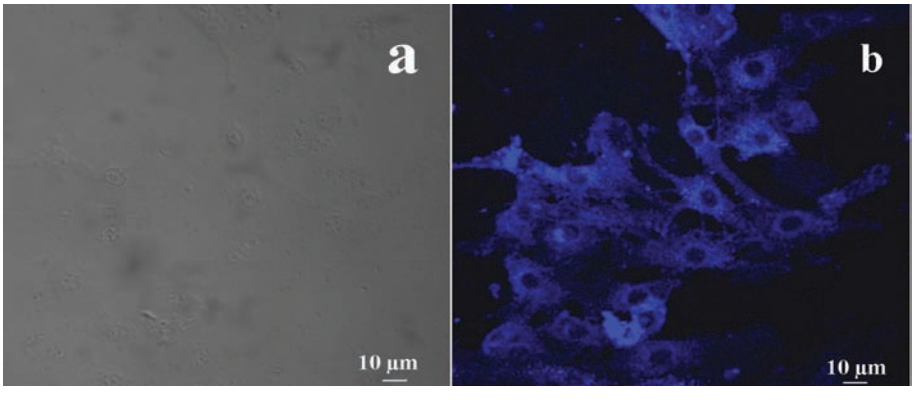


Figure 21. Confocal laser microscopic images under bright field of a) cells alone b) with Carbon dots modified with Digitonin and conjugated with methotrexate

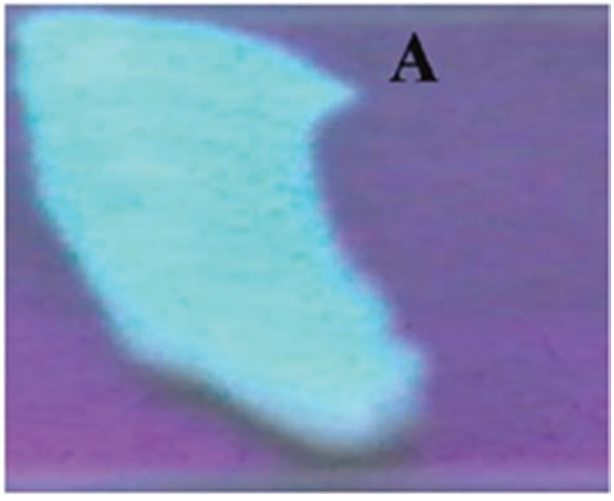


Figure 22. Photographic image of fat tissues incubated in CDNR

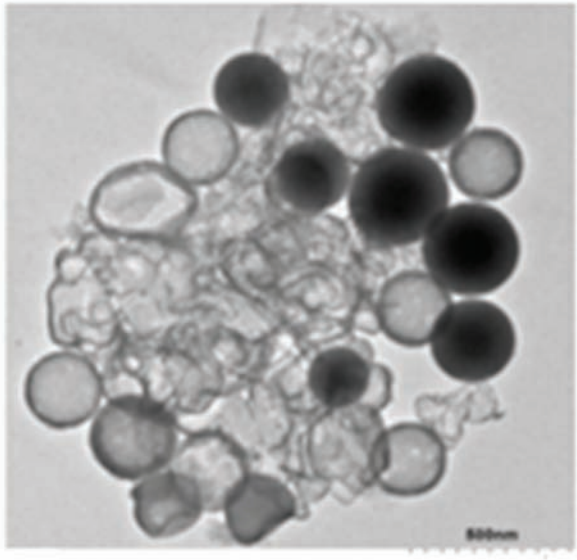


Figure 23. TEM image of the capsules

assist in better internalization of drug carriers and thus significantly increase the therapeutic potential of the drug. Potential theranostic probes can be created from CD by less complex chemical approaches.

2. *Hybrid nanoprobes for the imaging and disruption of cholesterol plaques*

Gold nanorods (NR) are widely used for sensing, imaging and drug delivery due to their unique light absorption and scattering features. A hybrid containing NR and CDDG (CDs conjugated with digitonin, DG) was designed for simultaneous detection and possible destruction of cholesterol deposits in the artery walls through photothermal therapy. DG was used in the hybrid considering its well-known affinity towards cholesterol. The hybrid (CDNR) can be used to locate cholesterol deposits on tissues exploiting the fluorescence of CDDG. It was reasoned that the photothermal property of NRs could be employed to destabilize the fat deposits by elevating the local temperature. This study involved characterization, cytotoxicity evaluation and cellular uptake of the hybrid probes. The nanoprobe appears to have the potential to serve as a therapeutic approach for simultaneous detection and possible removal of cholesterol deposits.

The tissue with atherosclerotic deposit incubated with CDNR was viewed under UV lamp (Figure 22). From the Figure, it is clear that the deposit incubated with CDNR is highly fluorescent, confirming the binding of the hybrid probe on to the tissue.

The morphology of the tissues incubated with CDDG and CDNR after the exposure to laser light was observed by ESEM analysis. The surface morphology of the tissue incubated with CDDG after laser light exposure was smooth, whereas the ESEM image of the tissue incubated with CDNR had a ruptured surface morphology. This may be due to the rise in temperature induced by gold nanorod by absorbing light. Thus, the hybrid system can be used for visualizing the cholesterol deposits on tissues and for the possible destruction of the plaques by elevating the temperature utilising the photo thermal property of NRs.

3. *Fluorescent smart nanocapsules for the oral delivery of peptides*

The oral formulation for insulin is challenging as the hostile environment in the intestinal tract causes its degradation. The pH-responsive nanocarriers are promising as they can encapsulate and protect insulin. Calcium carbonate (CaCO3) nanoparticles were chosen to serve as template. Silica layers were built over CaCO3 nanoparticles, followed by the conjugation of pH-responsive moieties. During the reaction, the calcium carbonate core particles were dissolved leading to the formation of hollow nanocapsules ranging in size from 225 nm to 246 nm and thickness of 19 nm to 58 nm (Figure 23). In addition, the influence of pH on release of insulin from the nanocapsules was studied. It was demonstrated that at pH 7.4, the nanoshells released 80% of the loaded insulin whereas at pH 2, the capsules nearly stopped the release of the drug.

4. *Colorimetric non-enzymatic method for detection of glucose*

Selective recognition and estimation of glucose in biological fluids is imperative for the management of diabetes. Many non-enzymatic methods have emerged to address the limitations of enzymatic approaches. A "green" approach was adopted here for the fabrication of a novel non-enzymatic glucose-sensing method based on the inclusion of 4-cyanophenyl boronic acid (CPBA) into αCyclodextrin (αCD)-stabilized gold nanoparticles (GNP). Solubility of CPBA, despite its good selectivity towards glucose, is low in aqueous media, which was addressed by addition of αCD. The three-component system was synthesized by a tandem one-pot method, and used as such for the selective and sensitive detection of glucose in aqueous medium. A concentration-dependent colour change was observed that was attributed to glucose-mediated aggregation of the probes as revealed by TEM analysis. This sensing methodology, using chemicals already available in the market can be adopted for routine glucose estimation.

The potential of this method to measure glucose concentration in real samples was illustrated by estimating glucose levels in serum collected from a clinical laboratory. The blood glucose levels obtained by this method was comparable to that of the clinical laboratory. The data validated the potential of the newly developed method for the detection of glucose in biological fluids. The notable feature of the method is its adaptability to rural set up as it can be generated by using available chemicals without complex synthetic procedures. The method seems to have the potential to translate into cost-effective technology for estimation of glucose.

Testing and Evaluation

The Laboratory extended its analytical facility for the testing and characterization of materials from both internal and external laboratories. Testing services were provided as per the quality policy of the Institute.

POLYMER DIVISION

Product Development

Polyurethane adhesive and potting compounds were prepared for the fabrication of extracorporeal medical devices, under the industry project with M/s Manalai Petrochemicals and M/s SIDD Life Sciences, Chennai. Cycloaliphatic isocyanate prepolymers (Chitra-PPH12 MDI and PG H12 MDI), modified castor oil (M-castor oil) and delayed action catalyst (DCM) were prepared for the development of non-aromatic potting compounds. Potting compounds with shorter pot life, biocompatibility and dispensability were prepared by mixing two components in a specific ratio using polymeric isocyanate, polyol-castor oil/polypropylene glycol, chain extender, delayed action catalyst and defoamer. The properties, namely, enhanced pot life (20-25 min), non-wicking and bubble-free potting character, hardness (70-75 Shore A), shear strength and haemocompatibility were optimized to suit extracorporeal devices. The polyurethane adhesive was prepared and optimized to offer controlled hardening time and better apparent shear strength of single lap joined polycarbonate to polycarbonate and aluminium to aluminium adhesively bonded specimen. Successful test trials were conducted for the prototype fabrication of haemoconcentrator at M/s SIDD Life Sciences.

Research Programmes

1. *Studies on novel biodegradable polymeric materials and tissue engineering as cardiac implants*

Different co-macromers, poly (propylene fumarate-co-sebacate-co-ethylene glycol) (SP) and mannitol-fumarate-poly ethylene glycol-fumarate-PEG (PEAM), were prepared for injectable hydrogel preparation, long-term cell encapsulation and antioxidant therapy. The injectable hydrogel for in situ gelation was prepared with neutralized and diluted co-macromer and PEG diacrylate. The present hydrogel has pores in micron size in diameter. Cardiomyoblast cells encapsulated in the hydrogels elicited long-term cell viability even after 30 days of culture (Figure 24). The hydrogels have appreciable free radical scavenging percentage, reducing power and total antioxidant activity. Studies on the protective effect of hydrogel on cardiomyoblast cells under oxidative stress revealed normal cell viability. The present hydrogels are possibly suitable for combined antioxidant and cell therapy of infarcted myocardium.

2. *Studies on polymer nanogels for theranostic applications*

A polymeric nanogel with innate near-emission capabilities for theranostic applications was developed. A photoluminescent co-macromer [PEG-poly (propylene fumarate)-citric acid-glycine] with excitation wavelength-dependent fluorescence (EDF) characteristics was synthesized. The co-macromer, when excited at different wavelengths in visible region from 400 nm to 640 nm, exhibited fluorescent emissions from 510 nm to 718 nm in aqueous condition. A nanogel, C-PLM NG, was prepared with this photoluminescent co-macromer and N, N-dimethyl aminoethyl methacrylate (DMEMA). The nanogel undergoes pH responsive swelling

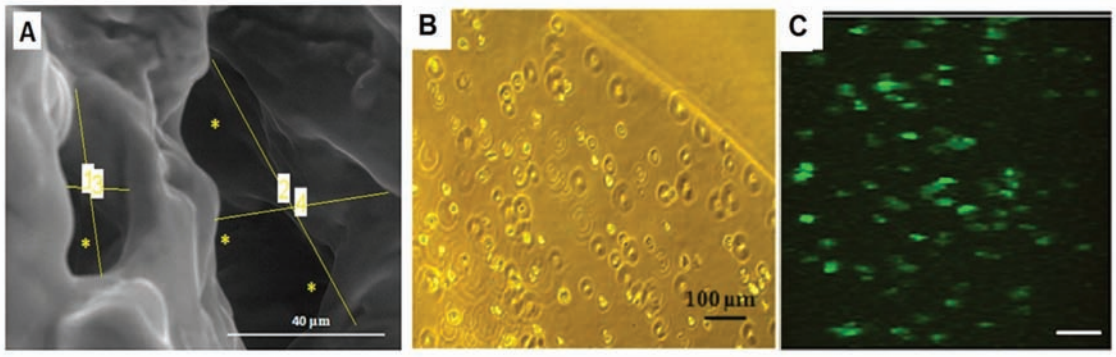


Figure 24. ESEM micrograph of the new hydrogel (A), cardiomyoblast cell encapsulated in hydrogel (B), live/dead assay of cardiomyoblast cell encapsulated in the hydrogel after 30 days of in vitro culture (C)

and responsive release of doxorubicin (DOX). The DOX-loaded C-PLM-NG encapsulated in HeLa cells induced lysis of cancer cells. The inherent EDF characteristics associated with C-PLM NG enable cellular imaging of HeLa cells. In vivo studies on bioimaging and distribution in the body of mice revealed bioimaging capability and safety of the material. The present nanogel is a potent candidate for theranostic applications.

3. *Development of bone composites*

Co-macromers based on carboxyl terminated polypropylene fumarate (CTPPF), PEG300 and ascorbic acid (AA) were prepared for the biodegradable polymeric composite materials for orthopaedic fixation devices. Hydroxyapatite (HA) was incorporated into the co-macromer matrix by silanisation and EDC technique to form bioactive and biodegradable hybrid polymer product (BHPP). SEM and EDAX analysis of the cross-linked BHPP as composite substantiated high in vitro bioactivity. SEM studies depicted a distinct porous structure with pore size of 50 to 200 μm. The cross-linked BHPP demonstrated no significant difference in compressive moduli after 4 weeks immersion in SBF. In particular, the values acquired for compressive moduli complemented that of trabecular bone. The formation of an apatite layer on the surface of the composites deterred initial degradation, leading to better mechanical properties. In addition, the cross-linked BHPP exhibited favourable albumin adsorption, cell viability, HOS cell adhesion and good cytocompatibility. The present study suggested that BHPP has potential as bioactive bone composite material.

4. *Development of theranostic nanoparticles*

A neodymium-doped hydroxyapatite (HAN) nanoparticle was developed for theranostic applications. The presence of neodymium in hydroxyapatite endowed near-infrared fluorescence capability. These HAN nanoparticles were then subsequently modified with alginic acid (HANA) to confer pH responsiveness to deliver them to the colon after oral administration (Figure 25). These nanoplatforms possessing optimum size, needle-shaped morphology and negative zeta potential, were conducive for cellular internalization. On excitation at 410 nm, they exhibited near infrared emission at 670 nm. Cytotoxic effects assessed using MTT and live/dead assays revealed excellent cell viability. Raman microscopic imaging technique used to visualize uptake in HeLa cells demonstrated increased uptake from 4 to 16 h, with growing cluster size and localization in the cytoplasm. Moreover, the concomitant presence of alginic acid augmented loading and pH-dependent release profiles of the model drug, 4 acetyl salicylic acid (4ASA). HANA that can be administered via the oral route is a promising tool for early tumor detection, targeted tumor therapy and monitoring of colon cancer.

5. *Targeted Protein Therapy for Endogenous βCell Regeneration for Treatment of Diabetes (DST-INSPIRE programme)*

A novel strategy for intracellular delivery of biologically active proteins using protein nanocapsules was developed. To achieve this, two amino acid-derived monomers, N-acryloyl ornithine and N-acryloyl lysine, and two disulfide crosslinkers, water-insoluble N,N`-bis(acryloyl)-cystamine and water-soluble N,N`-diacryloyl-cystine were synthesized. Bovine serum albumin (BSA)-encapsulated protein nanocapsules (PNCs) were prepared. The synthesized amino acid-derived monomers and disulfide cross-linkers were characterized by FTIR and Raman spectroscopy. Zeta potential of the synthesized BSA PNCs was measured using a Zetasizer instrument and PNC size and size distribution were determined using dynamic light scattering techniques and also confirmed by transmission electron microscopy

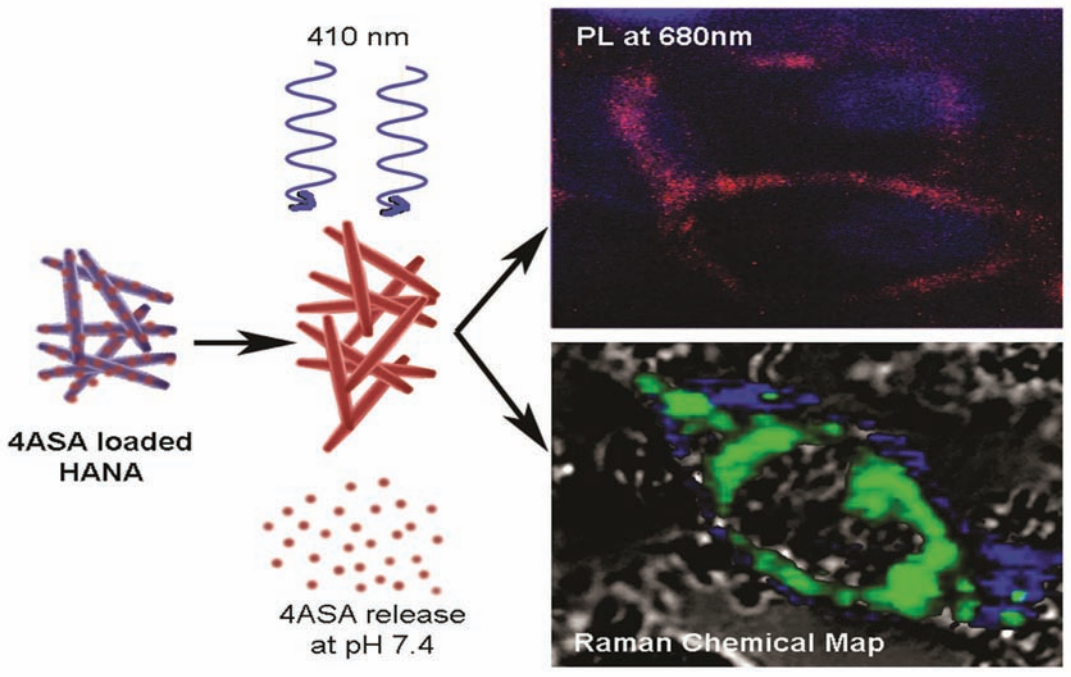


Figure 25. 4ASA-loaded alginic acid-modified neodymium-doped hydroxyapatite theranostic nanoparticles

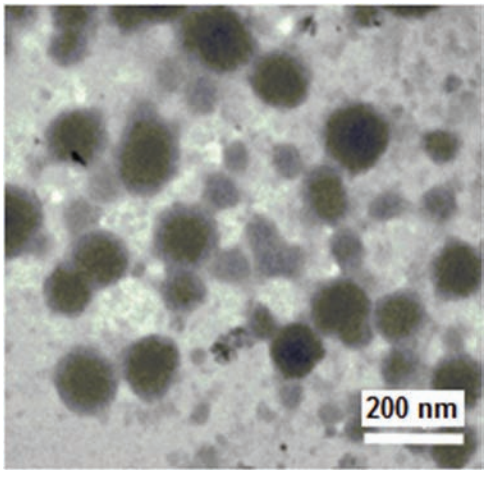


Figure 26. Size distribution of protein nanocapsules (TEM micrograph)

(Figure 26). Furthermore, cell uptake studies conducted on L929 fibroblast cells demonstrated efficient internalization by cells compared to protein-only controls. To demonstrate redox-responsive nature of the prepared PNCs, BSA-encapsulated PNCs were incubated in relevant intracellular concentrations of glutathione (GSH) and BSA release profiles were evaluated using silver staining of proteins in polyacrylamide gels.

6. Core-crosslinked pH-responsive pro-drug micelles for controlled drug release applications

Nanoparticle-based drug delivery systems, which offer several advantages over conventional pharmacological treatment methodologies, were investigated. A new micelle-based pro-drug approach was studied (Figure 27).

A model hydrophobic non-steroidal anti-inflammatory drug (NSAID), ibuprofen (Ibu), was tethered to amphiphilic methoxy polyethylene glycol-polypropylene fumarate (mPEG-PPF) diblock co-polymers via hydrolysable anhydride linkages to evaluate potential controlled release applications of NSAIDs. To this end, mPEG-PPF-Ibu polymer drug conjugates (PDCs) synthesized via simple two-step reaction, self-assembled to form monodisperse spherical micellar nanostructures in aqueous medium. The prepared PDC micelles exhibited low critical micelle concentration values ranging between 16 - 30 μg/mL, indicating good thermodynamic stability. Core-crosslinking of prodrug micelles with N,N`–dimethylaminoethyl methacrylate (DMAEMA) crosslinker conferred pH-responsive characteristics. Core-crosslinked PDC micelles exhibited

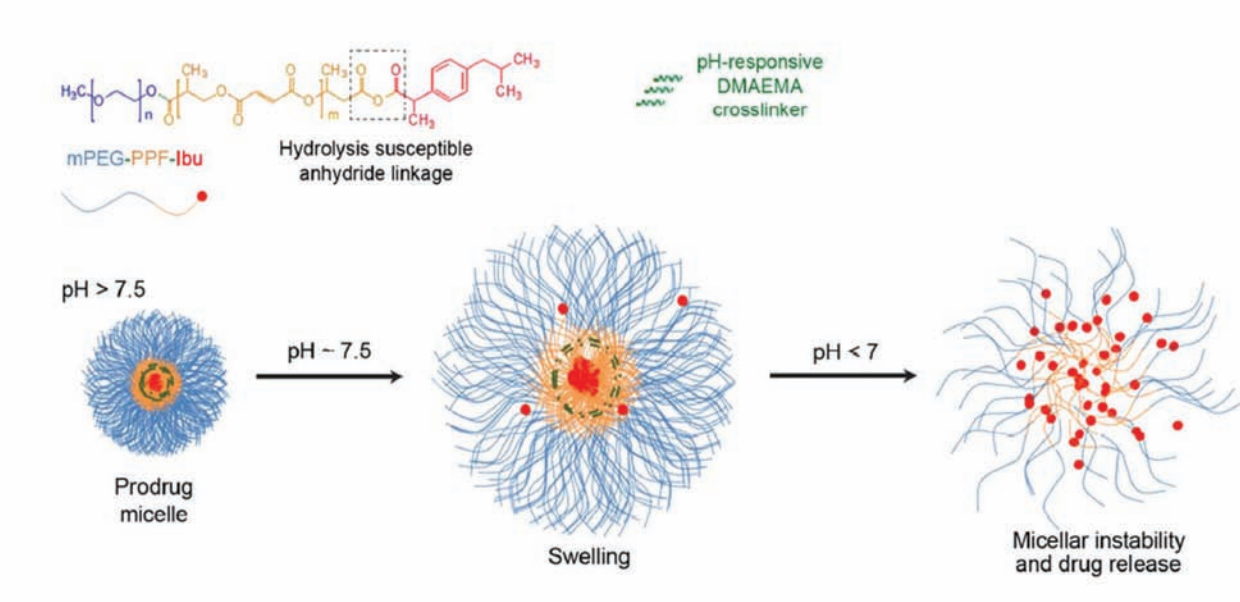


Figure 27. New pro-drug micelle-based approach for drug delivery systems

changes in size upon incubation in physiologically relevant mildly acidic conditions. The Ibu encapsulation efficiency of prepared prodrug micelles was modest at 2.3% (w/w). Ibu release was observed to increase with increasing acidic conditions and could be controlled by varying the wt% of cross-linker used. Furthermore, the prepared mPEG-PPF-based micelles demonstrated excellent cytocompatibilty and cellular internalization in vitro. More importantly, prodrug micelles exerted anti-inflammatory effects by significantly inhibiting increased expression of prostaglandin E levels upon co-administration with monosodium urate crystals in rabbit synoviocyte cultures in vitro. Cumulatively, the studies indicate that this new prodrug micelle approach is promising for NSAID-based therapies in the treatment of arthritis and cancer.

CERAMIC COATINGS FACILITY

The focus of the Facility is to develop ceramic coatings for biomedical applications, using state-of-the-art radio-frequency (RF)-powered Plasma Enhanced Chemical Vapour Deposition equipment.

Product Development

As a part of the coatings development in the Facility, non-reflective protective carbon coating was developed and optimised. Reflection of illumination from tools and instruments is a disturbing problem in microsurgeries. The non-reflective carbon coating will avoid the haze from metallic instruments, offer better tissue compatibility and give additional protection from corrosion.

Research Programmes

Biological validation of the diamond-like carbon coatings

During the past year, biological validation of the diamond-like carbon (DLC) coatings, aimed at orthopaedic and dental implant protection applications was performed.

The response of human periodontal ligament cells to DLC surface was investigated using titanium metal discs. Direct contact cytotoxicity and cell adhesion studies were compared between coated and uncoated titanium discs. Cell adhesion, spreading and non-cytotoxicity to periodontal ligament cells observed in the experiments confirmed the cytocompatability of DLC. Moreover, DLC did not inhibit the osteogenic potential of hPDL cells, indicating that DLC coated implant parts (like abutment) will not hinder the activity of the local stem cells.

To investigate the biofilm formation characteristics, microbial adhesion studies on DLC coated titanium discs were performed using Staphylococcus aureus, Escherichia coli, and Candida albicans. The samples were cultured with the organisms and the number of adherent organisms was

determined by viable count method. These observations were further appended using confocal Raman imaging and electron microscopy. A significant reduction in adhesion was seen with coated discs, when compared to uncoated discs. This confirmed that DLC is effective in resisting biofilm formation of microorganisms and can be useful in reducing implant-related infections.

Events organised by the Department

The International Symposium on Photonics Applications and Nanomaterials (ISPAN-2015) was organized by the Division of Biophotonics and Imaging at SCTIMST on 28-30 October 2015 (Figure 28). Dr R S Jayasree was the Organising Secretary.

Figure 28. International Symposium on Photonics Applications and Nanomaterials (ISPAN-2015)

AWARDS AND HONOURS

Dr H K Varma attended as nominee of DST, Government of India, the Joint Workshop organized at Turku, Finland, in connection with the implementation of an Indo-Finnish joint project titled "Structure of Gradient Nanocomposites: Interaction of Bioactive Glasses with Nanoparticles and Polymers" between CGCRI, Kolkota, India, and the University of Turku during 26-30 October 2015.

Ms Lakshmi V Nair won first prize for the oral presentation "Gold Nanocluster Mediated Cancer Diagnosis And Targeted Photodynamic Therapy" at the National Seminar on Photonics and its Applications, 9-11 December 2015, Department of Optoelectronics, University of Kerala.

Ms Resmi V Nair won the first prize for the poster "A Gold Nanorod Based Imaging and Photothermal Therapy System" at the National Seminar on Photonics and its Applications, 9-11 December 2015, Department of Optoelectronics, University of Kerala.

Ms Parvathy R S was awarded the Endeavour Research Fellowship to pursue part of her PhD programme at RMIT University, Melbourne.

Dr Kalyana Krishnan was invited to New Delhi to present development of the award winning intrauterine system (IUS) before a panel of experts and the Hon. Cabinet and Deputy Minister of Chemicals and Fertilizers on 23 April 2015.

Dr K Sreenivasan was awarded three years of free membership of the American Chemical Society in recognition of his services to the Society.

Dr K Sreenivasan visited the University of Nottingham, UK, from 16-26 October 2015 under the DST-UKIERI project.

Ms Remya K, PhD Scholar won the best paper award for the paper titled "Injectable hydrogels with inherent and consistent free radical scavenging property for cardiac applications" at the 28th Kerala Science Congress, 28-30 January 2016, University of Calicut, Malappuram.

FACULTY

Dr V Kalliyana Krishnan, Head of the Department, Scientist G (Senior Grade) & Scientist-in-Charge, Division of Dental Products

Dr K Sreenivasan, Scientist G & Scientist-in-Charge, Polymer Analysis Laboratory

Dr M Jayabalan, Scientist G & Scientist-in-Charge, Polymer Division

Dr P R Harikrishna Varma, Engineer F & Scientist-in-Charge, Division of Bioceramics

Dr Manoj Komath, Scientist F, Division of Bioceramics

Dr R S Jayasree, Scientist E & Scientist-in-Charge, Division of Biophotonics & Imaging

Dr Rekha M R, Scientist D & Scientist-in-Charge, Division of Biosurface Technology

Dr P P Lizymol, Scientist D, Division of Dental Products

Technical

Mr S Vijayan, Scientific Officer, Division of Bioceramics

Dr S Sureshbabu, Junior Scientific Officer, Division of Bioceramics

Mr Nishad K V, Technical Assistant (Instruments) - A, Division of Bioceramics

Mr P R Hari, Scientific Officer, Polymer Analysis Laboratory

Dr C Radhakumary, Junior Scientific Officer, Polymer Analysis Laboratory

Ms Jasmin Joseph, Technical Assistant (Instruments) - A, Division of Biosurface Technology

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

DEPARTMENT OF MEDICAL DEVICE ENGINEERING

The Department is responsible for research and development of medical devices, from design to preclinical evaluation including computer aided design, in-silico evaluation, fabrication, prototyping, and functional evaluation at various stages. The Department consists of the following six Divisions, four of which focus on different types of medical devices while two others specialise in precision prototyping of medical devices and animal models for medical device evaluation:

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

DIVISION OF ARTIFICIAL INTERNAL ORGANS

The Division initiated two development projects under Technology Development Fund (TDF) for: (i) a mitral annuloplasty ring, and (ii) a flow diverter intra-cranial stent. Two other projects in the Technical Research Centre (TRC) programme: (i) aortic stent grafts for endovascular treatment of thoracic aortic aneurysms, and (ii) atrial septal defect occluders using nitinol were initiated, in collaboration with the Cardiovascular and Thoracic Surgery, Interventional Radiology and Cardiology Departments, respectively. A joint proposal for developing voice prosthesis was initiated with Regional Cancer Centre, Trivandrum, for voice restoration in post-laryngectomy patients. A MoU was signed with RCC in this regard.

A proposal to develop a clot retriever stent for acute ischemic stroke therapy, in collaboration with the Department of Imaging Sciences and Interventional Radiology, SCTIMST, was sanctioned by the Department of Biotechnology under the bioengineering scheme.

Product Development

1. Flow Diverter Stent

The intra-cranial, flow diverter stent project was initiated under the institutional TDF scheme, in collaboration with the Department of Imaging Sciences and Interventional Radiology. Nitinol wires of 0.1mm diameter were braided into tubular structures. Several such models were hand-braided using up to 12 wires with a length of about 10 cm. A spot welder developed in-house by the Instrumentation laboratory was modified with appropriate copper heads and thyristor switching for enhanced control of the weld. The braided structures were heat set and shape memory imprinted into the structure so that at room temperature and body temperature the structure will adopt the designed shape.

2. Annuloplasty Ring

A project for development of an annuloplasty ring for mitral valve correction was initiated under the TDF scheme. Materials with proven biocompatibility and toxicity characteristics used in the TTK-Chitra valve are proposed to be used in this project. The device comprises a metallic ring made of commercially pure Titanium suitably shaped to conform to the mitral annulus, a silicon sheath around the ring to minimize metal contact and a polyester suture ring. 3D CAD models of the annuloplasty ring were developed.

Research Programmes

Wireless Power Transfer

A project on wireless power transfer for medical devices was successfully completed (M Tech level). It has led to patent application for a novel auto-tuning feature resulting in resonant operation of the wireless power transfer system with any perturbation during use, ensuring high switching efficiency and increased power transfer.

Testing and Evaluation

A testing project sponsored by M/s South India Textile Research Association (SITRA), Coimbatore for evaluation of nanofiber-coated polyester fabric material for use as leukocyte filter was completed. In addition, accelerated ageing studies, pin on wheel and sand slurry tests; microhardness, scratch testing etc were done for various industrial customers.

DIVISION OF EXTRACORPOREAL DEVICES

The major activities of the Division are focussed on medical devices for supporting the human cardiopulmonary system. Currently, the Division is developing paediatric and neonatal membrane oxygenators as an industry-sponsored project and is reaching the completion of proof of concept phase. Development of infrared energy based technologies for blood warmers and infant warmers, magnetic blood flow meters and transcutaneous energy transfer system are in various stages of development. The Division also supported interdepartmental product development activities.

Two projects were initiated under the Technology Research Centre (TRC) scheme of DST: development of paracorporeal left ventricular assist device and development of centrifugal blood pump along with drive unit and flow meter. An internal TDF-funded project for development of a system for detection of extravasation of radiological contrast material was initiated.

Product Development

1. *Development of paediatric and neonatal membrane oxygenators for extracorporeal cardiopulmonary bypass surgeries*

The project is nearing completion of proof of concept phase. The device has two major components namely, the heat exchanger and mass exchanger modules. The design of the former was previously validated and the design of the latter was validated using various techniques like, computational fluid dynamics, gas transfer estimation using oxygen consuming chemicals (Figure 29) and a limited number of in vitro gas transfer studies using bovine blood.

2. *Blood flow meter and warmer*

A miniature magnetic blood flow meter (Figure 30) with a novel rotating permanent magnet excitation was developed for measuring rate of blood flow in an extracorporeal circuit during open-heart bypass surgery.

A low cost blood and IV tube warmer suitable for slow and massive transfusion of blood and IV fluids, with a novel piece wise distributed infrared warming was developed (Figure 31). The warmer has a bag warming unit and an inline IV tube warming unit and uses the heating property of infrared radiations which are emitted from low power infrared light emitting diodes (IR LEDs) around the blood bag or IV tube.

3. *Infant warmer*

To prevent thermal loss from premature babies with low birth weight, a low cost infant warmer in the form of a bassinet

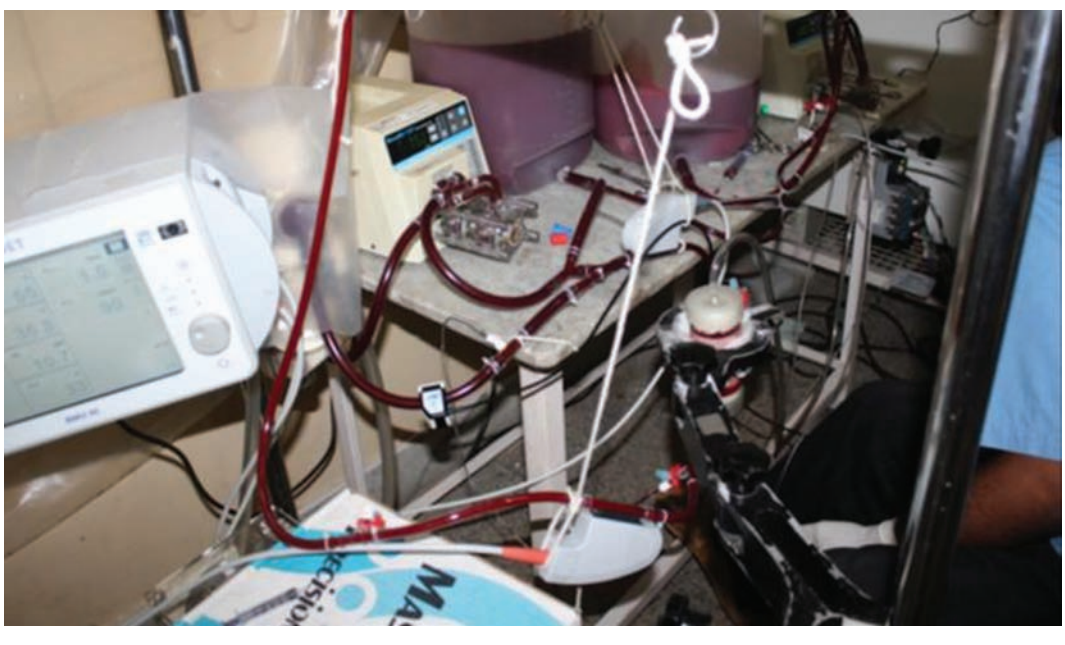


Figure 29. Experimental evaluation of gas transfer in an oxygenator

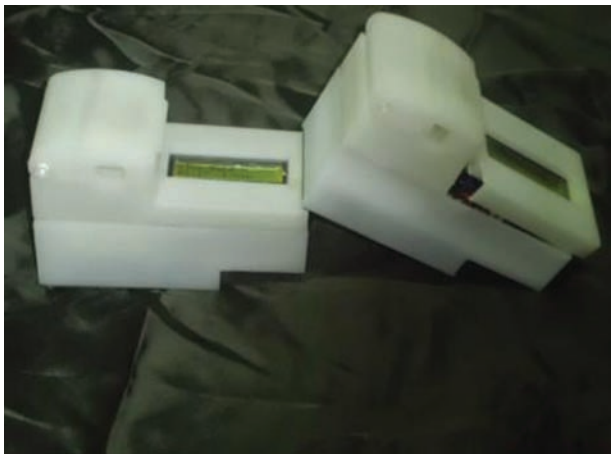


Figure 30. Blood Flow Meter

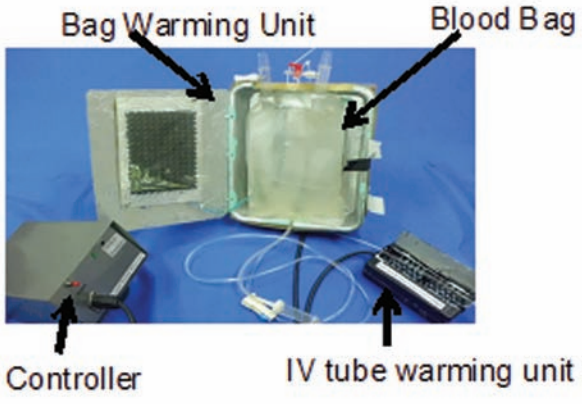


Figure 31. Blood and IV tube warmer

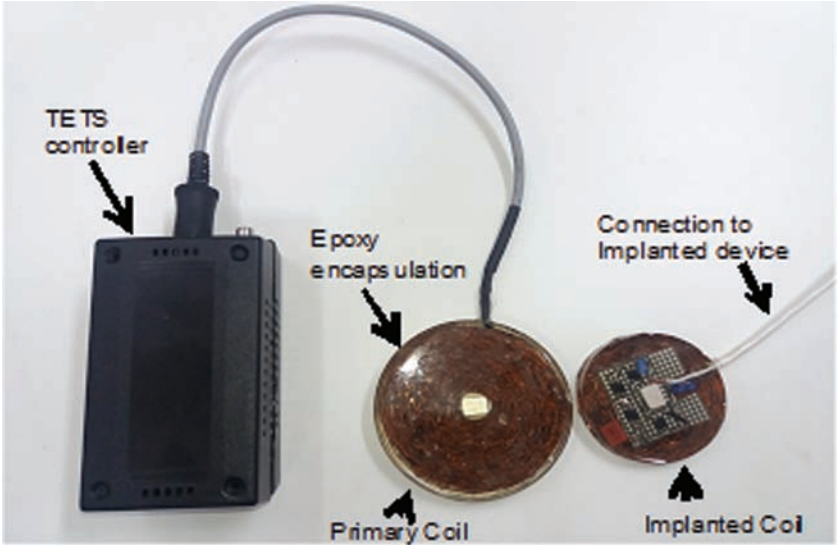


Figure 32. Transcutaneous energy transfer system

for bedside care and a wrapper to provide warmth during transportation were developed. Both the warmers are fitted with a cluster of low power IR LEDs that emit sufficient thermal energy to raise the temperature of the environment surrounding the baby to physiological 37°C.

Research Programmes

Transcutaneous energy transfer system

Complex, large, implanted life-saving devices like left ventricular assist (LVAD) and total artificial heart (TAH) need continuous supply of about 10W to 30W which cannot be supplied by a battery inside the body. These complex devices are currently powered percutaneously by connecting to external power sources. This limits the use of these life-saving devices for long-term implantation due to reasons such as, infection and difficulty in transportation of patients. Novel technologies in electrical power transmission need to be explored for making these devices fit for long-term use. Hence, a transcutaneous wireless energy transfer system (TETS) was developed (Figure 32), which can transfer electrical energy across skin to a depth of 30 mm for up to 50W. The system works on the principle of resonating power transfer and consists of a set of external primary coil, implanted secondary coils and a controller. When

the controller is powered on, the primary coil is energized and transfers the electrical energy to implanted secondary coil due to magnetic induction. A novel coil design and a power transfer algorithm for automatic coil positioning and voltage control for alignment variations was developed. In vitro studies showed power transfer efficiency of more than 80% and minimal variations with alignment change and skin thickness.

DIVISION OF IN VIVO MODELS AND TESTING

The major role of the Division is to conduct preclinical and proof-of-concept studies of medical devices and biomaterials in animal models. Apart from this, the Division also provides healthy, traceable large experimental animals such as pigs and sheep for animal studies.

This year, a project proposal was initiated with the objective of developing a modified valved conduit by improving the conduit design to prevent annular stenosis and to utilize heparin-coated thinner porcine pericardium to avoid leaflet adhesion.

Product Development

The proof-of-concept studies on pulmonary valved conduit and glutaraldehyde process with anti-mineralization treatment of xeno-pericardium are ongoing.

Research Programmes

1. *Project on Ankamali swine*

The Division is conducting a project on collecting and documenting baseline reference data of in-house bred Ankamali swine for physiological, haematological, biochemical and coagulation parameters; and phenotypic and genotypic characters. Collation of the data may lead to recognition of Ankamali swine as a mini pig model for use in preclinical device testing and as an animal model for biomedical research.

2. *Processed bovine and porcine pericardium for cardiovascular applications*

The Division is conducting research on development of processed bovine, buffalo and porcine pericardium such as decellularised or glutaraldehyde cross-linked pericardium with heparin cross-linking for various cardiovascular applications.

During the past year, the Division, along with the Cardiovascular and Thoracic Surgery Department, SCTIMST developed a method for construction of a bi-leaflet pulmonary valved conduit from processed bovine pericardium (decellularised bovine pericardium and non-calcifying glutaraldehyde-treated bovine pericardium) meant for RVOT reconstruction surgery. An Indian patent was filed for this device and its fabrication method. All the animals completed the implantation period of 6 months successfully. However, two major areas with room for improvement are stenosis of valve annulus and adhesion of leaflet to conduit wall.

DIVISION OF MEDICAL INSTRUMENTATION

This year, the DST-funded project titled 'Home-based vital signs monitor for pre-screening of sleep disorders' was completed and two projects under the TRC were initiated.

Product Development

A home-based vital signs monitor for screening of sleep disorders incorporating: a three-channel electrocardiogram (ECG), two-channel impedance pneumography and single channel oxygen saturation (SpO2) was developed.

The system incorporates an analog module with eight analog channels, a digital module for processing the data from the channels and a display/storage module for reproduction of data from the analog channels. The specifications for the hardware, digital and software modules were finalized. Prototypes for the hardware modules (Figures 33) were designed and fabricated. Two applications were developed in the Android platform for achieving online display /archival of the data from the analog channels and offline browsing and display of archived data.

Research Programmes

1. *Development of Deep Brain Stimulator system*

Parkinson's disease is a neurological condition that results from the death of dopamine-producing neurons in the brain. Patients with Parkinson's disease suffer from a variety of movement-related disorders, such as tremors, difficulty in maintaining posture, and bradykinesia. Deep brain stimulation involves directly targeting certain areas of the brain with electrical impulses administered via surgically-implanted electrodes. A project for the development of an indigenous deep brain stimulation system was initiated under the TRC programme in technical collaboration with Bhabha Atomic Research Centre.

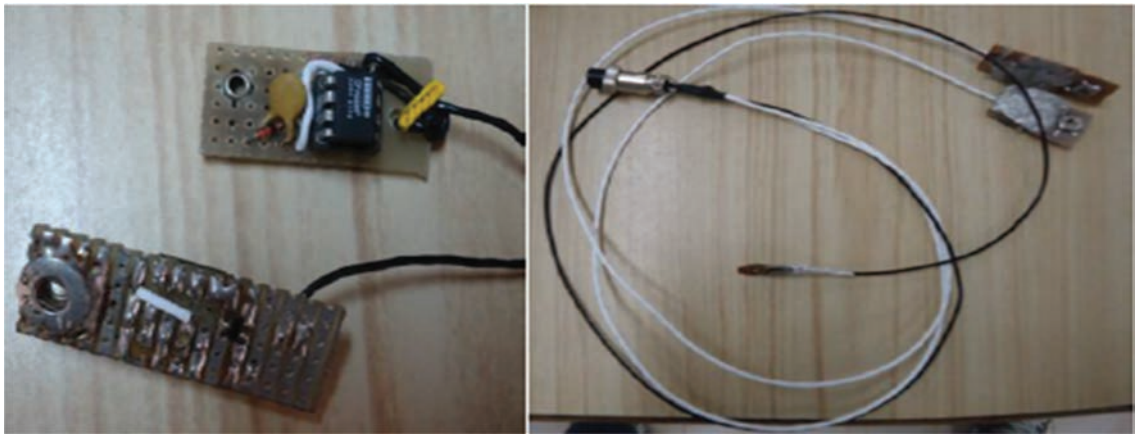


Figure 33. Sensing harnesses for ECG

2. *Development of intracranial electrodes for electrocorticography*

Intracranial EEG monitoring plays a critical role in the assessment of patients with medically refractory partial epilepsy. A project was initiated under the TRC programme for developing a set of intracranial electrodes to enable monitoring for up to 15 days.

DIVISION OF POLYMERIC MEDICAL DEVICES

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

A new project titled, 'Development of a light weight, lead free, polymer-based thyroid collar for medical and dental diagnostic radiology' funded by the Institute of Nuclear Medicine and Allied Sciences (INMAS, DRDO), Delhi, was initiated. An MoU in this regard was signed on 30 April 2015.

Another MoU was signed on 25 April 2015 between Regional Cancer Centre, Trivandrum, and SCTIMST for the design and fabrication of head phantom for dosimetric evaluation of radiotherapy treatment plans.

Product Development

An industry-sponsored programme on the 'Development of hydrogel sealed and fluoropolymer-coated vascular graft' reached final stages of product evaluation. Performance evaluation of the vascular grafts of various sizes ranging from 8 mm to 24 mm was completed. Technology document preparation, documentation for Technical Advisory Committee and documentation for clinical trials is nearing completion.

Research Programmes

1. *Development of electrospun composite scaffolds as bone substitute*

The potential of electrospun polycaprolactone-based scaffolds for the controlled delivery of pamidronate disodium pentahydrate (PDS), an anti-resorptive drug used in the treatment of osteoporosis, was carried out. In the successfully developed osteoporotic rat model, calvarial defect was created and the drug-loaded scaffold was implanted. X-ray and Micro CT images revealed that bone formation was prominent with 3% PDS after 3 months. The result underscored the effect of PDS in inducing bone formation.

2. *Electrospun poly(ethylene-co-vinyl alcohol) membranes for developing leukodepletion filters*

Membrane-based filtration is the most widely used method for leukocyte removal to prevent the adverse reactions mediated by donors' blood. Since electrospinning is a feasible and versatile technique for the production of fibroporous membranes, the technique was explored for developing leukodepletion filter materials. The major objective was to fabricate membranes for leukodepletion filters by electrospinning of poly(ethylene-co-vinyl alcohol) (EVAL). The haemocompatibility and leukodepletion efficiency of EVAL-based filters were assessed.

Testing and Evaluation

The Division offers its facility for testing biomaterials and medical devices to internal and external customers. The test facilities include mechanical testing, dynamic mechanical analysis and impact testing of polymeric materials and devices. About 146 external samples were tested and reports issued to customers.

DIVISION OF PRECISION FABRICATION

The Division facilitates technical services and support to other scientific/technical laboratories in designing and fabricating moulds; dies, jigs, fixtures and machining of prototype components related to various projects utilising the CNC and conventional machines to deliver quality precision work for the research and product development programmes of the Institute. During the year, the Division executed 60 work orders for different projects and inter-departmental activities.

The important design and prototyping activities carried out have been represented below: (i) Static adapter mixer in delrin material (Fig.34a), (ii) Hydroxyapatite cylindrical blocks (Fig.34b), (iii) Teflon moulds (Fig.34c), (iv) Square cavities, (v) Membrane oxygenator components (Fig.34d), (vi) Vascular graft holder, (vii) Integrated paediatric oxygenator components (Fig.34e), (viii) Stainless steel restrainer (ix) Gas exchanger components for oxygenator, (x) Flow diverter braiding fixture components(Fig.34f), (xi) Bearing caps, (xii) Wire bending fixture, (xiii) Flow meter chamber test set up (Fig.34g), and (xiv) Gas exchanger components, potting caps and shell caps.

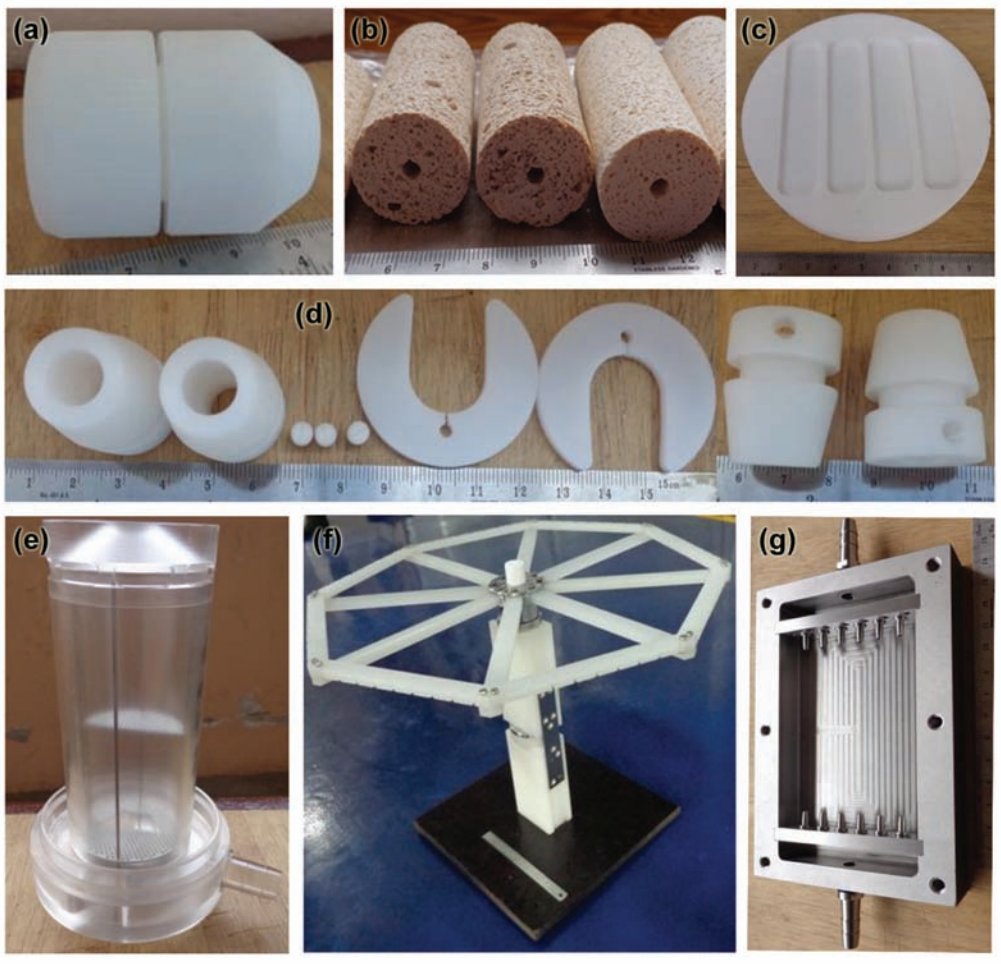


Figure 34. Prototypes and designs

AWARDS AND HONOURS

Ms Mayuri P V & Remya K R, PhD Scholars, Polymer Processing Laboratory, won the first prize in Quiz Competition at the National Conference on Biopolymers & Green Composites, BPGC- 2015, 9-10 October 2015, Kochi.

FACULTY

Mr Muraleedharan C V, Head of the Department, Scientist G & Scientist-in-Charge, Division of Artificial Internal Organs; Technical Manager, Quality Management System

Mr D S Nagesh, Scientist G & Scientist-in-Charge, Division of Extracorporeal Devices

Dr P R Umashankar, Scientist F & Scientist-in-Charge, Division of In Vivo Models and Testing

Dr Roy Joseph, Scientist F & Scientist-in-Charge (joint), Division of Polymeric Medical Devices

Dr P Ramesh, Scientist F & Scientist-in-Charge (joint), Division of Polymeric Medical Devices

Mr V Ramesh Babu, Engineer F & Scientist-in-Charge, Division of Precision Fabrication

Mr Vinod Kumar V, Co-ordinator of Department & Engineer E, Division of Extracorporeal Devices

Dr Sachin J Shenoy, Scientist E, Division of In Vivo Models and Testing

Mr Sujesh S, Engineer E, Division of Artificial Internal Organs

Mr Ranjith G, Engineer D, Division of Artificial Internal Organs

Mr Sarath S Nair, Engineer D, Division of Extracorporeal Devices

Mr Jithin Krishnan, Engineer B, Division of Medical Instrumentation

Technical

Mr Rajeev A, Scientific Assistant (Instruments), Division of Artificial Internal Organs

Mr Subhashkumar M S, Technical Assistant (Instruments) - A, Division of Artificial Internal Organs

Ms Sreedevi V S, Technical Assistant (Instruments) - A, Division of Extracorporeal Devices

Ms Smitha P, Technical Assistant (Anaesthesia) - B, Division of In Vivo Models and Testing

Mr Prem Mohan M, Technical Assistant (Lab) - B, Division of In Vivo Models and Testing

Mr Biju B, Technical Assistant (Instruments) - A, Division of Medical Instrumentation

Dr M C Sunny, Junior Scientific Officer, Division of Polymeric Medical Devices

Mr Reji Kumar S, Technical Assistant (Machine Operation) - A, Division of Polymeric Medical Devices

Mr Prathyush M, Technical Assistant (Machine Operation) - A, Division of Polymeric Medical Devices

Mr Biju V, Laboratory Animal Care Taker A, Division of In Vivo Models and Testing

Mr Manoj Kumar K, Laboratory Animal Care Taker A, Division of In Vivo Models and Testing

DEPARTMENT OF TECHNOLOGY AND QUALITY MANAGEMENT

The Department of Technology and Quality Management 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 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, where required, co-ordinates with external agencies to meet the requirements. Reference materials are maintained by the Cell for ensuring traceability of measurement.

Mechanical and thermal calibrations carried out by Calibration Cell are accredited by NABL, India. Mechanical calibration involves volumetric glassware, micropipettes, electronic balances, mass sets and rotational speed. Calibration of Relative Humidity (RH) monitors, thermometers and temperature chambers such as incubators are included in the thermal category.

NABL audit for mechanical and thermal calibrations was completed by February 2016. The Cell also participated in Inter-laboratory Comparisons (ILC) for temperature parameter with Fluid Control Research Institute (FCRI), Palakkad. Two study projects were completed for healthcare industries for the validation of sterilization (ethylene oxide and moist heat) systems, which included Installation qualification (IQ), Operational Qualification (OQ) and Performance qualification (PQ) based on ISO standards.

The Cell performed 308 internal and 105 external calibrations and measurements during 2015-16.

CENTRAL ANALYTICAL FACILITY

Central Analytical Facility (CAF) was established in the BMT Wing with effect from 1st June 2015 as a general testing facility for all staff, researchers and students of the Institute. Some of the major instruments and equipment available at CAF for the users include - Confocal Raman Microscope with mapping stage and attached Atomic Force Microscope (Witec alpha 300RA), an analytical High Pressure Liquid Chromatograph (LC2010AHT), Waters Q20 Differential Scanning Colorimetry, TA-XT plus Texture analyser for physical product characterisation, Leica DMI3000B Fluorescent microscope, TECAN infiniteM200 plate reader, Elchema Quartz Crystal Nanobalance, Biorad iQ5 RT-PCR, Fujifilm LAS4000 Image Analyser, RVA starchmaster viscoanalyser, and Climastatic chamber. This instrumentation facility was originally set-up with grant from the Department of Science and Technology, Government of India, under the project entitled "Facility for nano/microparticle based biomaterials for Advanced Drug Delivery Devices" (FADDS).

Confocal Raman microscope is used to determine and identify the chemical structure of the samples and to map the distribution of components in mixtures, particularly the presence of nanoparticles in tissue and cells. Identification and quantification of specific chemicals and degradation products are analysed by analytical HPLC. Differential scanning calorimeter is available for determining melting point, glass transition temperature, crystallinity, degree of curing, heat capacity and crystalline impurities of polymeric materials. Compressive and tensile forces, mucoadhesiveness, bloom strength, burst strength and consistency of gels could be analysed using Texture Analyser.

The number of samples tested at CAF this year was as follows: Confocal Raman Spectra - 140, Confocal Raman Chemical Mapping - 66, HPLC analysis - 858, Texture analysis - 54, and DSC analysis - 28. Apart from these, equipment such as Fluorescent image analyser, Fluorescent microscope and Fluorescent plate reader were used for routine analyses.

CUSTOMER SERVICE CELL

The Cell co-ordinates the internal and external testing services and study projects for the evaluation of medical devices biomaterials.

The summary of the testing services is as follows:

Description	External 2015-16	Internal 2015-16
Number of work orders	684	294
Number of test materials	1857	865
Income (Rs)	34,650,58	5,12,375

Two external studies were completed during the year:

1. Toxicity study of materials – Eucare Pharmaceuticals
2. Validation of EO sterilization system – TTK Healthcare Ltd

ELECTRICAL DIVISION

The Division looks after the electrical maintenance and installations.

NETWORK ENGINEERING SERVICES

A project titled "Development of tele-consultation system for patients with movement disorders" was initiated in collaboration with the Comprehensive Centre for Movement Disorder (CCMD), Computer Division and Telemedicine Departments. The project aims to use the possibilities of internet and communication technologies for patient review. The system will integrate with the existing SCTIMST patient portal and enable patients to interact directly with the doctor through video conferencing facility from Akshaya centres or from their homes.

QUALITY CELL

Activities of Quality Cell included the implementation, maintenance and improvement of quality management systems to assure that the facilities, equipment, personnel, methods, practices, records and its control are in conformance with the requirements of international standard ISO 17025.

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

1. COFRAC Surveillance Assessment: This was conducted on 15-16 October 2015. Extended scope received from COFRAC is effective from 15 January 2016.
2. NABL Assessment: Reassessment of NABL at Calibration Cell was carried out on 6-7 February 2016 and NABL has renewed the accreditation.
3. Management Review: The Management Review Committee meeting for 2014 was held on 22 April 2015 and for 2015 on 29 March 2016.Two Technical Management Committee meetings were held on 11 June and 14 December 2015.
4. Internal Audits: Two internal audits were carried out between 18-28 May 2015 and 23 November -3 December 2015.
5. Documents initiated/revised: The following were revised/issued during the period - (i) A total of 127 system procedures and work procedures were revised. (ii) Registers and logbooks (total 64) were prepared and issued to various laboratories/ sections.

TECHNOLOGY BUSINESS DIVISION

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

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

AGREEMENTS

The Division was involved in the signing of the following agreements:

1. A Non-Disclosure Agreement with Stempeutics Reseach Private Limited on 30 April 2015.
2. An agreement for academic co-operation and exchange between BNERC, Toyo University, Graduate School of Interdisciplinary New Science, Toyo University, and SCTIMST signed on 22 May 2015.

PATENTS

Total 15 Indian patents were filed during the financial year.

TECHNOLOGY TRANSFER COMMITTEES

The Standing Internal Technology Transfer Committee meetings were held on 5 May 2015 and 6 January 2016.

INDUSTRY VISITS AND DISCUSSIONS

The Division co-ordinated with the following industries for exploration of technology transfer, and for projects or R&D collaboration:

1. Azure Labs, Ernakulam
2. Parent company of Terumo Penpol, Terumo BCI USA
3. Nano Therapeutics, Gujarat
4. Biomagg Medica, Surat
5. Levram Lifesciences Pvt Ltd, Mumbai
6. HLL Lifecare Ltd, Thiruvananthapuram
7. Surgiwear, Uttar Pradesh

STAFF

Mr D S Nagesh, Head of the Department, Scientist G & Scientist-in-Charge, Technology Proving Facility

Mr S Balram, Scientist-in-Charge, Technology Business Division & CEO, TIMED

Mr D Ranjit, Engineer F & Scientist-in-Charge, Engineering Services

Dr Roy Joseph, Scientist F & Scientist-in-Charge, Central Analytical Facility

Dr Ramesh P, Scientist F, Quality Manager, Quality Cell

Ms Leena Joseph, Engineer E & Engineer-in-Charge, Calibration Cell & Deputy Quality Manager, Quality Cell

Dr Anugya Bhatt, Scientist D, Deputy Quality Manager, Quality Cell (GLP Studies)

Dr Arun Anirudhan V, Engineer D, Network Service Cell

Ms Sandhya C G, Engineer D, Technology Business Division

Mr Rajkrishna Rajan, Engineer D, Intellectual Property Rights Cell

Mr Sajithlal M K, Engineer D, Network Service Cell

Mr Willi Paul, Scientific Officer, Central Analytical Facility

Mr K Rajan, Junior Engineer (Instrumentation) - B, Engineering Services

Mr Asok Kumar K R, Junior Engineer (Civil) - B, Engineering Services

Mr Binu C P, Junior Engineer (MRAC) - A, Engineering Services

Mr Sabu K S, Junior Engineer (Electrical) - A, Engineering Services

Mr Arumugham V, Senior Scientific Assistant, Calibration Cell

Mr Rajesh R P, Scientific Assistant, Calibration Cell

Mr Sreekanth S L, Scientific Assistant, Quality Cell

Mr Premnath D, Senior Technical Assistant (Electrical), Engineering Services

Mr Mony K G, Senior Technical Assistant (MRAC), Engineering Services

Mr Raju A S, Technical Assistant (Machine Operation) - B, Engineering Services

Ms Asha Rani V, Technical Assistant (Instruments) - A, Customer Service Cell

Mr Saju S, Junior Technical Assistant (Electrical) - A, Engineering Services

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

ACHUTHA MENON CENTRE FOR HEALTH SCIENCE STUDIES

The Achutha Menon Centre for Health Science Studies persisted with its activities in the realm of public health. Research activities in collaboration with major universities such as the University of Arizona in the United States, Melbourne and Monash Universities of Australia, University of Edinburgh in the UK and University of Heidelberg, Germany were very productive. The Master of Public Health (MPH) programme continued to train students successfully.

Activities

Fifteen MPH, 1 DPH, and 3 PhD students completed their programme during the year. Fourteen MPH students continued into their second year and another 18 students joined in 2016. In addition to the MPH training programme of the Centre, the MPH programme was also offered to students from the National Institute of Epidemiology (NIE), Chennai, and the Christian Medical College (CMC), Vellore. Fifteen PhD students, 7 full-time and 8 part-time, pursued their training programme during the year. An additional four part-time PhD students joined in January 2016. Two external participants, 3 PhD students and 1 project staff along with 14 MPH students completed the short course on Ethics in Health Research.

Research Programmes

1. *Tobacco cessation in India and Indonesia*

One of the major research projects was on building capacity for tobacco cessation in India and Indonesia, supported by the Fogarty International Centre of the US National Institutes of Health. The major objective of this project was to develop and implement tobacco cessation modules for undergraduate medical education in India. To support teaching on tobacco cessation, 15 modules and 14 clinical videos were developed and implemented in five medical colleges in South India. These teaching aids are available at our quit tobacco website (www.quittobaccointernational.org). The universities of Kerala and Karnataka have also agreed to incorporate tobacco cessation and control in their undergraduate medical education curriculum. About 25 research articles were published from the project.

2. *Community interventions for health*

This project was supported by Oxford Health Alliance, UK, and was a pilot project implemented in three countries - China, India and Mexico. The major objectives of the project were to reduce three risk factors of non-communicable diseases through community-based interventions: tobacco use, unhealthy diet and physical inactivity. They were implemented in schools, work places, health centres and neighbourhood groups. Overall, the interventions were moderately effective in reducing the risk factors in these three communities. The first publication using data from all three sites came out this year.

3. *Kerala Diabetes Prevention Program*

The National Health and Medical Research Council of Australia through Melbourne University supported this project. The objective of this project is to reduce the incidence of diabetes through life style modification, focusing on improving dietary habits and physical activity. Two papers were published from this project.

4. *Controlling hypertension in rural India*

This project supported by the Global Alliance for Chronic Diseases and the National Health and Medical Research Council of Australia looks at the prevalence of hypertension and barriers for its control. This project 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 project is at the stage of post-intervention data collection in all three sites.

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

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

Activity 1: A multi-centred, prospective study on factors influencing postpartum reproductive choices in Jharkhand and Kerala.

Activity 2: A smaller-scale study on sexual and reproductive rights and reproductive choices among married and unmarried young women in Kerala.

Activity 3: Mapping and critical review of research on sexual and reproductive health and rights in India during 2000-2013.

For activities 1 and 2, field-based data collection is completed, with data analysis and report writing ongoing. From activity 3, three volumes of annotated bibliographies were published as web publications.

6. *Project on health equity*

Dr T K Sundari Ravindran organized the IDRC seminar on "Health equity: evidence and priorities for research in India" during 10-12 August 2015 (Figure 1), which brought together eminent public health researchers, health advocates, practitioners and policy makers from India.

The dual objectives of the seminar were to disseminate the results of a research-synthesis exercise on health equity research in India undertaken during the first year of the project and to identify and prioritize domains for future research on health equity in India. The seminar included a panel discussion on health equity in Kerala and overview presentations by eminent national and international scholars, including Professors Lesley Doyal, Daniel Reidpath, Imrana Qadeer, Gopal Guru and Manisha Gupte. Another important feature of the seminar was the participation by key policy makers who have worked in the health sector, including Mr Kesav Desi Raju (former Health Secretary, Government of India), Dr Girija Vaidyanathan (Tamil Nadu), Ms Meeta Rajeev Lochan (Maharashtra), Dr Himanshu Bhushan (National Health Systems Resource Centre) and Dr Nabam Peter (Health services, Arunachal Pradesh). While in each of the core sessions the discussants outlined research gaps and priority areas for future research on health equity in India, the final session was dedicated to brainstorming on research priorities for the future. A preliminary list of research priorities was generated, and further refined through online consultations. Presently, the team is in the process of receiving feedback from researchers, policy makers and civil society actors to finalize the list of priorities. The seminar was the first milestone in a four-year process. Springer Publications will publish the research-synthesis papers as an edited volume early next year. The project awarded fellowships for carrying out field work to two MPH students and to two PhD students.

The preliminary results from the research-priority-setting process highlighted the huge gap in information on the health of tribal populations of India. Through a call for proposals and a competitive selection process, three partner organizations from different parts of India were identified: the Action North-East Trust (ANT) from Assam, Public Health Resources Network (PHRN) from Chhattisgarh and Health Action by People (HAP) from Kerala to carry out research on inequities in tribal health. Two faculty research awards were also made to study issues related to tribal health in Kerala and Tamil Nadu, respectively. A Partners' Workshop was organized to discuss and finalize the research methodologies, during 29 February - 4 March 2016.

A health equity web portal was created as a means of networking with researchers in the field and sharing resources (www.healthinequity.com). The web portal had a membership of more than 160 by early March 2016.

Figure 1. Shri K M Chandrasekhar, President, SCTIMST, inaugurated the National Seminar on Health Equity: Evidence and Priorities for Research in India on 10 August 2015

New Initiatives

The Kerala Diabetes Prevention Programme was approved for funding by the World Diabetes foundation for an amount of US $ 250,541.

A Memorandum of Understanding was signed between the Public Health Foundation of India/Indian Institute of Public Health, Delhi, and Sree ChitraTirunal Institute for Medical Sciences and Technology, Trivandrum, on 28 December 2015 (Figure 2).

The Kerala Government issued an order granting administrative sanction for the project proposal on prevention and control of non-communicable diseases in Kerala for an amount of Rs 4,95,56,060.

Figure 2. MoU signed between Public Health Foundation of India and SCTIMST on 28 December 2015, by Prof Sanjay Zodpey, Director, Indian Institute of Public Health (IIPH-D), Gurgaon, and Director, SCTIMST, Trivandrum

Events organized by the Department

Dr Biju Soman organized a Workshop on health technology assessment in collaboration with the WHO collaborating Centre for Priority Medical Devices and Health Technology Policy, National Health Systems Resource Centre, New Delhi, on 30-31 May 2015 at AMCHSS and BMT Wing.

AROGYAM seminar on "Learning to do health equity research addressing multiple axes of inequalities" was arranged by Dr T K Sundari Ravindran on 13-14 August 2015.

An article writing Workshop was organized in collaboration with the Microbiology Department of our Institute by Dr Biju Soman on 17-18 September 2015 at AMCHSS (Figure 3).

The Workshop on "Analyzing Medical and Health Data using R" was organized by Dr V Ramankutty on 28-30 September 2015 in AMCHSS (Figures 4&5).

The Achutha Menon Centre for Health Science Studies Conference, 2015: "Gendered Experiences of Non-communicable Diseases, including Mental Health" was held on 1-2 December 2015 in AMCHSS under the leadership of Drs Mala Ramanathan and Ravi Prasad Varma.

AROGYAM Workshop on "Global Medical Flows Across Borders" was held at Trivandrum on 11-13 February 2016 was organized by Margret Frenz and Kannan Srinivasan, co-ordinators of the AROGYAM medical tourism group.

A three-day Workshop on "Geospatial Technologies for Public Health" took place in AMCHSS on 9-11 March 2016 under the aegis of the Natural Resources Data Management System of DST, Government of India (Figures 6&7).

Short course on "Basic Training on Ethics in Health Research" was held from 17- 21 August 2015 in AMCHSS jointly by AMCHSS and IEC, SCTIMST (Figure 8).

Webinar on "Health care financing: What has gender got to do with it" organized by "RINGS" on 1 July 2015 was a joint initiative of LSHTM and Johns Hopkins University. Dr T K Sundari Ravindran participated as panelist and spoke on "Health financing mechanisms in India and their implications for women's access to health care".

Dr T K Sundari Ravindran was an invited member of a WHO-Geneva (Reproductive Health and Research Department) Advisory Group on "Strengthening family planning's normative standards for monitoring, evaluation, and accountability at country, regional and global levels" (July 2015).

Figure 3. Dr Asha Kishore, Director, SCTIMST, inaugurated the Workshop on Article Writing for Medical Microbiologists on 17 September 2015

Figure 4. Workshop on Analyzing Medical and Health Data using 'R' was inaugurated by Dr K R Thankappan, AMCHSS, on 28 September 2015. Dr V Raman Kutty, Professor, AMCHSS, chaired the meeting.

Figure 5. Participants of the 'R' Workshop

Figure 6. Dr Asha Kishore inaugurated the Workshop on Geospatial Technologies in Public Health on 9 March 2016

Figure 7. Participants of the Workshop on Geospatial Technologies in Public Health

Figure 8. Dr Suresh Nair, Dean, inaugurated the short course on 'Ethics in Health Research' organized jointly by AMCHSS and SCTIMST IEC in August 2015

Important visitors

Dr R Chidambaran, Principal Scientific Advisor to the Government of India, held discussions on select future activities in AMCHSS on 19 May 2015.

Dr Richard Cash, Senior Lecturer in International Health and Director of the Program on Ethical Issues in International Health in the Department of Global Health and Population of the Harvard School of Public Health, conducted sessions on international health for MPH students on 12-15 January 2016 at SCTIMST.

Dr S S Lal, alumnus from the first batch of MPH in Sree Chitra, who is currently working as the TB Technical Officer in the US-based International NGO, PATH spoke about the

global scenario of TB control and interacted with the MPH students on World Health Day in a function held on 7 April 2015 at AMCHSS.

MPH students received a lecture on public health informatics on 8 May 2016 by Dr Ajith N Babu, Director, Centre for Advancement in Global Health and Clinical Professor, St Louis University, USA.

Dr Jitendar Kumar Sharma, Director, WHO Collaborating Centre for Priority Medical Devices and Health Technology Policy, National Health System Resource Centre, New Delhi, gave a talk on assessment of health technology on 30 May 2015.

Faculty

Dr K R Thankappan, Professor & Head

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

Dr V T Jissa, Scientist B

Support Staff

Ms Jayasree Neelakantan, Upper Division Clerk

DIVISION OF ACADEMIC AFFAIRS

Activities

The Institute continued to be a much sought-after destination for super-specialty courses leading to DM or MCh degrees in cardiac and neurosciences. This is also one of the few institutions that offer post-doctoral fellowship programs in the sub-specialty areas of cardiac and neurosciences.

In addition, the Institute offers Masters and PhD courses in medical, biomedical and public health sciences and diploma and PG diploma courses in related areas. The nationwide response from top performers bears testimony to the popularity of the courses offered by the Institute.

Programmes offered during the year

Post-doctoral courses

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

PhD/Master's

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

Diplomas

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

PG Diplomas

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

Advanced Certificate

30. Advanced Certificate Programmes in Physiotherapy

- Advanced Certificate Programme in Physiotherapy in Neurological Sciences
- Advanced Certificate Programme in Physiotherapy in Cardiovascular Sciences

Other Programmes

Joint Programmes:

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

Affiliated Programmes with other Centres:

National Institute of Epidemiology, Chennai

Master of Public Health (Epidemiology and Health Systems)

Christian Medical College, Vellore

1. MS Bioengineering
2. PhD in Bioengineering/Biomedical Sciences/Health Sciences
3. Master of Public Health (MPH)

IIITMK, Trivandrum

PhD (For Engineering Graduates)

PHFI (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. The Admission announcement is published all over India through advertisements in leading newspapers during 1st week of September every year and in the Institute website. The assessment and interview for admission to post-doctoral, doctoral, post-graduate and diploma programmes was held in the Institute in the month of November/December.

Number of students enrolled from 01.04.2015 to 31.03.2016

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

Course	2015-16	Total
DM/MCh and Post-doctoral Certificate Courses	47	113
PhD	23	91
M Phil Programme	9	9
Master of Public Health	18	32
MD Transfusion Medicine	1	1
Diploma/PG Diploma Programmes	33	67

A total of 138 candidates were offered admission to various programmes of study, out of which 131 candidates joined. The candidates admitted to various programmes had passed their qualifying examinations from 48 Indian Universities/ Institutions/Boards. The total strength of students in the Institute (excluding the joint programmes and affiliated programmes) as of March 2016 was 316.

The Institute implemented the recommendations of the Board of Studies for the up-gradation of the curriculums of the courses offered by the Institute. The mandatory requirements with respect to research publications, scientific presentations at conferences, essential grades in biostatistics course and posting of senior residents in biomedical technology departments were fulfilled.

The senior residents and PhD students were provided the opportunity to interact with the scientific community through the award of travel grants to attend national and international conferences. There were 154 presentations made at national conferences and 31 at international conferences by the students and faculty during the year. 80 of them won awards, among which 27 were bagged by the senior residents and students. The Institute also organized 27 academic events, which included symposia and conferences and 8 hands-on training sessions.

Degrees/Certificates Awarded (2015)

Name of Programme	Numbers	Remarks
DM	15	
MCh	10	
PDF	11	
PDCC	9	
PhD	10	
MPhil	3	
MPH	18	
MPH	19	NIE Chennai
MS - Bioengineering	2	CMC Vellore
DPH	4	
Post Graduate Diploma in HIV Epidemiology	4	
Diploma in Cardiaovascular & Thoracic Nursing	3	
Diploma in Neuro Nursing	10	
Diploma in Cardiac Laboratory Technology	4	
Diploma in Neuro Technology	6	
Diploma in Clinical Perfusion	1	
Diploma in Advanced Medical Imaging Technology	3	
Diploma in Medical Records Science	4	

Short - Term Training / Observership

Candidates sponsored by Government/Autonomous Institutions/Health Sector Organizations/Approved medical/dental/nursing/engineering colleges, paramedical Institutions were provided short-term training. The training/ observership and the time and duration of the training were decided in consultation with the respective departments. Observers from various Institutions all over the country spent varying periods, ranging from 15 days to 3 months, in different departments of the Institute.

Annual Convocation

Dr Harsh Vardhan, Hon'ble Minister for Science & Technology, and Earth Sciences, Government of India, delivered the convocation address (Figure 1) as Chief Guest at the Annual Convocation of the 31st batch of graduates on 16th May 2015. Prof Ashutosh Sharma, Esteemed Secretary, Department of Science and Technology, was the Guest of Honour. Shri K M Chandrasekhar, Former Central Cabinet Secretary and Institute President, presided over the function. 97 graduates received their degrees during the convocation.

G Parthasarathi Oration

The Annual G Parthasarathi Memorial Oration was delivered by Prof M S Valiathan, National Research Professor and Founder Director of the Institute, on 30 November 2015 (Figure 2).

National Science Day 2016 Celebrations

National Science Day 2016 was celebrated on 25 February 2016 in the Biomedical Technology Wing of the Institute (Figure 3). Several science-related events and quiz programmes were organized in the Institute premises to mark the occasion. A large number of students from nearby institutions participated in the celebrations with the theme 'Make in India – S & T-driven Innovations'. A demonstration of Raman Spectroscopy was organised for the staff and students.

New MoU / Agreements

The Institute has an exchange program with Bielefeld University in Germany for the Master of Public Health students. During the year, the Institute signed a Memorandum of Understanding with the Graduate School of Medicine, Osaka City University and Toyo University, Japan. Both of these will enable exchange of medical faculty and will strengthen the academic collaboration between the institutions. A Memorandum of Understanding was also signed with the Public Health Foundation of India to affiliate the Master of Public Health course at the New Delhi Centre. This is expected to open up new opportunities for researchers in this field to work together.

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 knowledge and use of Hindi. The Institute participated in the Town Official Language Implementation Committee meetings.

Figure 1. The dignitaries of the Annual Convocation of the 31st Batch. The Chief Guest, Dr Harsh Vardhan, Hon'ble Minister for Science & Technology, and Earth Sciences, Government of India, the Guest of Honour Prof Ashutosh Sharma, Secretary, Department of Science and Technology, Shri K M Chandrasekhar, Institute President, are seen on the dais along with the Director and the Dean.

Figure 2. Annual G Parthasarathi Memorial Oration by Prof M S Valiathan

Figure 3. National Science Day 2016 celebration

Staff

Dr Asha Kishore, Director & Chairperson

Dr V Kalliyana Krishnan, Dean of Academic Affairs (from 31-12-2015)

Dr T V Kumari, Associate Dean (PhD Affairs)

Dr Thomas Koshy, Associate Dean (Examinations & Curriculum)

Dr K Shivakumar, Associate Dean (Research & Publications)

Dr M Unnikrishnan, Associate Dean (Faculty Affairs)

Dr V G Shrinivas, Associate Dean (Student Affairs)

Dr A V George, Registrar

Dr Sundar Jayasingh, Deputy Registrar

Shiju V S, Assistant Administrative Officer (Academic) - A

Jeeva K H, Executive Assistant - A

Remya A, UDC - A

LIBRARY - HOSPITAL WING

Activities

The Hospital Wing library has a collection of 15375 books and 15728 back volumes of journals. During the year, the library subscribed to 110 journals. Electronic access to the journals subscribed to was activated and was available in both the campuses.

Being part of National Knowledge Resource Consortium (NKRC), the library continued to get 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, etc. and databases, namely, Web of Science and ASTM Standards.

An account was set up with iThenticate through NKRC for plagiarism check. During the year, 183 documents, which included journal articles, theses and dissertations, were checked for plagiarism.

Staff

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

Ms Sudha T, Librarian-cum Documentation Officer - B

Mr N Suresh, Senior Librarian-cum-Documentation Assistant

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 Biomedical Technology Wing has 10945 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 source for 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 R&D activities of BMT Wing are being constantly checked and updated.

The Document Archiving Cell forms a part of the the library and the Librarian-cum-Documentation Officer acts as the Archivist.

Staff

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

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

MEDICAL ILLUSTRATION

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

Activities

The Divisional activities involve three specialist areas:

Creating medical art and graphic design using traditional and state-of-the-art technology for purposes of publication and training.

Clinical photography for academic activities and routine photography at institutional events.

Providing audiovisual facilities during conferences, Workshops and seminars conducted by the Institute.

Staff

Mr G Lijikumar, Junior Scientific Officer

Ms Vasanthy S, Senior Artist

Mr Vijikumar N, Projectionist

PUBLICATIONS

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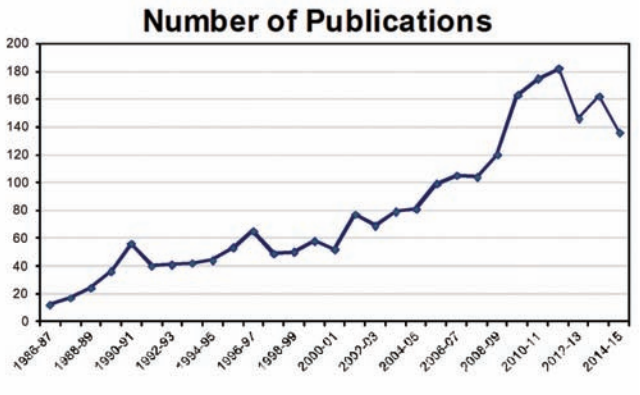
PUBLICATION ANALYSIS

Profile of Publications over the years

Total number of publications	2469
Total number of citations	22929
Average citations per article	9.29
h-index	54



5 articles that received more than 250 citations

Articles	Cited
Pillai CKS, Paul W, Sharma CP. Chitin and chitosan polymers: Chemistry, solubility and fiber formation. Progress in Polymer Science. 2009;34(7):641-78.	635
Rao SB, Sharma CP. Use of chitosan as a biomaterial: Studies on its safety and hemostatic potential. Journal of Biomedical Materials Research. 1997;34(1):21-8.	370
Chandy T, Sharma CP. Chitosan - As a Biomaterial. Biomaterials Artificial Cells and Artificial Organs. 1990;18(1):1-24.	350
Balakrishnan B, Mohanty M, Umashankar PR, et al. Evaluation of an in situ forming hydrogel wound dressing based on oxidized alginate and gelatin. Biomaterials. 2005;26(32):6335-42.	279
Balakrishnan B, Jayakrishnan A. Self-cross-linking biopolymers as injectable in situ forming biodegradable scaffolds. Biomaterials. 2005;26(18):3941-51.	266

Publications 2015-16

Total Publications			133
Publication type	Original articles	95	
	Reviews	4	
	Letters	7	
	Editorials	11	
	Conference Abstracts	16	
Total number of citations			65
Average citations per article			0.49
h-index			4

Publications from different Wings of SCTIMST	
Hospital	47
BMT	55
AMCHSS	20
Total joint publications between the three Wings	11

Joint publications with Indian collaborators	36
Joint publications with overseas collaborators	31

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RESEARCH PROJECTS

EXTERNALLY-FUNDED PROJECTS

Hospital Wing (Ongoing)

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs/US $)	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	Michel J Fox Foundation, USA	US $ 10976.00	3 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	2 years
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 influence of sleep architecture on the severity of memory disruption in amnestic mild cognitive impairment	Dr Ramshekhar N Menon	KSCSTE	08.41	3 years

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
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	2 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
ISCHEMIA: International Study of Comparative Health Effectiveness With Medical and Invasive Approaches	Dr Jaganmohan A Tharakan	National Institutes of Health, USA & New York University School of Medicine	23.75	5 years
Equipment for Heart Failure and Transplant Clinic	Dr Harikrishnan S	Jamsetji Tata Trust, Mumbai	317.00	1 Year
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 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
OPTOSIS: Portable Optical Brain-Computer Interface and Orthosis for Movement Restoration after stroke	Dr Kesavadas C	DBT	44.26	3 years
A Resting State fMRI & Task Based fMRI	Dr Kesavadas C	G E Technology Centre, Bangaluru	09.00	3 years

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
International Stroke Perfusion Imaging Registry (INSPIRE)	Dr Sylaja P N	University of Newcastle, Australia	02.27	3 years
Family led rehabilitation after stroke in India- ATTEND Trial	Dr Sylaja P N	The George Institute of Global Health, Hyderabad	13.12	3 years
Evaluating barriers and facilitators to stroke prevention to guide implementation research	Dr Sylaja P N	Centre for Chronic Disease Control, PHFI	01.33	8 months
Bio-Repository of DNA - Stroke	Dr Sylaja P N	Imperial College of Science, Technology and Medicine, London	03.95	2 years
Mitochondrial remodeling for prevention of chronic pressure overload induced cardiac remodeling	Dr Renuka Nair	ICMR	21. 20	3 years
Oxidative stress mediated stem cell modification promotes cardiac failure in hypertrophic remodeling	Dr Renuka Nair	BRNS	20.00	3 years
Molecular mechanisms in wound healing in the heart: Regulation of the cardiac fibroblast AT1 receptor	Dr Shivakumar K	DBT	37.80	3 years
Mitochondrial metabolism and function in type 2 diabetic heart	Dr Srinivas G	SERB	50.77	3 years
In vitro Beta Amyloid uptake by peripheral blood microphages: predictor for progression on mild cognitive impairement (MCI) to Alzheimer`s disease (AD)	Dr Srinivas G	ICMR	18.91	3 years
Tele Health and Medical Education	Dr Jawahar S K	Planning Board, GOK	23.00	1 year

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
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

Biomedical Technology Wing (Ongoing)

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
Bioresorbable nano porous bioceramic matrices for drug delivery in osteoporosis management	Dr H K Varma	DST	30.00	3 years
A new drug delivery method by ceramic modified superparamgnetic nanoparticles incorporated polymeric microspheres (Indo-Japan collaborative programme between SCTIMST and Osaka City University, Japan)	Dr H K Varma	DST-JSPS	05.20	2 years
Non-enzymatic blood glucose measurement system	Dr K Sreenivasan	ICMR	46.34	3 years
Visible light induced in situ gelling multifunctional hydrogels as potential wound dressings	Dr C Radhakumary	DBT	39.80	3 years
HAP-Polymer supramolecular structures for potential bioimaging and drug delivery applications	Dr Sunita Prem Victor	DST	25.00	3 years
Multifunctional HAP lanthanides core shell nanocomposites for NIR theranostic imaging	Dr Sunita Prem Victor	DBT-IYBA Award	45.00	3 years
Targeted protein delivery for transdifferentiation of pancreatic alpha cells to insulin-producing beta-like cells	Dr Shivaram Selvam	DST INSPIRE	35.00	5 years
Detection of Zinc in epileptic condition using ratiometric fluorescent molecular probes	Dr R S Jayasree	DBT	68.20	3 years

Gold nanorods for targeted photodynamic therapy and fluorescence imaging	Dr R S Jayasree	ICMR	41.15	3 years
Development of a dental restorative based on inorganic organic hybrid resin for the prevention of Barodontalgia	Dr P P Lizymol	DRDO	19.91	2 years
Biological evaluation of laser rapid manufactured Ti-porous structures	Dr A Sabareeswaran	BRNS	18.77	3 years
Preparation of hydrogel formulations from cholecystic extracellular matrix for biomedical applicaitions	Dr Akhila Rajan	SERB	31.20	3 years
Development of rapid UTI diagnostic kit with antibiotic sensitivity	Dr A Maya Nandkumar	DST	28.00	2 years
Adult stem cells as alternate cell sources for ocular surface regeneration	Dr T V Kumary	DST	48.00	3 years
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	3 years
In vitro osteoarthritic model to evaluate the regenerative capability of implants or engineered constructs	Dr Neethu Mohan	SERB	18.00	3 years
An in vitro skin tissue engineering approach for evaluating the potential of hair follicle derived stem cells- implication to wound healing	Dr Babitha S	SERB	25.00	3 years
Polymer inorganic hybrid scaffolds with cell adherent surfaces and enhanced mechanical properties for osteochondral tissue engineering	Dr Bindu P Nair	INSPIRE FACULTY	83.00	5 years
Controlled delivery of biological molecules using biodegradable microneedles	Dr Shiny Velayudhan	DBT-Biocare project	43.80	3 years
Treatment of large segmental bone defects with custom made triphasic hydroxyapatite scaffolds loaded with autologous MSCs in children-Clinical Trial at CMC Vellore	Dr Annie John (Co- PI)	DBT	80.00	3 years
Role of platelet protein on endothelial cell and smooth muscle proliferation	Dr Anugya Bhatt	KSCSTE	29.00	3 years
Translational Research on Biomaterials for Orthopaedic and Dental applications (Program support for Center of Excellence)	Dr H K Varma	DBT (Collaborative project with IISc)	70.73	5 years

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
Gold Nanorod Based Targeted Nanoprobe for Cancer Theranostics: Diagnosis By Surface Enhanced Raman Scattering (SERS) and Fluorescence Imaging and Therapy by PDT and PTT	Dr R S Jayasree	DBT (Collaborative project with NIIST)	27.97	3 years
Development of bioactive bone cement based on novel inorganic-organic hybrid resins	Dr P P Lizymol	KSCSTE, Kerala	17.26	3 years
Programme support on translational research on biomaterialsfor orthopaedic and dental applications	Dr A Sabareeswaran	DBT	23.1	5 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	CSRI-DST	44.08	3 years
An innovative tissue-engineered corneal regenerative therapy derived from a thermoresponsive bio-functionalized polymer and multipotent corneal stromal stem cells (Collaborative project with Dr A Hopkinson, Queen's Medical Centre Campus, University of Nottingham, UK)	Dr T V Kumary	DST UKIERI	UK £ 39900	2 years
Tissue-engineered ceramic for promoting osteointegration in osteoporotic animal models with relevance to the clinical problem in women	Dr Annie John	DST & Technology, Science for Equity Empowerment & Development Division	34.00	2 years
How actin/Intermediate filament structures within the cell are regulated bychanges in microtubule dynamics: Role of microtubule associated proteins and crosslinking proteins in maintaining cytoskeletal networking	Dr Renu Mohan	DBT Ramalingaswamy Re-entry Fellowship	88.00	5 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

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
Development of a light weight, lead free, polymer based thyroid collar for medical and dental diagnostic radiology	Dr Roy Joseph	INMAS & DRDO, New Delhi	19.62	2 years
Do platelets in patients with type II diabetes secrete proteins which can activate aortic endothelial cells?	Dr Anugya Bhatt	KSCSTE, Kerala	23	3 years

Industry sponsored R&D projects – Biomedical Technology Wing

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration
Development of polyurethane adhesive and potting compound for the fabrication of extracorporeal medical devices	Dr M Jayabalan	M/S SIDD-MPL, Chennai	24.00	2 years
Development of paediatric and neonatal membrane oxygenators	Mr D S Nagesh	SIDD Lifesciences Pvt Ltd., Chennai	27.00	3 years

Achutha Menon Centre For Health Science Studies

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration/ Status
Kerala Diabetes Prevention Program (KDPP)	Prof K R Thankappan	National Health and Medical Research Council, Australia	AUD 1.03 Million	5 years
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	3 years

Kerala Diabetes Prevention Program (KDPP II)	Prof K R Thankappan	World Diabetes 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, GOK	04.95 Crores	1 year
Closing the gaps: Health Equity Research Initiative in India	Prof T K Sundari Ravindran	International Development Research Centre, Canada	2.95 Crores	4 years
Research initiative on factors influencing women's reproductive intentions and their achievement	Prof T K Sundari Ravindran	Ford foundation, USA	US $ 42115	3 years
Availability of MTP/emergency contraceptive services to women in Kerala	Dr Ravi Prasad Varma	ICMR	07.54	18 months

IN-HOUSE RESEARCH PROJECTS

Hospital Wing

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration/ Status
Clinical application of cryopreserved homograft valves in cardiovascular surgery	Dr K Jayakumar	TDF- SCTIMST		Ongoing
Kerala Registry for Epilepsy and Pregnancy	Dr Sanjeev V Thomas	WCP- SCTIMST		Ongoing
Centre for Sleep Disorder	Dr Ashalatha R	SCTIMST		Ongoing

Comprehensive Stroke Care	Dr Sylaja P N	SCTIMST		Ongoing
Comprehensive Pain Clinic	Dr Rupa Sreedhar	SCTIMST		Ongoing
Neuro Intervention Centre (NIC)	Dr Jayadevan E R	SCTIMST		Ongoing
Health Technology Assessment	Dr Raman Kutty	TDF-SCTIMST	7.50	Ongoing
Comparison of propofol and sevoflurane induced burst suppression on cerebral blood flow and oxygenation	Dr Smitha V	SCTIMST	0.45	Ongoing
Development of a flexible ultrasound probe holder for central venous cannulations	Dr Manikandan	TDF-SCTIMST	0.25	1 year To be implemented
Impact of chronic non-communicable diseases on women`s lives and well being	Dr Raman Kutty & Dr Mala Ramanathan	WCP –SCTIMST	19.84	Ongoing
Formative research on medical tourism in Trivandrum	Dr Sreenivasan K	SCTIMST	00.70	Ongoing
Selective sub-temporal amygdalohippocampectomy versus anterior temporal lobectomy with amygdalohippocampectomy: a prospective randomized trial	Dr Mathew Abraham	SCTIMST	01.50	Ongoing

Biomedical Technology Wing

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees in Lakhs)	Duration/ Status
Development of a bioactive radiopaque inorganic-organic hybrid resin for dental and orthopaedic applications	Dr P P Lizymol	TDF-SCTIMST	8.03	2 years
Graphene-based nanoprobes as optical sensors to aid in rapid clinical diagnosis	Dr K Sreenivasan	OHF-SCTIMST	2.00	2 years
Biphasic hydroxyapatite-based keratoprosthesis evaluation in a rabbit model	Dr A Sabareeswaran	TDF-SCTIMST	2.05	30 months

Polymeric platform for developing 3D organotypic culture for *in vitro* toxicity evaluation	Dr P R Anil Kumar	TDF-SCTIMST	1.98	1 year
Small-scale production of fibrinogen concentrate and thrombin for clinical use	Dr Lissy Krishnan	TDF-SCTIMST	9.95	1 year
Application of decellularised bovine pericardium for fabrication of a novel valved conduit for RVOT reconstruction in sheep model	Dr Baiju S Dharan	TDF-SCTIMST	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	OHF-SCTIMST	2.5	2 years
Development of a prototype safety system to detect early and to prevent contrast extravasations especially in large volume intravenous power injections of contrast agents in CT and MR angiography	Dr Bijoy Thomas	TDF-SCTIMST	7.95	2 years
Flow Diverter Stent	Mr Sujesh S	TDF-SCTIMST	5.49	2 years
Mitral Valve Annuloplasty Ring	Mr Ranjith G	TDF-SCTIMST	9.41	2 years

MAJOR COMPLETED PROJECTS DURING 2015-16

Hospital Wing

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees In Lakhs)	Status
Molecular basis of cardiac fibroblast resistance to oxidative stress	Dr Shivakumar K	DBT	41.81	Completed
Comprehensive Heart Failure Program	Dr Harikrishnan S	ICMR	58.22	Completed
Indo-US collaborative Stroke Registry & Infrastructure Development	Dr P N Sylaja	DBT	23.26	Completed

Autofluorescence characterization of lung and mediastinal tumours	Dr Santhosh Kumar	SERB	28.00	Completed
Development of a computer based language therapy software (Malayalam version) for post stroke patient with aphasia and finding its efficacy compared to conventional speech therapy	Dr P N Sylaja	Centre for Disability Studies, Kerala	04.18	Completed
Development and validation of a comprehensive clinical and neuropsychological test battery for use in Indian context for patients with Vascular Cognitive Impairement (VCI)	Dr Ramshekhar Menon	ICMR	14.05	Completed
Biomedical signal analyzer for seizure prediction	Dr Ramshekhar Menon	Ministry of Communication & IT	4.62	Completed
LDL Receptor on macrophages as a ligand for Lp (a)- anti-gal antibody immune complex from plasma: A possible route for Lp (a) incorporation in atherosclerotic plaques	Dr Binu (PDF)	KSCSTE	7.39	Completed

Biomedical Technology Wing

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees In Lakhs)	Status
Synthesis of oxide-based magnetic nanoparticles for biocompatibility studies, magnetic hyperthermia and MRI applications	Dr H K Varma	DST	17.00	Completed
Nonviral 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	Completed
Role of Transforming Growth Factor - alpha in neuronal growth and regeneration	Dr Anoopkumar Thekkuveettil	KSCSTE	16.00	Completed

The effects of maternal sleep deprivation on cognition in the offspring in an animal model	Dr Kamalesh K Gulia	CSRI-DST	42.47	Completed
To investigate the effects of short and long-term administration of alpha-asarone on oxidative stress and anxiety alleviation in insomnia model in rats	Dr Kamalesh K Gulia	CSIR	26.80	Completed
Action of *Guibourtia tessmannii* (Caesalpiniaceae) extracts on sleep and reproductive system in obese male rats	Dr Deeh Defo Patrick Brice	NAM S &T Centre, DST	2.70	Completed
Musculoskeletal stem cells in tissue regeneration	Dr Prabha D Nair	DBT and Danish Ministry of Science & Technology	637.89	Completed
Regeneration of intervertebral discs – A tissue engineering approach	Dr Annie John	KSCSTE	15.99	Completed
Molecular and immune - toxicological effects of dextran coated ferrite and hydroxylapitite nanomaterials	Dr P V Mohanan	DST	49.40	Completed
Validation of diamond-like carbon coatings for orthopedic implants	Dr Manoj Komath	TDF-SCTIMST	1.37	Completed
Development of zerovalent iron nanoparticles as positive contrast agent for molecular imaging/ angiography	Dr R S Jayasree	OHF-SCTIMST	2.50	Completed
To investigate the effects of REM sleep restriction on the blood-brain barrier (BBB) functions on the basis of gold nanoconstructs and the circulatory inflammatory markers in an animal model	Dr Kamalesh K Gulia	OHF-SCTIMST	2.50	Completed
Evaluation of tissue engineered Strontium incorporated hydroxyapatite (SrHA) for the healing of osteoporotic bone defect in sheep model	Dr Annie John	OHF-SCTIMST	2.50	Completed

NEW RESEARCH INITIATIVES FOR 2016-17

Title of the Project	Principal Investigator	Funding Agency	Total Outlay (Rupees In Lakhs)	Status
Effects of yoga on motor cortex plasticity, motor learning and motor deficits of Parkinson's Disease	Dr Asha Kishore	DST (SATYAM)	32.81	3 years - awaiting IEC approval
Deciphering the genetic architecture of Parkinson's Disease in the Indian population	Dr Asha Kishore	Michael J Fox Foundation, USA	US $299,992	3 years - awaiting IEC approval
Effect of yoga on neuropsychological functions and brain connectivity networks in mild cognitive impairment (MCI) and cognitively normal subjects	Dr Ramshekhar Menon	DST (SATYAM)	33.82	3 years - awaiting IEC approval
Effects of Pre-operative Pranayama on improvement in post-operative pulmonary functions and reduction in post-operative pulmonary complications following neurosurgery	Dr Manikandan	DST (SATYAM)	9.8	3 years - IEC under process
Head Position in Stroke Trial	Dr Sylaja P N	Head Post International co-ordinating Centre & George Institute for Global Health, Australia	2.5	To be implemented by June 2016
Apolipoprotein B and A1 in ischemic stroke subtypes	Dr Sylaja P N	Emory University, USA	6.16	Fund to be released in June 2016
Meres 1 trial- A prospective, multi center, single arm, open label, pilot clinical study of MeRes 100 Sirolimus-eluting bioresorbable vascular scaffold system in the treatment of de novo native coronary artery lesions	Dr Ajit Kumar V K	Meril Life Science Pvt Ltd	1.50	3 years – fund release awaited
Non-communicable disease risk factors among working population - an Institution- based study	Dr G K Mini, AMCHSS	PHFI	29.78	Approved - fund release awaited

INSTITUTE BODY
(April 2015 to March 2016)

Shri K M Chandrasekhar (President)
Former Central Cabinet Secretary & Vice-Chairman
Kerala State Planning Board
Pattom, Trivandrum

Shri Joy Abraham
Member of Parliament (Rajya Sabha)
Mazhuvannoor House, Melampara P O
Bharananganam, Kottayam

Shri N K Premachandran
Member of Parliament
Maheswary Cantonment
P O Kollam

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

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

Shri J B Mohapatra
Joint Secretary and Financial Advisor
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Director General of Health Services (DGHS)
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Nirman Bhavan, Maulana Azad Road
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Executive Vice-President, KSCSTE
Kerala State Council for Science, Technology and Environment
Sasthra Bhavan, Pattom,
Trivandrum

Dr K Ellangovan
Secretary to the Government of Kerala
Department of Health & Social Welfare
Trivandrum

Prof P K Radhakrishnan
Vice-Chancellor
University of Kerala
Palayam, Trivandrum

Dr G K Singh
Director
All India Institute of Medical Sciences Patna
Phulwari Sharif, Patna, Bihar

Prof Sneh Anand
Professor
Department of Biochemical Engineering
Indian Institute of Technology Delhi
Hauz Khas, New Delhi

Dr Suranjan Bhattacharji
Christian Hospital
Bissamcuttack, Rayagada District
Orissa

Prof Kamala Krithivasan
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Indian Institute of Technology Madras
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Professor of Medicine
Institute of Medical Sciences
Banaras Hindu University, Varanasi

Dr Balram Bhargava
Professor
Department of Cardiology
All India Institute of Medical Sciences,
New Delhi

Prof V Ramgopal Rao
Institute Chair Professor
Department of Electrical Engineering
Indian Institute of Technology Bombay
Powai, Mumbai

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

Shri O S Neelakantan Nair
Acting Head
Biomedical Technology Wing, SCTIMST

GOVERNING BODY

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Former Cabinet Secretary & Vice-Chairman
Kerala State Planning Board
Pattom, Trivandrum

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Secretary to Government of India
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Joint Secretary and Financial Advisor
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Prof M V Padma Srivastava
Professor, Department of Neurology
Room No 708, 7th Floor, Neurosciences Centre
All India Institute of Medical Sciences
New Delhi

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

Shri O S Neelakantan Nair
Acting Head, Biomedical Technology Wing, SCTIMST

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

ACADEMIC COMMITTEE

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

Dr V Kalliyana Krishnan (Member Secretary)
Dean, Academic Affairs & Scientist G (Senior Grade)
SCTIMST

Dr P K Radhakrishnan
Vice-Chancellor
University of Kerala, Trivandrum

Prof Sunil Chandy
Director
Christian Medical College, Vellore

Dr C P Reghunadhan Nair
Deputy Director, VSSC, Trivandrum

Prof Mukesh Doble
Department of Biotechnology
Indian Institute of Technology Madras
Adyar, Chennai

Prof K P Aravindan
Department of Pathology
Government Medical College, Calicut

Prof V Ramakrishnan
Director, IISER, Trivandrum

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

Prof Ajit Kumar V K
Department of Cardiology, SCTIMST

Prof V Ramankutty
AMCHSS, SCTIMST

Prof Muralidharan Nair
Head, Department of Neurology, SCTIMST

C V Muraleedharan
Scientist G & Head, Department of Medical Devices and Engineering, BMT Wing, SCTIMST

TECHNOLOGY DEVELOPMENT COMMITTEE

Dr Asha Kishore (Chairperson)
Director, SCTIMST

Head
BMT Wing, SCTIMST

Prof V Ramgopal Rao
Institute Chair Professor, Department of Electrical Engineering
IIT Bombay, Powai, Mumbai

Shri C Balagopal
Maryanoll Bungalow, TC 4/246, Thaliyath Lane
Kuravankonam, Kowdiar, Trivandrum

Dr Suresh Das
Executive Vice-President, KSCSTE
Kerala State Council for Science, Technology and Environment
Sasthra Bhavan, Pattom, Trivandrum

Shri A V Ramani
Group Senior Vice-President (R & D)
TTK Group of Companies
11th Floor, Brigade Road, Bangalore

Prof Vrisha Madhuri
Department of Orthopaedics,
Christian Medical College, Vellore

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

Shri C V Muraleedharan
Scientist G & Head, Department of Medical Devices and Engineering, BMT Wing, SCTIMST

Prof Ajit Kumar V K
Department of Cardiology, SCTIMST

Prof Shrinivas V G (from 1st October 2015)
Department of Anaesthesiology, SCTIMST

FINANCE COMMITTEE

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

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

Shri J B Mohapatra, JS & FA
Department of Science and Technology
Technology Bhavan, New Mehrauli Road, New Delhi

Shri O S Neelakantan Nair
Acting Head, BMT Wing, SCTIMST

Shri V K Girijavallabhan (Ex-officio Convener) (from January 2016)
Senior Deputy Director & Chief Financial Advisor
SCTIMST

BUILDING COMMITTEE

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

Dr Suresh Das
Executive Vice-President, KSCSTE
Kerala State Council for Science, Technology and Environment, Sasthra Bhavan, Pattom, Trivandrum

Shri G Vijayaraghavan
Member
Planning Board, Government of Kerala

Shri O S Neelakantan Nair
Acting Head, BMT Wing, SCTIMST

Mr K M Nair
Head CMD (Retired) VSSC/ISRO, Trivandrum

Shri V K Girijavallabhan
(Ex-officio Convener) (from January 2016)
Senior Deputy Director & Chief Financial Advisor
SCTIMST

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
Abha, 20/1677, Number 8, Sasthri Nagar
Karamana, Trivandrum

Dr Rema M N
(Former DME and Professor, and Head of the Department of Pharmacology)
Manjush, Puthupally Lane, Trivandrum

Dr M D Gupte
(Former Director,
National Institute of Epidemiology (ICMR), Chennai)
K 502, West End Village,
Bhusari Colony, Paud Road
Kothrud, Pune

Dr R V G Menon
Number 22, Haritha, Kesavadev Road
Poojappura, Trivandrum

Smt Sathi Nair
Retired Chief Secretary
Samtripthi, Devapalan Nagar
Peroorkada, Trivandrum

Dr K R S Krishnan
Director, Technical & Operation
HLL Life Care Limited, Poojappura, Trivandrum

Dr N Subha
(Retired Professor & Head of the Department of Psychiatry, Medical College)
Professor & Head of Psychiatry, Sree Gokulam Medical College, Venjaramoodu, Trivandrum

Dr Christina George
Head, Department of Psychiatry
Dr Somervell Memorial CSI Medical College and Hospital
Karakonam P O, Trivandrum

Dr Kala Kesavan P
Professor of Pharmacology
Medical College, Trivandrum

Dr Jaganmohan A Tharakan
Director-in-Charge, SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015), SCTIMST

Head
BMT Wing, SCTIMST

Dr V Raman Kutty (Internal Member)
Professor

Dr Mala Ramanathan (Member Secretary)
Additional Professor
AMCHSS, SCTIMST

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

INSTITUTIONAL ANIMAL ETHICS COMMITTEE

Shri O S Neelakantan Nair (Chairman),
Acting Head, BMT Wing, SCTIMST

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

Dr Kavita Raja
Professor
Department of Microbiology, SCTIMST

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

Dr J C Stephenson (CPCSEA Main nominee)

Dr Robin D Culas (Scientist from outside the Institute)

Mr A G Babu (socially aware member)

Dr Annie John (Member Secretary)
Scientist F, Division of Laboratory Animal Science
BMT Wing, SCTIMST

INSTITUTIONAL COMMITTEE FOR STEM CELL RESEARCH (ICSCR)

Dr M Radhakrishna Pillai (Chairman)
Director
Rajiv Gandhi Centre for Biotechnology
Thycaud P O, Poojappura, Trivandrum

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director, SCTIMST

Prof R V G Menon
Number 22, Haritha, Kesavadev Road
Poojappura, Trivandrum

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

Dr Jackson James
Scientist-E1, Neuro-Stem Cell Biology Lab
Rajiv Gandhi Centre for Biotechnology
Thycaud P O, Poojappura, Trivandrum

Dr Vikram Mathews
Professor of Clinical Haematology
Christian Medical College, Vellore

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

Shri Jaideep G Nair
Advocate
Anjali, Veera Bhadra Gardens, Trivandrum

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

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

Dr Anoop Kumar T
Scientist F, Division of Molecular Medicine
BMT Wing, SCTIMST

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

Ms Sreepriya C S (Co-ordinator)
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

RESEARCH COUNCIL

Prof P Balram (Chairman)
Molecular Biophysics Unit
Indian Institute of Science, Bangalore

Dr 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 Number 80, Mahatma Gandhi Marg
Lucknow

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

Dr Shyamala Mani
Associate Professor, Centre for Neuroscience
Indian Institute of Science, Bangalore

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 Senior Vice-President (R & D)
TTK Group of Companies
11th Floor, Brigade Road, Bangalore

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

Dr G Sundararajan
Former Director,
International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI),
Hyderabad, Telangana

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

SENIOR STAFF SELECTION COMMITTEE

Dr Jaganmohan A Tharakan
Director-in-Charge
SCTIMST (Till July 2015)

Dr Asha Kishore
Director (From July 2015)
SCTIMST
Head
BMT Wing, SCTIMST

Nominee of the Secretary, DST

An expert from outside the Institute

A scientist from among the members of the Institute Body

A senior academic staff of the Institute

JUNIOR STAFF SELECTION COMMITEE

Medical Superintendent
SCTIMST

Head
BMT Wing, SCTIMST

A representative of the Academic Wing

Three members nominated by the President

INTERNAL COMPLAINTS COMMITTEE FOR PREVENTION OF SEXUAL HARASSMENT OF WOMEN AT WORKPLACE

The Internal Complaints Committee (ICC) of the Institute for Prevention of Sexual Harassment of Women at Workplace conducted awareness programmes for staff and students. A Standard Operating Procedure (SOP) was uploaded on the Institute website. The ICC received one complaint during 2015-16. An inquiry was duly conducted and the report submitted to the Director within the stipulated time.

VISITORS

1. **A team from the parent company of Terumo Penpol,** Terumo BCI USA consisting of Ms Marschner Susanne - Director, Scientific Affairs, TBCT I&D, Mr Blakslee Jeff- Director, Whole Blood Automation, TBCT I&D, Mr Motomura Tadahiro - Scientist, Terumo I&D, Mr A Manoj, Associate Vice-President, Innovation & Development India, Ms Ashalatha, Assistant Manager visited the Biomedical Technology Wing and had discussions with the faculty.
2. **Dr Aby Aprem**, Deputy Vice-President, Dr Mukund, QA & Projects, Dr Binu Raj, Manager, Production, Dr Rahul Shetty, R&D, Mr Prem Sagar, Plant Manager, HLL Lifecare visited the Dental Products Laboratory, BMT Wing on 20th July and held discussions regarding IUD development.
3. **Dr Sunil Chacko**, Adjunct Professor, MDI Gurgaon, Dr Chockalingam, Former Director in NHLBI, NIH, USA, and Dr Iwasaki, Orthopaedic Surgeon, Anshin Hospital, Kobe, Japan visited BMT Wing on 24th July and held discussions to explore areas of mutual interest.
4. **Mr Shanavas**, Director - TEQZO Consulting, an industrial design consultant visited BMT Wing for exploring the possibility of including industrial design inputs in design of medical devices.
5. **Dr L M Kukreja,** Professor, Homi Bhabha National Institute and Head, Laser Material Processing Division (LMPD) and Dr C P Paul, Scientific Officer, Raja Ramanna Centre for Advanced Technology (RRCAT), Indore visited the Histopathology Laboratory at the BMT Wing as part of collaborative work.
6. **Prof Prasad Patnaik**, Department of Applied Mechanics, IIT Madras visited the Biomedical Technology Wing and identified possible areas of collaborative research for medical device development.
7. **Dr Ravi**, Orthopaedic Surgeon, Mother Cell Regenerative Centre (MCRC), Trichy, Tamil Nadu visited the Biomedical Technology Wing.
8. **Dr Chintamani Das**, Programme Officer and Dr Suprasanna, Review Member, BRNS, BARC, Mumbai visited the Institute to assess the progress of research programme funded by BRNS.

9. Prof Santanu Dhara from Department of Medical Science & Technology, IIT Kharagpur, delivered a talk on Development of Customized Implants and Bioresorbable Implants via Reverse Engineering Approach on 18th August at BMT Wing campus. Prof Santanu's research interests include Biomaterials and Regenerative Medicine: Fabrication-Bioactivation-Biological assay, Customized implant development, Bioactivation of Implant, Tissue Engineering, Near Net Shape Forming, Green machining, Medical Textile, 3D printing and patterning and Dense and Porous Implants.

10. A talk on technology transfer was delivered by Dr Hanumanth Purushotham, Chairman and Managing Director of National Research Development Corporation (NRDC) on 17th October 2015.

11. Mr Siddhant Saboo, CEO Levram Lifesciences Pvt. Ltd. visited the Institute on 26th October 2015.

12. Dr Prasanth Varkey, Plastic Surgeon, Mission Hospital, Trichur visited the Institute and held discussions on wound dressing programme on 7th & 17th November 2015.

13. Mr Mohammad Shyjal & Partner of KCK Dental, Calicut visited the Institute and held discussions on possibilities for technology transfer on 3rd November 2015.

14. A team from M/s HLL Lifecare Ltd visited the Institute and had discussions with the team involved in the development of blood & IV fluid warmer, electromagentic and battery operated blood flow meter, bioengineered fibrin skin substitutes, microneedle system for controlled drug/biomolecule delivery to explore possibilities for collaboration.

15. Prof Richard Lindley (Prof of Geriatric Medicine, Sydney Medical School, Australia), Prof Anne Forster (University of Leeds, UK), and Prof Marion Walker (University of Nottingham, UK) had visited our Institute and the stroke unit on 1st December 2015. They lectured on acute stroke care and thrombolysis and advances in stroke rehabilitation.

16. Prof Joseph Chacko, Director of Neuro-Ophthalmology at the Harvey and Bernice Jones Eye Institute, University of Arkansas Medical School, United States & Professor for the Departments of Ophthalmology and Neurology, UAMS College of Medicine, gave a talk on Neuro-Opthalmology 4th January 2016.

17. Prof Tarasankar Pal from IIT Kharagpur, Dr Sriram from CLRI, and Dr Sudha from NIIST, Trivandrum, visited the Institute.

18. Dr G D Agrawal, Chairman of SURGIWEAR medical device company visited the Institute on 18th February 2016 and carried out discussion with the laboratories regarding collaboration. He also gave a talk at TIMed.

19. Dr Shyam Vasudev, Founder, FORUS Health, gave a talk at TIMed on 19th February 2016 and also discussed possible collaboration with the scientists.

STATEMENT OF ACCOUNTS

SREE CHITRA TIRUNAL INSTITUTE FOR
MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31st MARCH 2016

CORPUS/CAPITAL FUND AND LIABILITIES	Schedules	2015-16	2014-15
		[Rs.]	[Rs.]
CAPITAL FUND	1	2415358210	2376196137
RESERVES & SURPLUS	2	468881828	567019319
EARMARKED ENDOWMENT FUNDS	3	568504318	211742527
SECURED LOANS & BORROWINGS	4	0	0
CURRENT LIABILITIES & PROVISIONS	7	387485547	177767447
TOTAL		3840229903	3332725430
ASSETS			
FIXED ASSETS	8	1688144242	1540131215
INVESTMENTS FROM EARMARKED ENDOWMENT FUNDS	9	129333293	123583199.00
INVESTMENTS-OTHERS	10	468881828	567019319
CURRENT ASSETS , LOANS, ADVANCES ETC	11	1553870540	1101991697
MISCELLANEOUS EXPENDITURE (TO THE EXTENT NOT WRITTEN OFF)		0	0
TOTAL		3840229903	3332725430
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		
		0.00	

Sd/-
CHIEF FINANCIAL ADVISOR

Sd/-
DIRECTOR

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st MARCH 2016

			2014-15
INCOME	Schedules	TOTAL	HOS
		Rs.	Rs.
Income from Sales / Services	12	904119253	817631349
Grants Received from Govt of India(Salary,General,Non Plan)	13	957813000	840588000
Fees/Subscription	14	8432450	6101380
Income from Investments	15	126982987	12029861
(Income on Investment from earmarked/endow.Funds transferred to Funds)			
Income from Royalty, Publication etc	16	1091864	586646
Interest Earned	17	50548463	89168342
Other Income	18	11070681	9246047
TOTAL		2060058698	1775351625
EXPENDITURE			
Establishment Expenses	20	1144529802	1023042825
Other Administrative Expenses	21	901825681	797725390
Bank Charges	23	118506	247154
Depreciation (Net Total at the year-end-corresponding to Schedule 8)		161168080	143476883
TOTAL		2207642070	1964492252
Balance being Excess Expenditure over Income		147583372	189140627
Add: Transfer to Special Reserve Account		1796684	26889638
BALANCE BEING DEFICIT CARRIED TO CAPITAL FUND		149380056	216030265
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Sd/-
CHIEF FINANCIAL ADVISOR

Sd/-
DIRECTOR

SCHEDULES

	2015-16	2014-15
PARTICULARS	[Rs.]	[Rs.]
SCHEDULE 1 - CORPUS/CAPITAL FUND		
Balance as at the beginning of the year	4126604027	4148187087
Less Depreciation up to the end of the previous year	1750407889	1606931005
Net balance at the beginning of the year	2376196137	2541256080
Add: Plan Grants received from Government of India	202597000	66250000
Add: Grants received from Others for Capital Assets(WCP)	0	0
Less:Contribution towards Corpus/Capital Fund	0	0
Deduct: Balance of net expenditure transferred from the Income and Expenditure Account	149380056	216030265
Less:Value of Assets Written off during the year	14054871	15279678
DeductTransfer to BMT/Add Transfer from CHO	0	0
BALANCE AS AT THE YEAR-END	2415358210	2376196137
SCHEDULE 2-RESERVES AND SURPLUS:		
1. Capital Reserve:		
As per last Account	--	--
Addition during the year	--	--
Less:Deduction during the year	--	--
3. Special Reserves:		
As per last Account	567019319	559945101
Addition during the year (Current year transfer- Increase in provision)	1862509	7074218
Less: Deductions during the year	-100000000	
4. General Reserve:		
As per last Account	--	--
Addition during the year	--	--
Less: Deductions during the year	--	--
TOTAL	468881828	567019319

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS		
a) Opening balance of the funds		
b) Additions to the funds:		
i. Donations/grants		
ii. Income from Investments made on account of funds		
iii. Other additions (Specify nature)		
TOTAL (a+b)		
c) Utilisation / Expenditure towards objective of funds		
i. Capital Expenditure		
- Fixed Assets		
- Others		
Total (Detailed Schedule Attached)		
ii. Revenue Expenditure		
- Salaries, Wages and allowances etc.	568504318	211742527
- Rent		
- Other Administrative expenses		
Total	568504318	211742527
TOTAL (c)		
NET BALANCE AS AT THE YEAR-END (a+b+c)	568504318	211742527

SCHEDULE 3-EARMARKED/ENDOWMENT FUNDS - AS ON 31.03.2016		(Amount Rs)				
PROJ#	NAME OF GRANTEE/PRINCIPAL INVESTIGATOR	FUND-WISE BREAK UP			TOTAL	
		OPENING BALANCE	ADDITIONS TO FUND			
			GRANTS	OTHER RECEIPTS		FIXED ASSETS
5000	PROJ-MISCELLANEOUS	2832451.50	6202332.00	37000.00	9071783.50	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	869749.70	0.00	0.00	869749.70	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
5082	HEALTH AWARENESS PROGRAM	127537.00	0.00	0.00	127537.00	0.00
5091	EURO REG. OF EPILEPSY & PREGNANCY	71796.00	0.00	0.00	71796.00	0.00
5094	KERALA STATE AIDS CONTROL SOCIETY	254989.00	22500.00	0.00	277489.00	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	1961635.94	0.00	0.00	1961635.94	0.00
5119	STAKE HOLDER-PERCEPT/INST.REV BO	104492.73	0.00	0.00	104492.73	0.00
5128	INDENT. OF MYCOBACTERIAL/DST/V.V.RADHAKRISHN	136107.00	0.00	0.00	136107.00	0.00
5130	TELE-HEALTH & MEDICAL EDUCATION/JAWAHAR	321629.00	0.00	0.00	321629.00	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	1382245.00	0.00	0.00	1382245.00	41589.00
5137	MECHANISM OF ANTICANCER/DAE, BRS	2761.00	0.00	0.00	2761.00	0.00
5139	A 24 WEEK, MULTICENTER/DR. MATHURANATH	2602046.78	0.00	0.00	2602046.78	0.00
5140	HARVARD SCHOOL OF PUBLIC HEALTH	91794.32	0.00	0.00	91794.32	0.00
5142	BANKING FOR BETTER HEALTH-MEDISAVE	153911.36	0.00	0.00	153911.36	0.00
5146	DEVELOPMENT OF SPECTROSCOPIC PROTOCOL	11026.00	0.00	0.00	11026.00	0.00
5150	PROTOCOL 6002-INT 001	235886.60	0.00	0.00	235886.60	9860.00
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	1366298.00	0.00	0.00	1366298.00	83350.00
5168	PROJ/VERMEER STUDY	1361300.00	0.00	0.00	1361300.00	0.00

UTILISATION						TOTAL EXPENDITURE	NET BALANCE
CAPITAL EXPENDITURE		REVENUE EXPENDITURE					
OTHERS	TOTAL	SALARIES/WAGES	RENT/CONSUMABLES	OTHER ADMN EXP	TOTAL		
0.00	0.00	7746385.00	270445.00	866.00	8017696.00	8017696.00	1054087.50
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	11613.00	0.00	0.00	11613.00	11613.00	858136.70
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	127537.00	127537.00	127537.00	0.00
0.00	0.00	0.00	0.00	45129.00	45129.00	45129.00	26667.00
0.00	0.00	0.00	19668.00	650.00	20318.00	20318.00	257171.00
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	611638.00	611638.00	611638.00	1349997.94
0.00	0.00	0.00	0.00	0.00	0.00	0.00	104492.73
0.00	0.00	0.00	0.00	136107.00	136107.00	136107.00	0.00
0.00	0.00	180000.00	0.00	7421.00	187421.00	187421.00	134208.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	215059.00
0.00	41589.00	0.00	0.00	14350.00	14350.00	55939.00	1326306.00
0.00	0.00	0.00	0.00	2761.00	2761.00	2761.00	0.00
0.00	0.00	0.00	0	0.00	0.00	0.00	2602046.78
0.00	0.00	0.00	0	0.00	0.00	0.00	91794.32
0.00	0.00	0.00	0.00	0.00	0.00	0.00	153911.36
0.00	0.00	0.00	0.00	0.00	0.00	0.00	11026.00
0.00	9860.00	46000.00	0.00	41000.00	87000.00	96860.00	139026.60
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	83350.00	0.00	0.00	0.00	0.00	83350.00	1282948.00
0.00	0.00	0.00	288286.00	0.00	288286.00	288286.00	1073014.00

5170	SAFETY OF E 2007 IN LEVODOPA	1442261.00	0.00	0.00	1442261.00	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
5181	PARKINSONS DISEASE NEUROIMAGING	-14350.00	0.00	14350.00	0.00	0.00
5182	KERALA REGISTRY FOR EPILEPSY AND PREGNANCY	256832.00	0.00	0.00	256832.00	0.00
5183	OXFORD HEALTH SCHEME,LONDON	1147757.92	0.00	0.00	1147757.92	0.00
5184	COMP HEALTH CARE PROJECT ST	795316.00	500000.00	0.00	1295316.00	0.00
5189	IMPACT CV DISEASE ON HOUSEHOLD	1012.00	0.00	0.00	1012.00	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	68079.50	0.00	0.00	68079.50	0.00
5192	TO PROVIDE INFRASTRUCTURE TO AMCHSS	256405.50	0.00	0.00	256405.50	0.00
5193	SAFE MOTHERHOOD PROGRAMME	71796.00	0.00	0.00	71796.00	0.00
5198	MODULATION OF ENERGY METABOLISM	6142.00	0.00	0.00	6142.00	0.00
5199	CLINICAL APPLICATION CRYOPRESE	547617.00	1000000.00	0.00	1547617.00	0.00
5201	OPEN LABEL TRIAL IN PARKINSON	3437052.50	0.00	0.00	3437052.50	0.00
5203	STUDY IN MRI - ISIR	45243.00	0.00	0.00	45243.00	0.00
5205	EFFICACY AND SAFETY OF AP-1200	213090.00	0.00	0.00	213090.00	0.00
5207	BRAIN MRI STUDIES	6692.00	0.00	0.00	6692.00	0.00
5209	MANAGEMENT - CORONARY EVENT	421158.00	395934.00	0.00	817092.00	0.00
5210	EMPOWERMENT OF WOMEN	993896.00	0.00	0.00	993896.00	0.00
5212	YOUNG CORONARY ARTERY DISEASE	15873.00	0.00	0.00	15873.00	0.00
5213	CREATION OF AMC FUND	665696.00	0.00	6747993.00	7413689.00	0.00
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	419061.00	0.00	0.00	419061.00	0.00
5226	ISOLATION, CHARACTERIZATION OF GLIOMAS	357092.00	0.00	0.00	357092.00	0.00
5227	MONOTHERAPY/ ACTIVE CONTROL	919498.00	255609.00	20268.00	1195375.00	0.00
5229	REAL TIME FMRI IN STROKE	60780.00	0.00	0.00	60780.00	0.00

0.00	0.00	135000.00	12939.00	0.00	147939.00	147939.00	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	0.00	0.00	0.00	0.00
0.00	0.00	181700.00	68224.00	0.00	249924.00	249924.00	6908.00
0.00	0.00	94479.00	0.00	930154.00	1024633.00	1024633.00	123124.92
0.00	0.00	0.00	0.00	890541.00	890541.00	890541.00	404775.00
0.00	0.00	0.00	0.00	1012.00	1012.00	1012.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	42210.00
0.00	0.00	0.00	54986.00	66.00	55052.00	55052.00	13027.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	256405.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	71796.00
0.00	0.00	0.00	0.00	6142.00	6142.00	6142.00	0.00
0.00	0.00	493107.00	177606.00	27179.00	697892.00	697892.00	849725.00
0.00	0.00	0.00	51884.00	39857.00	91741.00	91741.00	3345311.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45243.00
0.00	0.00	0.00	0.00	213090.00	213090.00	213090.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6692.00
0.00	0.00	394267.00	0.00	64535.00	458802.00	458802.00	358290.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	993896.00
0.00	0.00	0.00	0.00	15873.00	15873.00	15873.00	0.00
0.00	0.00	0.00	0.00	5911046.00	5911046.00	5911046.00	1502643.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1053692.10
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	162000.00	0.00	12696.00	174696.00	174696.00	244365.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	357092.00
0.00	0.00	303381.00	52042.00	34570.00	389993.00	389993.00	805382.00
0.00	0.00	0.00	0.00	60780.00	60780.00	60780.00	0.00

5232	CEREBELLUM AND CORTICAL	226476.00	0.00	0.00	226476.00	0.00
5233	DEVELOPING AN INDO-CANADIAN COLLABORATION	91.00	0.00	0.00	91.00	0.00
5234	IMPROVING LOCALIZATION IN LESION NEGATIVE	92266.00	0.00	0.00	92266.00	17500.00
5235	REGULATION OF THE CARDIAC FIBROBLAST C..	8001.00	0.00	0.00	8001.00	0.00
5237	KERALA DIABETES PREVENTION PROGRAM(K-DPP	4278842.50	2919950.00	0.00	7198792.50	0.00
5238	IMPROVING LOCALIZATION IN LESION NEGA...	4884.00	0.00	0.00	4884.00	0.00
5243	STEROIDS IN CARDIAC SURGERY	273153.00	2910.00	0.00	276063.00	0.00
5244	MOLECULAR BASIS OF CARDIAC FIBROBLAST ..	16000.00	0.00	0.00	16000.00	0.00
5245	IMPROVING LOCALIZATION IN LESION N..	452455.00	0.00	0.00	452455.00	0.00
5246	COMPREHENSIVE HEART FAILURE	2394240.00	31898.00	0.00	2426138.00	900000.00
5247	A PHASE 3, 12-WEEK, DOUBLE BLIND, PLA...	2404406.10	0.00	0.00	2404406.10	29914.00
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	0.00
5250	DIABETES, PREDIABETES AND INSU	1734.00	0.00	0.00	1734.00	0.00
5251	NEUROBIOLOGICAL MARKER OF POPULATION D..	22916.00	0.00	0.00	22916.00	0.00
5252	INDO-US COLLABERATIVE STROKE	644062.00	0.00	0.00	644062.00	0.00
5255	PRIVATIZATION OF HEALTHCARE	327241.50	0.00	0.00	327241.50	0.00
5256	HEALTHY LIFE STYLE	5232496.00	649724.00	0.00	5882220.00	0.00
5257	PULMONARY HYPERTENSION,BMPRII	53524.00	0.00	0.00	53524.00	0.00
5259	EFFICACY OF THE THETA BURST	63568.00	0.00	0.00	63568.00	0.00
5260	INFLUENCE OF SLEEP ARCHITECTUR	353769.00	0.00	0.00	353769.00	0.00
5261	IMAGE PROCESSING FOR IMPROVING	2475.00	0.00	0.00	2475.00	0.00
5263	MITOCHONDRIA SPECIFIC ANTI-OXI	149755.00	583990.00	0.00	733745.00	0.00
5264	FLUORESCENCE OPTICAL BIOPSY	42355.00	900000.00	0.00	942355.00	0.00
5265	DEVELOPING PHYSCIAN EDUCATION	189650.00	0.00	0.00	189650.00	8900.00
5266	RAPID ASSESSMENT OF THE SCHEME	3910.00	0.00	0.00	3910.00	0.00
5267	EVALUATION STUDY OF THE ASHA	131449.00	188000.00	0.00	319449.00	0.00
5271	DEVELOPMENT OF A COMPUTER BASED LANGUAGE -	249595.00	0.00	0.00	249595.00	0.00
5272	PORTABLE OPTICAL BRAIN-COMP	3188640.00	314470.00	0.00	3503110.00	3249761.00
5273	INTERNATIONAL STROKE	132217.00	93300.00	0.00	225517.00	0.00
5274	IMPROVING THE CONTROL OF HYPERTENSION .	2712306.82	787600.00	0.00	3499906.82	45000.00
5275	ENCODING OF INTERHEMISPHERIC -	3409552.00	0.00	0.00	3409552.00	158948.00

0.00	0.00	0.00	65243.00	0.00	65243.00	65243.00	161233.00
0.00	0.00	0.00	0.00	91.00	91.00	91.00	0.00
0.00	17500.00	14600.00	0.00	59512.00	74112.00	91612.00	654.00
0.00	0.00	0.00	0.00	8001.00	8001.00	8001.00	0.00
0.00	0.00	1833224.00	0.00	1691985.00	3525209.00	3525209.00	3673583.50
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4884.00
0.00	0.00	0.00	0.00	10281.00	10281.00	10281.00	265782.00
0.00	0.00	0.00	0.00	16000.00	16000.00	16000.00	0.00
0.00	0.00	0.00	0.00	267517.00	267517.00	267517.00	184938.00
0.00	900000.00	631488.00	0.00	794650.00	1426138.00	2326138.00	100000.00
0.00	29914.00	89581.00	0.00	43641.00	133222.00	163136.00	2241270.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2041792.70
0.00	0.00	0.00	0.00	0.00	0.00	0.00	594651.00
0.00	0.00	0.00	0.00	1734.00	1734.00	1734.00	0.00
0.00	0.00	0.00	0.00	22916.00	22916.00	22916.00	0.00
0.00	0.00	104097.00	0.00	64212.00	168309.00	168309.00	475753.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	327241.50
0.00	0.00	0.00	0.00	1267557.00	1267557.00	1267557.00	4614663.00
0.00	0.00	0.00	0.00	53524.00	53524.00	53524.00	0.00
0.00	0.00	0.00	0.00	63568.00	63568.00	63568.00	0.00
0.00	0.00	117773.00	36384.00	202.00	154359.00	154359.00	199410.00
0.00	0.00	0.00	0.00	2475.00	2475.00	2475.00	0.00
0.00	0.00	53677.00	184981.00	1284.00	239942.00	239942.00	493803.00
0.00	0.00	638065.00	18459.00	176731.00	833255.00	833255.00	109100.00
0.00	8900.00	37500.00	0.00	71392.00	108892.00	117792.00	71858.00
0.00	0.00	0.00	0.00	3910.00	3910.00	3910.00	0.00
0.00	0.00	0.00	0.00	126615.00	126615.00	126615.00	192834.00
0.00	0.00	118065.00	60034.00	171.00	178270.00	178270.00	71325.00
0.00	3249761.00	323646.00	0.00	617.00	324263.00	3574024.00	-70914.00
0.00	0.00	0.00	11317.00	0.00	11317.00	11317.00	214200.00
0.00	45000.00	1466127.00	0.00	356239.00	1822366.00	1867366.00	1632540.82
0.00	158948.00	482775.00	0.00	102173.00	584948.00	743896.00	2665656.00

5276	VALIDATION OF FMRI	122767.00	500000.00	0.00	622767.00	0.00
5277	VASCULAR CONGNITIVE IMPAIRMENT	296709.00	401770.00	0.00	698479.00	0.00
5278	INDO-GERMAN SYMPOSIUM -	68160.00	0.00	0.00	68160.00	0.00
5279	FAMILY LED REHABILITATION AFTER STROKE..	195804.00	529290.00	25860.00	750954.00	20218.00
5280	DEVELOPMENT OF A TECHNICAL GUIDE: INTE.. -	1488027.00	0.00	0.00	1488027.00	0.00
5281	LDL RECEPTOR ON MACROPHAGES -	254628.00	0.00	0.00	254628.00	0.00
5282	INDIAN –EUROPEAN RESEARCH	544551.00	0.00	0.00	544551.00	0.00
5283	RESEARCH INITIATIVE ON FACTORS	807723.00	0.00	0.00	807723.00	0.00
5284	INTERNATIONAL STUDY FOR COMPARATIVE	236964.00	44409.00	0.00	281373.00	0.00
5285	INTERNATIONAL RANDOMIZED	28893.00	0.00	0.00	28893.00	0.00
5287	STUDY OF CARBAMAZEPINE ...	399950.00	800000.00	0.00	1199950.00	0.00
5288	BIO-REPOSITORY OF DNA -STROKE	99176.47	276000.00	0.00	375176.47	0.00
5289	MITOCHONDRIAL METABOLISM...	2369316.00	1000000.00	0.00	3369316.00	1534603.00
5290	CLOSING THE GAP;HEALTH EQUITY	3713957.04	4803495.47	7944.00	8525396.51	0.00
5291	OXIDATIVE STRESS MEDIATED STEM..	133299.00	609873.00	0.00	743172.00	0.00
5292	A RESTING STATE FMRI & TASK ..	115497.00	681200.00	0.00	796697.00	0.00
5293	DECIPHERING LRRK2 GENE	447115.00	0.00	0.00	447115.00	0.00
5294	MTP/EC SERVICES OF WOMEN	772380.00	0.00	0.00	772380.00	27374.00
5296	ELECTROENCEPHALOGRAPHY WORKSHOP	180918.00	617400.00	152000.00	950318.00	0.00
5297	THE HUMAN BRAIN MAPPING PROJ..	933458.00	0.00	0.00	933458.00	156477.00
5298	MOLECULAR MECHANISMS	1594648.00	0.00	0.00	1594648.00	528801.00
5299	BIOMEDIAL SIGNAL ANALYSER	462000.00	35.00	0.00	462035.00	0.00
5300	ANALYSING FUNCTIONAL NETWORKS	500000.00	0.00	0.00	500000.00	0.00
5301	IN VITRO BETA AMYLOID UPTAKE	0.00	996400.00	0.00	996400.00	0.00
5302	/DISABILITY STUDIES IN EPILEPSY	372900.00	0.00	0.00	372900.00	0.00
5303	MITOCHONDRIAL REMODELING	0.00	797096.00	0.00	797096.00	0.00
5305	A FAMILY BASED RANDOMIZED	0.00	338800.00	0.00	338800.00	0.00
5306	3 DAYS TRAINING	0.00	200000.00	0.00	200000.00	0.00
5307	A RESTING FMRI	0.00	855000.00	0.00	855000.00	0.00
5308	EPILEPSY CARE THROUGH SCHOOLS	0.00	1854000.00	0.00	1854000.00	0.00
5309	STRENGTHENING ECO-SYSTEM	0.00	676818.00	0.00	676818.00	0.00
5310	KERALA DIABETES PREVENTION	0.00	4160200.00	0.00	4160200.00	0.00
5312	EVALUATING BARRIERS AND BARR	0.00	168794.00	0.00	168794.00	0.00

0.00	0.00	213874.00	51930.00	122723.00	388527.00	388527.00	234240.00
0.00	0.00	370080.00	149248.00	27281.00	546609.00	546609.00	151870.00
0.00	0.00	0.00	0.00	68160.00	68160.00	68160.00	0.00
0.00	20218.00	419694.00	0.00	18492.00	438186.00	458404.00	292550.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1488027.00
0.00	0.00	204185.00	50443.00	0.00	254628.00	254628.00	0.00
0.00	0.00	0.00	0.00	540656.00	540656.00	540656.00	3895.00
0.00	0.00	0.00	0.00	807723.00	807723.00	807723.00	0.00
0.00	0.00	0.00	17910.00	40750.00	58660.00	58660.00	222713.00
0.00	0.00	0.00	0.00	28893.00	28893.00	28893.00	0.00
0.00	0.00	728700.00	24222.00	139587.00	892509.00	892509.00	307441.00
0.00	0.00	88200.00	62608.00	0.00	150808.00	150808.00	224368.47
0.00	1534603.00	248900.00	772743.00	268275.00	1289918.00	2824521.00	544795.00
0.00	0.00	789967.00	0.00	3754823.00	4544790.00	4544790.00	3980606.51
0.00	0.00	99960.00	134736.00	94809.00	329505.00	329505.00	413667.00
0.00	0.00	553488.00	49824.00	0.00	603312.00	603312.00	193385.00
0.00	0.00	167338.00	148501.00	25505.00	341344.00	341344.00	105771.00
0.00	27374.00	310356.00	0.00	170378.00	480734.00	508108.00	264272.00
0.00	0.00	31200.00	0.00	893888.00	925088.00	925088.00	25230.00
0.00	156477.00	212516.00	69650.00	91270.00	373436.00	529913.00	403545.00
0.00	528801.00	96000.00	673214.00	73998.00	843212.00	1372013.00	222635.00
0.00	0.00	0.00	0.00	288235.00	288235.00	288235.00	173800.00
0.00	0.00	129720.00	54835.00	105654.00	290209.00	290209.00	209791.00
0.00	0.00	298800.00	183623.00	38505.00	520928.00	520928.00	475472.00
0.00	0.00	97548.00	0.00	102225.00	199773.00	199773.00	173127.00
0.00	0.00	141519.00	409035.00	94863.00	645417.00	645417.00	151679.00
0.00	0.00	137678.00	0.00	15246.00	152924.00	152924.00	185876.00
0.00	0.00	0.00	170650.00	0.00	170650.00	170650.00	29350.00
0.00	0.00	0.00	0.00	31608.00	31608.00	31608.00	823392.00
0.00	0.00	308057.00	0.00	369697.00	677754.00	677754.00	1176246.00
0.00	0.00	25000.00	0.00	297577.00	322577.00	322577.00	354241.00
0.00	0.00	194516.00	0.00	9815.00	204331.00	204331.00	3955869.00
0.00	0.00	15000.00	0.00	10445.00	25445.00	25445.00	143349.00

5313	EQUIPMENT FOR HEART FAILURE	0.00	20000000.00	10000.00	20010000.00	0.00
5314	NON COMMUNICABLE DISEASES	0.00	49556060.00	0.00	49556060.00	0.00
6054	PROJ/DR RADHAKRISHNAN NEUROLOGY	200.54	0.00	0.00	200.54	0.00
6055	MOVEMENT DISORDER SURGERY	-3426921.00	3426921	0.00	0.00	0.00
6058	ATHIYANOOR SCT ACTION/DR.K.R.T	21006.00	0.00	0.00	21006.00	0.00
6064	SPEECH THERAPY	-883914.00	883914.00	0.00	0.00	0.00
6065	COMPREHENSIVE CENTRE FOR SLEEP DISORD	-4251337.00	4199423.00	219000.00	167086.00	0.00
6072	COMPREHENSIVE STROKE CARE	-18346063.00	22727380.00	0.00	4381317.00	0.00
6075	CORRELATION FETAL ECHOCARDIO	109885.00	0.00	0.00	109885.00	0.00
6077	TECHNICAL ADVISORY COMMITTEE	-534355.00	0.00	693161.00	158806.00	0.00
6080	COMPREHENSIVE PAIN CLINIC	409000.00	0.00	0.00	409000.00	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)	-9928154.00	13668213.00	23948.00	3764007.00	0.00
6087	AUTONOMIC DYSFUNCTION	110480.00	0.00	0.00	110480.00	0.00
6089	THE EFFECTS OF PROPOFOL	32650.00	0.00	0.00	32650.00	0.00
6090	STUDY ON THE EFFECT OF DEXMEDE	45000.00	0.00	0.00	45000.00	0.00
6091	PUBLIC HEALTH DOCUMENTATION -	528771.00	0.00	0.00	528771.00	0.00
6093	EVALUATION OF VASCULAR GRAFT	136360.00	0.00	0.00	136360.00	0.00
6095	COMPREHENSIVE HEART FAILURE CLINC	0.00	0.00	699630.00	699630.00	0.00
6096	MOLECULAR BIOLOGY OF PEDIATRIC	50000.00	0.00	0.00	50000.00	0.00
6097	DEVELOPMENT OF E LOG BOOK	59921.00	0.00	0.00	59921.00	0.00
6098	RESEARCH ON MEDICAL TOURISM	70000.00	0.00	0.00	70000.00	0.00
6099	CLINICO PATHOLOGICAL CORR...	130000.00	0.00	0.00	130000.00	0.00
6100	CLINICO PATHOLOGICAL CORRELATION	43200.00	0.00	0.00	43200.00	0.00
6101	EXECUTIVE FUNCTION IN PERSONS	50000.00	0.00	0.00	50000.00	0.00
6102	SELECTIVE SUB-TEMPORAL SELE	0.00	150000.00	0.00	150000.00	0.00
6103	DEVELOPMENT OF A FLEXIBLE ARM	0.00	25000.00	0.00	25000.00	0.00
6104	HEALTH TECHNOLOGY ASSESSMENT	0.00	750000.00	0.00	750000.00	0.00
7101	ADVANCE TO P I	-1982.00	0.00	3231765.00	3229783.00	0.00
		41825374.69	150545708.47	11882919.00	204254002.16	6812295.00
	OTHER PROJECTS					
1014	NEW PENSION SCHEME	10710775.05		77474962.00	88185737.05	

0.00	0.00	0.00	0.00	10479.00	10479.00	10479.00	19999521.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	49556060.00
0.00	0.00	0.00	0.00	201.00	201.00	201.00	-0.46
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	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	142914.00	0.00	8640.00	151554.00	151554.00	15532.00
0.00	0.00	4381317.00	0.00	0.00	4381317.00	4381317.00	0.00
0.00	0.00	0.00	0.00	109885.00	109885.00	109885.00	0.00
0.00	0.00	158806.00	0.00	0.00	158806.00	158806.00	0.00
0.00	0.00	34500.00	0.00	0.00	34500.00	34500.00	374500.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	142710.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	70321.00
0.00	0.00	3763936.00	71.00	0.00	3764007.00	3764007.00	0.00
0.00	0.00	0.00	0.00	110480.00	110480.00	110480.00	0.00
0.00	0.00	0.00	5920.00	0.00	5920.00	5920.00	26730.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	45000.00
0.00	0.00	112240.00	0.00	18233.00	130473.00	130473.00	398298.00
0.00	0.00	0.00	50400.00	0.00	50400.00	50400.00	85960.00
0.00	0.00	492003.00	0.00	0.00	492003.00	492003.00	207627.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	50000.00
0.00	0.00	13500.00	0.00	0.00	13500.00	13500.00	46421.00
0.00	0.00	20000.00	0.00	3316.00	23316.00	23316.00	46684.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	130000.00
0.00	0.00	0.00	39950.00	3250.00	43200.00	43200.00	0.00
0.00	0.00	0.00	10070.00	0.00	10070.00	10070.00	39930.00
0.00	0.00	37610.00	0.00	0.00	37610.00	37610.00	112390.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	25000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	750000.00
0.00	0.00	0.00	3231758.00	0.00	3231758.00	3231758.00	-1975.00
0.00	6812295.00	30697672.00	7733839.00	23197563.00	61629074.00	68441369.00	135812633.16
				76223227.00		76223227.00	11962510.05

1301	EMPLOYEES PENSION FUND	101089702.65		142623025.00	243712727.65	
1075	PATIENT WELFARE FUND	4125477.35		2230564.00	6356041.35	
1078	DR. RICHARD A CASH & DR K MOHANDS AWARD	120491.00		92655.00	213146.00	
1080	STAFF BENEVOLENT FUND	3349117.25		3060369.00	6409486.25	
1081	CONTINUUM - SPECIAL CME PUBLICATION FUND - Hospital	51707.00			51707.00	
		119447270.30		225481575.00	344928845.30	
5000	PROJECT SUSPENSE	548975.00	2318439.00	0.00	2867414.00	0.00
5057	DYNAMIC ORTHOPAEDIC PVT LTD, HYDROXY	6787.55	0.00	0.00	6787.55	0.00
5089	DETEC & TREAT OF CANCER BY LASER	3959.00	0.00	0.00	3959.00	0.00
7000	MISCELLANEOUS PROJECT	30944.09	0.00	0.00	30944.09	0.00
7001	PRO;SAHAJANAND VASCU;DR.AURTHUR	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
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	672450.50	0.00	600.00	673050.50	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	STEC-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

				132315287.00		132315287.00	111397440.65
				20454.00		20454.00	6335587.35
				15000.00		15000.00	198146.00
				1959238.00		1959238.00	4450248.25
						0.00	51707.00
				210533206.00	0.00	210533206.00	134395639.30
0.00	0.00	0.00	0.00	2364532.00	2364532.00	2364532.00	502882.00
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	0.00	0.00	0.00	0.00	84759.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13876.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2537.40
0.00	0.00	0.00	0.00	0.00	0.00	0.00	551.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13656.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	181074.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4761.75
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213826.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	13674.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39424.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	5407.00
0.00	0.00	0.00	104046.00	0.00	104046.00	104046.00	569004.50
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

7032	DST. DR. ANNIE/BONE REGENERATION	29166.00	0.00	0.00	29166.00	0.00
7033	BIOFUNCTIONAL EVALUATION DR. UMA SHANKAR	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 ACUTE…..	44684.00	0.00	0.00	44684.00	0.00
7040	BIOMED/ C.V. MURALEEDHARAN	44000.00	0.00	0.00	44000.00	0.00
7041	CSIR-GRANT-ASHA S MATHEW,PHD STUDENT	55973.00	0.00	0.00	55973.00	0.00
7042	CSIR-GRANT-BERNADETTE K. MADATHIL,PHD	25870.00	0.00	0.00	25870.00	0.00
7043	CSIR-GRANT-SAILAJA.G.S.SRF	9067.00	0.00	0.00	9067.00	0.00
7044	LISI NO TRIAL TRIAL MERIND	21672.65	0.00	0.00	21672.65	0.00
7045	NIRMALA RACHEL, CSIR	14063.00	0.00	0.00	14063.00	0.00
7047	U.G.C. GRANT- RESEARCH FELLOW	300935.00	0.00	0.00	300935.00	0.00
7048	CSIR GRANT- JOSENA JOSEPH	47473.00	0.00	0.00	47473.00	0.00
7049	CSIR GRANT - MARY VARGHESE	35837.00	0.00	0.00	35837.00	0.00
7050	INTEREST-PROJECT ACCOUNT	0.00	2972837.00	0.00	2972837.00	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	0.00	-229010.25	0.00
7053	DR.SREENIVASAN/DEVEL.OF TEMP.RES.CO-OPLY	22619.00	0.00	0.00	22619.00	0.00
7054	DST-DR.ANOOP-DIFF:EXPR:RAT BRAIN……	44434.00	0.00	0.00	44434.00	0.00
7055	CSIR-NMITLI SCHEME-C.V.MURALEEDHARAN	756552.00	0.00	0.00	756552.00	0.00
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. KUMARY, DBT.BIOGENE	38659.00	0.00	0.00	38659.00	0.00
7067	DBT. DR. JAYABALAN, DEV:&STUDIES…..	-27459.00	0.00	0.00	-27459.00	0.00
7069	VSSC - PROJECT. D.S. NAGESH	153475.00	0.00	0.00	153475.00	0.00
7070	CHO PROJECT - 5146 JAYASREE	-872.00	0.00	0.00	-872.00	0.00
7071	STEC-PROJECT: DR.MAYA NANDKUMAR	375.00	0.00	0.00	375.00	0.00
7072	SAHAJANAND MED.TECH. C.V.MURALIDHARAN	76292.00	0.00	0.00	76292.00	0.00
7073	STUDY PROJECT:DR.P.V.MOHANAN	-95386.00	0.00	0.00	-95386.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	29166.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	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
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	1078253.00	1078253.00	1078253.00	1894584.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12062.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-229010.25
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	0.00	0.00	0.00	110047.00
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	-27459.00
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
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

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
7090	PROJ/7090/TISSUE ENGINEER VASCULAR	130504.00	0.00	0.00	130504.00	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	2024683.00	530370.00	10000.00	2565053.00	0.00
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	49972.00	0.00	0.00	49972.00	0.00
7108	PROJ/7108/CSIR/FRANCIS.B.FERNANDEZ	2154.00	0.00	0.00	2154.00	0.00
7109	PROJ/7109/CSIR/TARA.S	8733.00	259200.00	0.00	267933.00	0.00
7110	PROJ/7110/CSIR/DEEPA.R	17090.00	0.00	0.00	17090.00	0.00
7111	PROJ/7111/CSIR/SHEEJA LIZA EASO	25806.00	283200.00	0.00	309006.00	0.00
7112	PROJ/7112/ICMR/JASEER MOHAMMED	0.00	107302.00	0.00	107302.00	0.00
7113	PROJ/7113/KSCSTE/RATHIKALA	3519.00	0.00	0.00	3519.00	0.00
7200	JOINT PROGRAME/M.TECH	581996.00	0.00	0.00	581996.00	0.00
7210	PROJ/7210/CSIR/SOMA DEY	81953.00	36000.00	0.00	117953.00	0.00
7220	COST OF ANIMAL FEED	3608519.00	0.00	0.00	3608519.00	0.00
7230	PROJ/7230/CSIR/MANJU.S	12421.00	0.00	0.00	12421.00	0.00
7240	PROJ/7240/CSIR/SUNITHA CHANDRAN	3312.00	351200.00	0.00	354512.00	0.00
7250	PROJ/7250/CSIR/KIRAN.S.NAIR	15281.00	0.00	0.00	15281.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	289303.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	11935.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	399773.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	10518.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	88349.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	878.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	30882.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	26381.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-86027.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	39103.00
0.00	0.00	0.00	0.00	130504.00	130504.00	130504.00	0.00
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	0.00	31200.00	387836.00	27013.00	446049.00	446049.00	2119004.00
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	15890.00	15890.00	15890.00	34082.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2154.00
0.00	0.00	259200.00	0.00	8733.00	267933.00	267933.00	0.00
0.00	0.00	0.00	0.00	6171.00	6171.00	6171.00	10919.00
0.00	0.00	283200.00	0.00	19453.00	302653.00	302653.00	6353.00
0.00	0.00	107302.00	0.00	0.00	107302.00	107302.00	0.00
0.00	0.00	0.00	0.00	3605.00	3605.00	3605.00	-86.00
0.00	0.00	0.00	0.00	23005.00	23005.00	23005.00	558991.00
0.00	0.00	36000.00	0.00	80312.00	116312.00	116312.00	1641.00
0.00	0.00	0.00	450932.00	0.00	450932.00	450932.00	3157587.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	12421.00
0.00	0.00	331200.00	0.00	23312.00	354512.00	354512.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	15281.00

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	48000.00	0.00	72034.00	0.00
7300	PROJ/7300/CSIR/ARIYA SARASWATHY	17436.00	259200.00	0.00	276636.00	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	14795.00	523400.00	0.00	538195.00	0.00
7350	UGC GRANT - LAXMI.R.NAIR - BMT PROJECT	41215.00	995000.00	0.00	1036215.00	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-	171614.00	112050.00	63421.00	347085.00	0.00
7375	ICMR PROJECT- MS. RENU RAMESH	10000.00	491533.00	0.00	501533.00	0.00
7385	CSIR GRANT - CAROLINE DIANA SHERLY	64091.00	512000.00	0.00	576091.00	0.00
7390	TOXICITY STUDY OF MATERIALS DR. P V MOHANAN	210528.00	0.00	0.00	210528.00	0.00
7395	RAISNG ANTIBODIES IN RABBITS - DR V S HARIKRISH	38965.00	37640.00	0.00	76605.00	0.00
7400	CSIR GRANT :SHAIJU S NAZEER	3333.00	216000.00	0.00	219333.00	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	41117.00	0.00	0.00	41117.00	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 KUMARY	35836.00	146856.00	0.00	182692.00	0.00
7406	CSIR GRANT - R ARATHI	12531.00	0.00	0.00	12531.00	0.00
7407	TRSF MESENCHYMAL STEM CELL	12444.00	0.00	0.00	12444.00	0.00
7408	DURGADAS - PhD STUDENT - CSIR	4837.00	575867.00	0.00	580704.00	0.00
7409	SRUTHI PHD STUDENT UGC	15000.00	433600.00	0.00	448600.00	0.00
7411	DEV POLY ADHESIVE & POTT	498728.00	1058165.00	0.00	1556893.00	0.00
7412	REMYA K CSIR FELLOW	44146.00	381467.00	0.00	425613.00	0.00
7413	PROJ/7413/ANTIMICROBIA	0.00	427276.00	0.00	427276.00	0.00
7414	PROJ/7414/EFFECT OF	0.00	211600.00	0.00	211600.00	0.00
7415	PROJ/7415/AXONAL	0.00	369200.00	0.00	369200.00	0.00
7416	PROJ/7416/PULMONARY	0.00	380000.00	0.00	380000.00	0.00
7417	PROJ/7417/INVITRO &	0.00	380000.00	0.00	380000.00	0.00
7418	PROJ/7418/THE NATURE	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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	149985.00
0.00	0.00	48000.00	0.00	0.00	48000.00	48000.00	24034.00
0.00	0.00	259200.00	0.00	17443.00	276643.00	276643.00	-7.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	166674.00
0.00	0.00	518400.00	0.00	12600.00	531000.00	531000.00	7195.00
0.00	0.00	943200.00	0.00	48992.00	992192.00	992192.00	44023.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	266292.00
0.00	0.00	0.00	61672.00	0.00	61672.00	61672.00	285413.00
0.00	0.00	485200.00	0.00	0.00	485200.00	485200.00	16333.00
0.00	0.00	477600.00	15341.00	0.00	492941.00	492941.00	83150.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	210528.00
0.00	0.00	8700.00	0.00	0.00	8700.00	8700.00	67905.00
0.00	0.00	216000.00	0.00	38880.00	254880.00	254880.00	-35547.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	100747.00
0.00	0.00	0.00	0.00	41117.00	41117.00	41117.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	761369.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	182692.00
0.00	0.00	0.00	0.00	6396.00	6396.00	6396.00	6135.00
0.00	0.00	0.00	10758.00	0.00	10758.00	10758.00	1686.00
0.00	0.00	580704.00	0.00	0.00	580704.00	580704.00	0.00
0.00	0.00	425600.00	0.00		425600.00	425600.00	23000.00
0.00	0.00	200957.00	184050.00	58776.00	443783.00	443783.00	1113110.00
0.00	0.00	384000.00	19888.00	4961.00	408849.00	408849.00	16764.00
0.00	0.00	251960.00	0.00	0.00	251960.00	251960.00	175316.00
0.00	0.00	201600.00	0.00	0.00	201600.00	201600.00	10000.00
0.00	0.00	349200.00	0.00	10220.00	359420.00	359420.00	9780.00
0.00	0.00	217742.00	0.00	0.00	217742.00	217742.00	162258.00
0.00	0.00	247000.00	0.00	0.00	247000.00	247000.00	133000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	284000.00
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

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/IMPLANTED....CONTROL	21565.00	0.00	0.00	21565.00	0.00
8011	PROJ/8011/NANOFRONT/DR.NIRANJAN/INTRAMAS	139900.00	0.00	0.00	139900.00	0.00
8012	PROJ/8012/VSSC/DR.NIRANJAN/DESIGN STUDIES	2148623.00	0.00	0.00	2148623.00	0.00
8014	PROJ/8014/DBT/DR.ROY JOSEPH/DEV....V.GRAFT	-17063.00	0.00	0.00	-17063.00	0.00
8015	PROJ/8015/DR.ANOOPKUMAR/PROGRAMME...	4566.00	0.00	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	358677.00	83833.00	0.00	442510.00	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
8025	PROJ/8025/	41499.00	0.00	0.00	41499.00	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	535954.00	621000.00	0.00	1156954.00	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	950000.00	0.00	518898.00	0.00
8040	PROJ/SYNTHESIS OF OXIDE-DR.H.K.VARMA	-30337.00	0.00	0.00	-30337.00	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
8048	PROJ/STUDIES DR.KAMALESH GULIA	774.00	0.00	0.00	774.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	139019.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	21565.00	21565.00	21565.00	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
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	252182.00	0.00	252182.00	252182.00	190328.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79036.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-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	41499.00	41499.00	41499.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	3339.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	79732.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22332.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-305162.00
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	166433.00	0.00	166433.00	166433.00	990521.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	22201.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1182223.00
0.00	0.00	950000.00	0.00	0.00	950000.00	950000.00	-431102.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-30337.00
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	774.00	774.00	774.00	0.00

8049	PROJ/NEW VISION BIOMAT-DR.C.P.SHARMA	-44861.00	0.00	0.00	-44861.00	0.00
8050	PROJ/GENOTOXICITY STUDY-DR.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	486576.00	0.00	80461.00	567037.00	0.00
8054	PROJ/MUSCULOSKELETAL STEM CELL/DR.PDNAIR	2696318.00	5494546.00	269340.00	8460204.00	0.00
8055	PROJ/MUSCULOSKELETAL STEM /DR.H.K.VARMA	-129801.00	672000	0.00	542199.00	0.00
8058	PROJ/AORC FELLOWSHIP/MAYURI.P.V.	3485.00	419715.00	0.00	423200.00	0.00
8059	PROJ/CELL SHEET ENGG-DR.P.R.ANILKUMAR	-11986.00	119986.00	0.00	108000.00	0.00
8060	PROJ/DEVELOPMENT OF SKIN GRAFT	36510.00	0.00	2840.00	39350.00	0.00
8061	PROJ/VISIBLE LIGHT INDUCED../DR.RADHAKUMARI	-74458.00	599707.00	0.00	525249.00	0.00
8062	PROJ/ACCELERATED AGEING../MR.C.V.MURALI	213728.00	0.00	0.00	213728.00	0.00
8063	PROJ/EFFECTS OF MATERIAL SLEEP/DR.K.GULIA	210369.00	300000.00	1000.00	511369.00	0.00
8064	NONVIRAL GENE DELIVERY VECTORS- DR.REKHA	-491067.00	958586.00	6393.00	473912.00	0.00
8065	PROJ/8065/RARE EARTH BASED MATERIALS	-223827.00	1400000.00	200000.00	1376173.00	0.00
8066	TO INVESTIGATE THE EFFECTS OF/ DR.GULIA	77485.00	413819.00	0.00	491304.00	0.00
8067	QUANTUM DOT CONJUGATED -DR.R.S.JAYASREE	-4160.00	0.00	0.00	-4160.00	0.00
8068	INSPIRE RESEARCH PROJECT -DR. BINDU. P. NAIR	1143178.00	1518081	0	2661259.00	12557.00
8069	PROJ/8069/STUDIES BIODEGRADABLE	1425.00	0.00	0.00	1425.00	0.00
8070	PROJ/8070/PINSPIRE FACULTY AWARD-DR.SHIV	2189023.00	0.00	158502.00	2347525.00	0.00
8071	PROJ/8071/REGEN .OF INTERVERTEBRAL DISC	-79945.00	453533.00	6880.00	380468.00	0.00
8072	PROJ/8072/NANO CALCIUM PHOSPHATE	289834.00	400000.00	0.00	689834.00	0.00
8073	PROJ/8073/DEVELOP.OF CARDIOPULMONARY	193824.00	1000000.00	0.00	1193824.00	0.00
8074	PRODUCTION OF NOVEL NANO INDO-UK DR.CP.S	467793.00	0.00	0.00	467793.00	0.00
8075	DST INSPIRE FELLOWSHIP - ASWATHY B S	5640.00	422560.00	0.00	428200.00	0.00
8076	ICMR - DR K SREENIVASAN	93143.00	999217.00	0.00	1092360.00	0.00
8077	HOME BASED VITAL SIGNS - DR.NIRANJAN.D.	476167.00	700000.00	0.00	1176167.00	0.00
8078	PROJ/8078/AN INVITRO SKIN TISSUE ENG	249636.00	950000.00	0.00	1199636.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	-44861.00
0.00	0.00	0.00	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	429227.00	0.00	429227.00	429227.00	137810.00
0.00	0.00	0.00	4085215.00	28346.00	4113561.00	4113561.00	4346643.00
0.00	0.00	268750.00	218872.00	0.00	487622.00	487622.00	54577.00
0.00	0.00	403200.00	19818.00	0.00	423018.00	423018.00	182.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	108000.00
0.00	0.00	0.00	39350.00	0.00	39350.00	39350.00	0.00
0.00	0.00	282294.00	19372.00	92000.00	393666.00	393666.00	131583.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	213728.00
0.00	0.00	252000.00	49508.00	0.00	301508.00	301508.00	209861.00
0.00	0.00	158993.00	279546.00	0.00	438539.00	438539.00	35373.00
0.00	0.00	873931.00	471687.00	0.00	1345618.00	1345618.00	30555.00
0.00	0.00	105600.00	128263.00	0.00	233863.00	233863.00	257441.00
0.00	0.00	930.00	0.00	0.00	930.00	930.00	-5090.00
0.00	12557.00	1108017.00	276709.00	0.00	1384726.00	1397283.00	1263976.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1425.00
0.00	0.00	1068670.00	750212.00	162791.00	1981673.00	1981673.00	365852.00
0.00	0.00	148719.00	143260.00	0.00	291979.00	291979.00	88489.00
0.00	0.00	111948.00	327938.00	0.00	439886.00	439886.00	249948.00
0.00	0.00	772045.00	76919.00	0.00	848964.00	848964.00	344860.00
0.00	0.00	0.00	164613.00	0.00	164613.00	164613.00	303180.00
0.00	0.00	403200.00	5000.00	0.00	408200.00	408200.00	20000.00
0.00	0.00	100877.00	24586.00	0.00	125463.00	125463.00	966897.00
0.00	0.00	192754.00	404278.00	0.00	597032.00	597032.00	579135.00
0.00	0.00	780000.00	190202.00	0.00	970202.00	970202.00	229434.00

8079	DOSE RANGING STUDY FOR DES / DR.SABAREES	761725.00	0.00	0.00	761725.00	0.00
8080	PROJ/8080/DETECTION OF ZINC IN EPILEPTIC	4579848.00	0.00	194504.00	4774352.00	3909062.00
8081	EXPLORING THE POTENTIAL OF ISLET-DR. PRABH	278121.00	0.00	0.00	278121.00	0.00
8082	ASSESSMENT OF CERAMIC CONSTRUCTS - FRANC	43477.00	0.00	0.00	43477.00	0.00
8083	IN VITRO OSTEOARTHRITIC-DR.NEETHUMOHAN	375653.00	1000000.00	0.00	1375653.00	0.00
8084	ROLE OF NMDA- DR.PRADEEP PUNNAKKAL- RAM	1674953.00	1610000.00	150272.00	3435225.00	6925.00
8085	PROJ/8085/ELECTROCHEMICALLY ASSISTED	98094.00	1000000.00	0.00	1098094.00	0.00
8086	PROJ/8086/GOLD NANORODS FOR THERAPY	2587747.00	0.00	6140.00	2593887.00	0.00
8087	PROJ/8087/CONTROLLED DELIVERY	615596.00	1683393.00	81233.00	2380222.00	0.00
8088	CANCER TISSUE ENGINEERING A 3D - ARAVIN	-13420.00	438526.00	0.00	425106.00	0.00
8089	DO PLATELETS IN PATIENTS -DR.ANUGYABHATT	312978.00	835532.00	0.00	1148510.00	0.00
8090	INSPIRE FELLOW PHD KEERTHI S JRF	16160.00	401600.00	0.00	417760.00	0.00
8091	BIORESORBABLE NANO- DR H K VARMA	1925065.00	0.00	0.00	1925065.00	0.00
8092	BIOLOGICAL STRUCTURES	303671.00	786208.00	4324.00	1094203.00	0.00
8093	A NEW DRUG-CERAMIC MOD SUPER-DR. H K VARMA	96542.00	150000.00	0.00	246542.00	0.00
8094	ALTERNATE	1712341.00	0.00	137523.00	1849864.00	65333.00
8095	DEV RAPID UTI DR. MAYA-DST	2191709.00	0.00	0.00	2191709.00	0.00
8096	PREP OF HYDROGEL -DR AKHILA RAJAN	517594.00	950000.00	0.00	1467594.00	0.00
8097	MULTIFUNCN - DBT SUNITHA PREM	1880000.00	0.00	0.00	1880000.00	893586.00
8098	HOW ACTIN FILAMENT STRUCTUDR RENU MOHAN	2903.00	2585266.00	0.00	2588169.00	0.00
8099	INSPIRE FELLOW RESHMA S	154400.00	509600.00	0.00	664000.00	0.00
8100	DETAILED . . .CONDITIONS- ARUN ANIRUDHAN	632200.00	0.00	0.00	632200.00	0.00
8101	ACTION OF GUIBOURTIA	0.00	270000.00	0.00	270000.00	0.00
8102	"ENGINEERING BIOMIMETIC. . . . NICHE TARA.S"	0	422351.00	0.00	422351.00	0.00
8103	"CORNEAL REGENERATIVE THERAPY. . . Dr.ANNIE JOHN"	0	1945818	0.00	1945818.00	0.00

0.00	0.00	0.00	30015.00	0.00	30015.00	30015.00	731710.00
0.00	3909062.00	80000.00	340179.00	0.00	420179.00	4329241.00	445111.00
0.00	0.00	191381.00	3330.00	0.00	194711.00	194711.00	83410.00
0.00	0.00	0.00	6359.00	0.00	6359.00	6359.00	37118.00
0.00	0.00	110000.00	543215.00	0.00	653215.00	653215.00	722438.00
0.00	6925.00	1199936.00	742409.00	0.00	1942345.00	1949270.00	1485955.00
0.00	0.00	780000.00	289472.00	0.00	1069472.00	1069472.00	28622.00
0.00	0.00	204800.00	50027.00	0.00	254827.00	254827.00	2339060.00
0.00	0.00	480000.00	306377.00	0.00	786377.00	786377.00	1593845.00
0.00	0.00	330000.00	26937.00	0.00	356937.00	356937.00	68169.00
0.00	0.00	142110.00	323669.00	0.00	465779.00	465779.00	682731.00
0.00	0.00	381600.00	15540.00	0.00	397140.00	397140.00	20620.00
0.00	0.00	12880.00	439737.00	0.00	452617.00	452617.00	1472448.00
0.00	0.00	421133.00	222923.00	0.00	644056.00	644056.00	450147.00
0.00	0.00	0.00	243681.00	0.00	243681.00	243681.00	2861.00
0.00	65333.00	321600.00	1017831.00	0.00	1339431.00	1404764.00	445100.00
0.00	0.00	81589.00	40546.00	0.00	122135.00	122135.00	2069574.00
0.00	0.00	605000.00	265510.00	0.00	870510.00	870510.00	597084.00
0.00	893586.00	185015.00	213609.00	0.00	398624.00	1292210.00	587790.00
0.00	0.00	103871.00	0.00	2483169.00	2587040.00	2587040.00	1129.00
0.00	0.00	414000.00	15605.00	0.00	429605.00	429605.00	234395.00
0.00	0.00	175044.00	294432.00	0.00	469476.00	469476.00	162724.00
0.00	0.00	203226.00	66774.00	0.00	270000.00	270000.00	0.00
0.00	0.00	408186.00	11707.00	0.00	419893.00	419893.00	2458.00
0.00	0.00	156000.00	457017.00	0.00	613017.00	613017.00	1332801.00

8104	"PROJ/8104/CORNEAL REGENERATIVE THERAPY"	0.00	828000.00	80489.00	908489.00	0.00
8105	"PROJ/8105/STUDY IN MOLECULAR MECHANISM"	0.00	380000.00	0.00	380000.00	0.00
8106	PROJ/8106/MECHANISM OF ANGIOGENESIS	0.00	231200.00	0.00	231200.00	0.00
8107	"PROJ/8107/MECHANO -BIOLOGY"	0.00	1780000.00	68710.00	1848710.00	0.00
8108	"PROJ/8108/DEVELOPMENT OF A DENTAL RES..."	0.00	991760.00	0.00	991760.00	0.00
8109	PROJ/8109/CHRONIC WOUND HEALING	0.00	899000.00	0.00	899000.00	0.00
8110	"PROJ/8110/TO ALLEVIATE COGNITIVE DEFECTS"	0.00	2516200.00	800.00	2517000.00	22635.00
8111	"PROJ/8111/FILAMENT STRUCTURES"	0.00	2110000.00	0.00	2110000.00	0.00
8112	"PROJ/8112/DEVELOPMENT THYROID COLLAR"	0.00	991760.00	0.00	991760.00	0.00
8113	"PROJ/8113/TREATMENT OF BONE DEFECTS"	0.00	139800.00	0.00	139800.00	0.00
8114	"PROJ/8114/NANO PARTICLES WITH CELLS"	0.00	242177.00	0.00	242177.00	0.00
8115	"PROJ/8115/TECHNOLOGY RESEARCH CENTRE"	0.00	229000000.00	7486148.05	236486148.05	0.00
8116	"PROJ/8116/PROGRAMME SUPPORT ON TRAN..."	0.00	3392000.00	0.00	3392000.00	0.00
8117	"PROJ/8117/GOLD NANOROD BASED TARGETED"	0.00	1154000.00	0.00	1154000.00	0.00
8118	PROJ/8118/THE ROLE OF NMDA	0.00	6744800.00	0.00	6744800.00	0.00
8119	PROJ/8119/MESENCHYMAL STEM CELLS	0.00	2009000.00	0.00	2009000.00	0.00
	Total of external projects	47669416.59	301175976.00	9009580.05	357854972.64	4910098.00
	INTERNAL PROJECTS					
6200	SCALE UP AND SMALL SCALE PRODUC-Dr Lissy	0.00	0.00	429663.00	429663.00	0.00
6201	DEVELOP. OF INTRACRANIAL- DR.NIRANJAN	0.00	199800.00	160595.00	360395.00	0.00
6202	"VALIDATION OF DIAMOND-DR.MANOJ.KOMATH"	0.00	61691.00	0.00	61691.00	0.00
6203	PRE-CLINICAL EVALUATION OF TISSUE	0.00	25440.00	0.00	25440.00	0.00

0.00	0.00	0.00	462426.00	0.00	462426.00	462426.00	446063.00
0.00	0.00	0.00	295080.00	33065.00	328145.00	328145.00	51855.00
0.00	0.00	0.00	211200.00	13220.00	224420.00	224420.00	6780.00
0.00	0.00	0.00	765000.00	319694.00	1084694.00	1084694.00	764016.00
0.00	0.00	0.00	107520.00	542.00	108062.00	108062.00	883698.00
0.00	0.00	0.00	322581.00	144451.00	467032.00	467032.00	431968.00
0.00	22635.00	0.00	127000.00	58987.00	185987.00	208622.00	2308378.00
0.00	0.00	0.00	921917.00	136338.00	1058255.00	1058255.00	1051745.00
0.00	0.00	0.00	129438.00	16877.00	146315.00	146315.00	845445.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	139800.00
0.00	0.00	223548.00	10274.00	0.00	233822.00	233822.00	8355.00
0.00	0.00	0.00	8410631.50	0.00	8410631.50	8410631.50	228075516.55
0.00	0.00	0.00	24388.00	0.00	24388.00	24388.00	3367612.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	1154000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	6744800.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	2009000.00
0.00	4910098.00	22056012.00	27512069.50	7573486.00	57141567.50	62051665.50	295803307.14
0.00	0.00	11445.00	418218.00	0.00	429663.00	429663.00	0.00
0.00	0.00	0.00	360395.00	0.00	360395.00	360395.00	0.00
0.00	0.00	0.00	61691.00	0.00	61691.00	61691.00	0.00
0.00	0.00	10440.00	15000.00	0.00	25440.00	25440.00	0.00

6204	INTELLECTUAL PROPERTY	0.00	44885.00	0.00	44885.00	0.00
6205	BIPHASIC HYDROXYAPATITE	0.00	15840.00	0.00	15840.00	0.00
6206	DEV NON INVASIVE STRESS - DR V S HARIKRISHNAN	88793.00	0.00	23625.00	112418.00	0.00
6207	POLYC PLTERM DEV 3D	0.00	99872.00	0.00	99872.00	0.00
6208	IN VITRO DIFFERENTIATION	86042.00	0.00	0.00	86042.00	0.00
6209	MENISCAL DR ANNIE	85257.00	0.00	0.00	85257.00	0.00
6210	DEV OF BIO ...APPLCN P P LIZYMOL	0.00	276657.00	0.00	276657.00	0.00
6211	"DEV OF PROTOTYPE ANEURYSM SUJESH SREEDHAR"	0.00	132441.00	0.00	132441.00	0.00
6212	"DEV OF ...VALVE CORRECTION RANJITH G"	0.00	143592.00	0.00	143592.00	0.00
6213	"WEB BASED REGISTRY DR. SANJEEV THOMAS"	0.00	253428.00	0.00	253428.00	0.00
6214	"PROJ/6214/GRAPHENE BASED NANOPROBES"	0.00	200000.00	70899.00	270899.00	0.00
6215	PROJ/6215/PROTOTYPE SAFETYSYSTEM	0.00	472800.00	0.00	472800.00	0.00
6500	OHF PROJECT DR. ANNIE JOHN	3050.00	0.00	0.00	3050.00	0.00
6501	OHF PROJECT DR KALADHAR	160000.00	0.00	0.00	160000.00	0.00
6502	OHF PROJECT DR SACHIN J SHENOY	180000.00	0.00	0.00	180000.00	0.00
6503	CONSTRUCTION OF TEBV	17520.00	0.00	0.00	17520.00	0.00
6504	DEVELOPMENT OF IRON NANO PRACTICLE	250000.00	0.00	0.00	250000.00	0.00
6505	REM SLEEP RESTRICTION	239634.00	0.00	0.00	239634.00	0.00
7380	"NETWORKING SERVICES- NTC BLDING-ARUN ANIRUDHAN"	0	0.00	0.00	0.00	0.00
7410	APPLICATION OF DECELLULARISED - DR. BIJU	0.00	332232.00	0.00	332232.00	0.00
7420	FEASIBILITY OF USING GLUTARA-DR.GIRISH M	-30600.00	0.00	32600.00	2000.00	0.00
2622	OHF- FOR INNOVATIVE PROJECTS	1460000.00	200000.00	0.00	1660000.00	0.00
2621	IIPC FUND(INDUSTRY INSTITUTE PARTNERSHIP - BMT	260769.00	0.00	0.00	260769.00	0.00
	Total of internal projects	2800465.00	2458678.00	717382.00	5976525.00	0.00
	Total of external & internal projects	50469881.59	303634654.00	9726962.05	363831497.64	4910098.00
	GRAND TOTAL	211742526.58	454180362.47	247091456.05	913014345.10	11722393.00

0.00	0.00	44885.00	0.00	0.00	44885.00	44885.00	0.00
0.00	0.00	0.00	7200.00	8640.00	15840.00	15840.00	0.00
0.00	0.00	0.00	105094.00	0.00	105094.00	105094.00	7324.00
0.00	0.00	99872.00	0.00	0.00	99872.00	99872.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	86042.00
0.00	0.00	0.00	74664.00	0.00	74664.00	74664.00	10593.00
0.00	0.00	178838.00	97819.00	0.00	276657.00	276657.00	0.00
0.00	0.00	127502.00	4939.00	0.00	132441.00	132441.00	0.00
0.00	0.00	143592.00	0.00	0.00	143592.00	143592.00	0.00
0.00	0.00	253428.00	0.00	0.00	253428.00	253428.00	0.00
0.00	0.00	0.00	141798.00	0.00	141798.00	141798.00	129101.00
0.00	0.00	0.00	472800.00	0.00	472800.00	472800.00	0.00
0.00	0.00	0.00	1653.00	0.00	1653.00	1653.00	1397.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	160000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	180000.00
0.00	0.00	0.00	28640.00	0.00	28640.00	28640.00	-11120.00
0.00	0.00	0.00	157053.00	0.00	157053.00	157053.00	92947.00
0.00	0.00	0.00	123949.00	0.00	123949.00	123949.00	115685.00
0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
0.00	0.00	0.00	332232.00	0.00	332232.00	332232.00	0.00
0.00	0.00	0.00	2000.00	0.00	2000.00	2000.00	0.00
0.00	0.00	0.00	200000.00	0.00	200000.00	200000.00	1460000.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	260769.00
0.00	0.00	870002.00	2605145.00	8640.00	3483787.00	3483787.00	2492738.00
0.00	4910098.00	22926014.00	30117214.50	7582126.00	60625354.50	65535452.50	298296045.14
0.00	11722393.00	53623686.00	37851053.50	241312895.00	122254428.50	344510027.50	568504317.60

SCHEDULE 4-SECURED LOANS AND BORROWINGS:		
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		
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:		
a) Acceptances secured by hypothecation of capital equipment and other assets	--	--
b) Others		
TOTAL	--	--

SCHEDULE 7-CURRENT LIABILITIES AND PROVISIONS		
A. CURRENT LIABILITIES		
1. Acceptances		
2. Sundry Creditors:		
a) For Goods	61776704	55276315
b) Others	58958249	3759099
3. Advances Received	191417977	59179090
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		
b) Others	11610263	10155896
6. Other current Liabilities	63026533	48675051
TOTAL(A)	386789726	177045451
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	175000	135350
Sinking fund contribution O. BAL	0	0
Additional contribution Rs.	520821	586646
TOTAL(B)	695821	721996
TOTAL(A+B)	387485547	177767447

SCHEDULE 8- FIXED ASSETS

PARTICULARS	GROSS BLOCK			
	Cost/valuation as at the beginning of the year (01.04.2015)	Additions during the year 2015-16	Deductions during the year 2015-16	Cost/valuation at the year end (31.03.2016)
A. FIXED ASSETS:				
1. LAND:				
a) Freehold	16894606	0	0	16894606
b) Leasehold				
2.BUILDINGS:				
a) On Freehold Land *	47037608	0	0	47037608
b) On Leasehold Land				
c) Ownership Flats/Premises				
d) Superstructures on Land not belonging to the entity	155974660	0		155974660
3. PLANT MACHINERY & EQUIPMENT	2037048340	278498259	13756754	2301789846
4. VEHICLES	7474234	0	0	7474234
5. FURNITURE,FIXTURES	50462247	1138637	257524	51343360
6. OFFICE EQUIPMENT	1236622	0	0	1236622
7. COMPUTER/PERIPHERALS	5017555	1612630	12500	6617685
8. ELECTRIC INSTALLATIONS	54612684	0	0	54612684
9. LIBRARY BOOKS	173649951	6965886	28093	180587744
10. TUBEWELLS & W.SUPPLY	301965	0		301965
11. OTHER FIXED ASSETS				0
a) OXYGEN CYLINDERS	234319	0		234319
b) AIR CONDITIONERS	46882948	748053	0	47631001
c) TELEPHONE INSTALLATIONS	2151442	0		2151442
d) COLD ROOM INSTALLATION	341700	0		341700
e) WATER COOLERS	62867	0		62867
f) LIFT INSTALLATION	11250942	2107800		13358742
g) KITCHEN EQUIPMENTS	1405978	0		1405978
h)CANTEEN EQUIPMENTS	358160	0		358160
I) PAINTINGS	450216	0		450216
k) LIVESTOCK	0	0	0	0
l) GAS PLANT INSTALLATIONS	1171261	0		1171261
m) SURGICAL EQUIPMENTS	7203975	0	0	7203975
Total for the year (Total -A)	2621224278	291071265	14054871	2898240672
Total for the previous year	2457855558	178648398	15279678	2621224278
Captial Work in Progress (B)	669314826	32164714	0	701479540
Total for the year (A+B)	3290539104	323235979	14054871	3599720212

* *Depreciation for item2(a) has been provided along with depreciation on 2(d)*

DEPRECIATION				NET BLOCK	
Depreciation as at the beginning of the year (01.04.2015)	Depr on items written off	During the year 2015-16	Total up to the year end (31.03.2016)	As at the end of current year end (31.03.2016)	As at the previous year end (31.03.2015)
0	0	0	0	16894606	16894606
0		0	0		
119018201	0	8399407	127417608	75594660	83994066
1347142379	11479259	133439750	1480582129	821207716	689905961
6024536		217455	6241991	1232243	1449697
34344575	194434	1524888	35869463	15473897	16117672
974408		26221	1000629	235992	262214
4709818	12483	1139727	5849545	768140	307737
29751640	0	2486104	32237745	22374939	24861044
162625217	28093	10766279	173391496	7196248	11024734
187645		11432	199077	102888	114320
0		0	0	0	0
233540		468	234008	312	780
25721769	0	2190923	27912692	19718309	21161179
1995030		15641	2010671	140770	156412
340277		142	340420	1280	1423
62734		13	62747	120	133
8182699		517604	8700304	4658439	3068243
1063969		34201	1098170	307808	342009
189702		16846	206548	151612	168458
385619		6460	392078	58137	64597
0	0	0	0	0	0
1140877		18230	1159108	12154	30384
6313253	0	356289	6669542	534433	890722
1750407888	11714269	161168080	1911575969	986664702	870816389
1606931005	0	143476883	1750407888	870816389	850924553
0	0	0	0	701479540	669314826
1750407888	11714269	161168080	1911575969	1688144242	1540131215

SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		
1. In Government Securities	56010278	56010278
2. Other approved Securities	5685391	5685391
3. Shares	0	0
4. Debentures and Bonds	0	0
5. Subsidiaries and Joint Ventures	0	0
6. Others (to be specified)		
Pension & staff funds	67637624	61887530
TOTAL	129333293	123583199
SCHEDULE 10 - INVESTMENTS-OTHERS		
1. In Government Securities	--	--
2. Other approved Securities	--	--
3. Shares	--	--
4. Debentures and Bonds	--	--
5. Subsidiaries and Joint Ventures	--	--
6. Others (to be specified) Sinking Fund Investments	400000000	500000000
Technology Fund	68881828	67019319
6. Others (to be specified)	--	--
TOTAL	468881828	567019319
SCHEDULE 11 - CURRENT ASSETS,LOANS,ADVANCES ETC		
A. CURRENT ASSETS		
1. Inventories:		
a) Stores and Spares	218182275	221894991
b) Instruments & Loose Tools	50741374	50626324
c) Stock-in trade		0
Store items	98847467	50203562
Stamps	124574	0
Medicine	15371287	11809064
2. Sundry Debtors:		

a) Debts Outstanding for a period exceeding six months	39961872	44679523
b) Others	278468469	94190929
2.1 Income tax deducted at source	11007009	
3. Cash balances in hand(including cheques/drafts and imprest)	1435619	1441133
4. Bank Balances:	0	0
a) With Scheduled Banks:	0	0
-On Current Account	1.15	1.15
-On Deposit Accounts(L.C. margin & Commitment deposit)	36917317	181972785
-On Savings Accounts	632573775	130699396
b) With non-Scheduled Banks:		
-On Current Account	0	0
-On Deposit Accounts	0	0
-On Savings Accounts	0	0
5. Post-Office-Savings Accounts	0	0
TOTAL(A)	1383631039	787517709
B.LOANS, ADVANCES AND OTHER ASSETS		
1. Loans:		
a) Staff	9782254	11982491
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	111729799	217231086
b) Prepayments		
c) Others	20540570	41204489
3. Income Accured:	0	0
a) On Investments from Earmarked/endowment Funds	27615835	44055923

b) On Investments-Others	0	0
c) On Loans and Advances	0	0
d) Others (Royalty)	571043	0
(includes income due unrealised Rs)	0	0
4. Claims Receivable	0	0
From Govt of India on Plan Funds	0	0
TOTAL(B)	170239500	314473989
TOTAL(A+B)	1553870540	1101991697
Savings bank account includes Rs.15/- (GL code No.2410-Synd Bank vikas certificate)		
SCHEDULE 12 - INCOME FROM SALES/SERVICES		
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	896942242	810189582
	0	0
From Projects	3082056	2835965

Testing & Facility charges received	4094955	4605802
TOTAL	904119253	817631349
SCHEDULE 13 - GRANTS/SUBSIDIES		
(Irrevocable Grants & Subsidies Received)		
1. Central Government	957813000	840588000
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	957813000	840588000
SCHEDULE 14 - FEES/SUBSCRIPTIONS		
1. Entrance Fees	1351750	1398700
2. Annual Fees/ Subscriptions	6172570	3842380
3. Seminar/Program Fees	0	0
4. Consultancy Fees	0	0
5. Examination Fees and others	908130	860300
TOTAL	8432450	6101380
SCHEDULE 15 - INCOME FROM INVESTMENTS		
(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	125707124	4955643
2. Interest on Technology Fund	1275863	7074218
TOTAL	126982987	12029861
SCHEDULE 16 - INCOME FROM ROYALITY,PUBLICATION ETC		
1) Income from Royalty	1091864	586646
2) Income from Publications	0	0
3)Others(Specify)	0	0
TOTAL	1091864	586646
SCHEDULE 17- INTEREST EARNED		
1) On Term Deposit		
a) With Scheduled Banks	20748835	43203988
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	9079829	8627289
b) With non-scheduled banks	0	0
c) Post Office Savings Account	0	0
d) Others(accrued)	19956067	36396155
3) On Loans	0	0
a) Employees/Staff	763732	940910
b) Others	0	0

4) Interest on Debtors and other Receivables		
TOTAL	50548463	89168342
SCHEDULE 18- OTHER INCOME		
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	1880101	2293671
3. Fees for Miscellaneous Services	0	0
4. Miscellaneous Income (income from Projects)	4200	97600
Other Income	9186380	6854776
Prior period income	0	0
TOTAL	11070681	9246047
SCHEDULE 20 - ESTABLISHMENT EXPENSES		
a) Salaries and Wages	797528779	751111663
b) Allowances and Bonus	6904358	7296428
c) Contribution to Provident Fund	0	0
d) Contribution to other fund(specify)	0	0
e) Staff Welfare Expenses	17211993	19036141
f) Expenses on Employee's Retirement and Terminal Benefits	182928682	125114063
g) Others(Specify) PG Training & Accademic payments	139955990	120484530
TOTAL	1144529802	1023042825

SCHEDULES 21- ADMINISTRATIVE EXPENSES		
a) Purchases	538635803	516982013
b) Concession to Poor patients/Labour and processing expenses	125223366	132714270
c) Cartage and Carriage Inwards	111392	147859
d) Electricity and power	56113763	45904579
e) Water charges	7167544	4622676
f) Insurance	275357	244056
g) Repairs and maintenance	79097437	50304198
h) Excise duty	0	0
i) Rent,Rates and Taxes	472977	227070
j) Vehicles Running and Maintenance	723725	722746
k) Postage,Telephone and Communication Charges	2269212	2346782
l) Printing and Stationary	2009349	2015369
m) Travelling and Conveyence Expenses	4341131	2624265
n) Expenses on Seminar/Workshop	1287785	1618415
o) Subscription Expenses	203720	131175
p) Expenses on Fees	0	0
q) Auditors Renumeration	352544	841566
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) Distribution Expenses	0	0
y) Advertisement and Publicity	4018696	6851780
z) Others(specify)	79521880	29426571
TOTAL	901825681	797725390
SCHEDULE 23-INTEREST		
a) On Fixed Loans		
b) Bank Charges)	118506	247154
c) Others(specify)	0	0
TOTAL	118506	247154

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

RECEIPTS & PAYMENTS ACCOUNTS FOR THE PERIOD FROM 01-04-2015 TO 31-03-2016

	RECEIPTS	2015-16	2014-15		Payments	2015-16	2014-15
		Rs.	Rs.			Rs.	Rs.
I	Opening Balances			I	Expenses		
a)	Cash In Hand	1441133.06	1260190.56				
b)	Bank Balances				a) Establishment expenses	875899245.60	771067498.10
	I) In Current Account	1.15	1.15		b) Administrative Expenses		
	ii)In deposit Account				For Purchases	336382577.00	330888154.00
	iii)Savings Account *	134438733.43	146827995.91		Other expenses	125864508.00	66029193.00
				II	Payments made against funds for various		
II	Grant Received				Projects		
	From Government of India				As Per schedule	99874350.50	89233083.00
	Under Plan - Capital scheme	202597000.00	66250000.00				
	Under Plan Salary/General scheme	937813000.00	814465000.00	III	Investments & Deposits made		
	Unde Plan scheme -NCMMR	144567.00	1614248.00				
	Non-Plan scheme	20000000.00	26123000.00		a) Out of Earmarked funds	128496931.00	92927595.00
					b) Out of own funds		
III	Receipts against Earmarked Funds						

				IV	Expenditure on Fixed Assets & Capital work		
	a) Earmarked funds	66516470.00	5554266.00		-in- progress		
	b)Own funds						
					a) Purchase of Fixed Assets	56367336.05	203551298.00
IV	Interest Received				b)Capital work-in-progress		
	a) On Bank deposits	93608240.40	33269314.49	V	Refund of Loans		
	b) Loans Advances etc	5092.00	180584.00				
V	Receipts from services						
				VI	Finance Charges(Bank charges)	33411.24	59501.00
	Receipts from Patient services	718580678.98	623823664.04				
	Other receipts including Royalty	23736885.35	20478375.00	VII	Other Payments		
					To Funds/ Deposit- refunds	832014198.90	694195703.00
VI	Other receipts			VIII	Closing Balance		
	Grant received for Projects	466953778.57	108695810.30		a) Cash in hand	1435619.28	1441133.06
	Refund of Deposits(LC Margin)				b) Bank Balances		
	Other receipts	426990278.00	535289443.29		I) In current Account	1.15	1.15
					ii) In Deposit Account		
					iii) Savings Account *	636457679.22	134438733.43
	Total	3092825857.94	2383831892.74		Total	3092825857.94	2383831892.74

*Closing balance of Bank include grant amount received from DST for setting up of NCMMR, Thiruvananthapuram

PROVIDENT FUND ACCOUNT FOR THE YEAR ENDED 31-03-2016		
Particulars	2015-16	2014-15
	[Rupees]	[Rupees]
LIABILITIES		
MEMBERS BALANCE	232906381	251599543
MEMBERS CREDITS [for march]	3817426	3941042
BALANCE DUE TO MEMBERS NOT IN SERVICE		
Under EPF scheme	7696523	7696523
,, GPF ,,	532055	532055
PENSION FUND DUES	51168169	51168169
RESERVES&SURPLUS-INTEREST	113307672	82854794
TOTAL	409428226	397792126
ASSETS		
INVESTMENT AT COST	365572702	343058764
DUES TO PF ACCOUNT		
FROM INSTITUTE	3817426	3941042
FROM PF COMMISSIONER	8403467	8403467
INTEREST ACCRUED NOT DUE	24065966	22598675
BALANCE WITH BANKS		
SBT -GPF A/C	7568664	19790178
TOTAL	409428226	397792126

Sd/-
CHIEF FINANCIAL ADVISOR

Sd/-
DIRECTOR

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH - Receipts & Payments Account for the period 01.04.2015 -31.03.2016

	2015-16	2014-15		2015-16	2014-15
Receipts	Rs.		Payments	Rs.	
Opening Balance - Bank	3739337	3548469	Advertisement charges	703655	703655
Grant in aid		750000	Bank Charges	56	56
Interest earned	144579	144579	Closing Balance - Bank	3180205	3739337
	3883916	4443048		3883916	4443048

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH - Income & Expenditure Account for the period 01.04.2015 -31.03.2016

	2015-16	2014-15		2015-16	2014-15
Expenses	Rs.		Income	Rs.	
Printing and Stationery	480		Interest	145047	144579
Bank Charges		56			
Advertisement charges		703655			
Excess of Income over expenditure	144567	0	Excess of Expenditure over income		559132
	145047	703711		145047	703711

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

NATIONAL CENTRE FOR MOLECULAR MATERIALS RESEARCH - BALANCE SHEET AS ON 31-03-2016		
Particulars	2015-16	2014-15
	[Rupees]	[Rupees]
LIABILITIES		
CAPITAL FUND		
Opening Balance	3739337	3548469
Add: Grant received	0	750000
Add/Less (-): Excess of Expendiure over income	144567	-559132
TOTAL	3883904	3739337
ASSETS		
BANK BALANCE	3883904	3739337
(Union Bank of India Account No.541502010002675)		
TOTAL	3883904	3739337

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY, THIRUVANANTHAPURAM

SCHEDULES FORMING PART OF ACCOUNTS AS AT 31-03-2016

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 Crores.

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.

CHIEF FINANCIAL ADVISOR DIRECTOR

SCHEDULE 25-CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES		
Rs. In lakhs		
	2015-16	2014-15
Claims against the Institute not acknowledged		
as debts	13.20	6.00
Bank Guarantee given by Institute	39.37	35.53
Letters of credit opened on behalf of Institute	00.00	466.37
In respect of claims from parties for non- execution of orders	NIL	NIL

Service Tax :

" The office of the Commissioner of Central Excise and Customs vide order no: C.No.IV/16/152/2014 ST ADJ. Dated 08.06.2015 confirm demand of Service tax Rs.4.72 Lakhs under section 73(2) of the Finance Act 1994, being service tax short paid under the category "Technical Inspection and certification service" during the period 1.4.2009-31.03.2012 . Further impose a penalty of Rs 2.36 lakhs towards penalty under section 78 and Rs.0.05 lakhs for contravention of section 70 of the Act. In order to file appeal against the order, the institute paid Rs.0.35 lakhs towards deposit (i e 7.5% of demand confirmed)."

Name of the Statute	Nature of Dues	Amount in Rs. in lakhs	Period to which the amount relates	Forum where dispute is pending.
Service Tax	Service tax and penalty	7.13	01/04/2009 to 31/03/2012	Commissioner Appeals, Central Excise

2. UNEXPIRED CAPITAL COMMITMENTS

Rs. In lakhs		
Estimated value of orders remaining to be executed on Capital Account	1809.83	1256.09
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 lakhs	
	2015-16	2014-15
5.1 Value of Imports Capital Goods Stores	76.18	469.66
Spare & Consumables	31.18	152.75
5.2 Expenditure in foreign currencyTravel 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.22.96 lakhs (previous year Rs.15.131 lakhs).

7. Claim for Audit fees by C&AG amounting to Rs.1.35 lakhs has been paid during the year. Provision for Audit fees has been made for current year amounting to Rs.1.75 lakhs.

8. Grants received for Salary and General Expenses has been treated as Non-Plan grants as suggested by C&AG Auditors and approved by Competent Authority of the Institute.

9. Accrued Interest on Investment amounting Rs.199.56 lakhs (previous year Rs. 363.96 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.983.58 lakhs has been expended over and above the sanctioned 12% Institute contribution (amounting to Rs.367.28 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 Life Insurance Corporation of India. As per their valuation report the liability is as follows :

Present value of the past service gratuity	Rs.1971.06 lakhs
Present value of the past service pension	Rs.9687.00 lakhs
Present value of the past service leave encashment	Rs.2542.45 lakhs

They have submitted proposal for funding the future liability and based on further discussions, steps will be taken to build a corpus fund for the same.

12.The report of the Auditors, appointed to Review the Systems and Operations of the Institute, pointed out that glass wares, spares, instruments and loose tools carried forwarded as Current assets, which are not available in Stores Section, needs to be reviewed to confirm retention/ write off. They also pointed out the old outstanding dues under sundry debtors and difference in stock verification. Accordingly the same has been quantified as 1) Stock of Glasswares, spares instruments and loose tools Rs.2181.82 lakhs, 2) Inpatient dues Rs.216.94 lakhs and 3) Difference in physical verification of Store items Rs.104.12 lakhs. Pending detailed analysis of individual items, Institute is of the view that creation of provision or write off shall be made after a due diligence process and the management is convinced about the losses. Accordingly, a Committee is being constituted to review the above current assets.

13. 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 lakhs
FY 2014-15	Rs. 15.36 lakhs
FY 2015-16	Rs.117.22 lakhs

Since the cost of acquisition of these assets is nil, no depreciation has been charged on these assets.

14. Emergency Reserve Fund & Technology Development Fund

The Emergency Reserve Fund has touched the upper limit of Rs.5000.00 lakhs and therefore no further addition could be made during the year. During the year Rs.1000.00 lakhs was utilized from Emergency Reserve Fund for meeting the various liabilities of the Institute.

An amount of Rs.18.62 lakhs (previous year Rs.70.74 lakhs) was tansferred to Technology Development Fund. During the year Rs.16.04 lakhs has been spent from Technology Development Fund.

15. Overhead Fund Scheme

During the year an amount of Rs.2.00 lakhs (previous year Rs. 10 Lakhs) has been transferred to the Fund from the Overhead Charges collected from External Projects.

16. Funding of In house Projects to set off negative balance.

Administrative expenses include an amount of Rs.449.35 lakhs transferred to nullify the negative balances in the In house projects accounts.

17. 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.

18. National Centre for Molecular Materials Research, Thiruvananthapuram

Receipts and Payments Account, Income and Expenditure Account and Balance Sheet in respect of NCMMR has been prepared separately and annexed to the accounts.

19. Corresponding figures for previous years have been regrouped, wherever necessary.

Schedules 1 to 25 annexed, form an integral part of the Balance Sheet as at 31-03-2016, and Income & Expenditure Account for the year ended on that date.

Chief Financial Advisor Director

Separate Audit Report of the Comptroller & Auditor General of India on the Accounts of Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum for the year ended 31 March 2016

1. We have audited the Balance Sheet of Sree Chitra Tirunal Institute of Medical Sciences and Technology (SCTIMST), Thiruvananthapuram as at 31 March 2016, 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 draft Separate Audit Report contains the comments of the Comptroller & Auditor General of India on the accounting treatment only with regard to classification, conformity with the best accounting practices, accounting standards and disclosure norms, etc. Audit observations on financial transactions with regard to compliance with the Law, Rules & Regulations (Propriety and Regularity) and efficiency-cum-performance aspects etc., if any, are reported through Inspection Reports/ CAG's Audit Reports separately.

3. We have conducted our audit in accordance with auditing standards generally accepted in India. These standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatements. An audit includes examining, on a test basis, evidences supporting the amounts and disclosure in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of financial statements. We believe that our audit provides a reasonable basis for our opinion.

4. Based on our audit, we report that:

i. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.

ii. The Balance Sheet, Income & Expenditure Account and Receipt & Payment Account dealt with by this report have been drawn up in the format approved by the Government of India, Ministry of Finance.

iii. In our opinion, proper books of accounts and other relevant records have been maintained by the SCTIMST as required under Section 18 (1) of SCTIMST Act, 1980 in so far as it appears from our examination of such books subject to observations made hereunder.

iv. Based on our audit, we further report that:

(A) Balance Sheet

A.1 Current liabilities and provisions (Schedule-7) Rs.38.75 crore

According to Notes and Instructions for compilation of financial statements framed by Ministry of Finance (MoF) for the Central Autonomous Bodies liability payable towards Gratuity, Superannuation and Accumulated Leave Encashment needs to be accounted on accrual basis and provided upto the year end under Schedule-7 Current Liabilities and Provisions.

As per para 8 of Schedule 24 significant Accounting Policies, retirement benefits are being accounted for on cash basis. As per the actuarial valuation liability of SCTIMST towards gratuity, pension and accumulated leave encashment was Rs.19.71 Crore, Rs.96.87 crore and Rs.25.42 crore respectively by year ending March 2016.

Against this Institute has created pension fund amounting to Rs.11.14 crore only as on 31 march 2016. This has resulted into understatement of Current Liabilities and provisions and overstatements of Capital Fund by Rs.130.86 Crore (Rs.142 crore – Rs.11.14 crore) each.

A.2 Current Assets Loans and Advances – Rs.155.39 crore

As per Schedule 11 appended to Financial statement for the year 2015-16 an amount of Rs.46.30 lakh received in

advance from M/s Kerala Social Security Mission-Thaalolam (General Ledger Code-1324) which was to be shown under sundry creditors in Schedule 07-Current Liabilities and Provision, however it was shown as (-) Rs.46.30 lakh under sundry debtors account. Thus both Assets and Liabilities in Financial Statement were understated by an amount of Rs.46.30 lakh.

(B) General

B.1 Classification of Fixed Assets

According to Uniform Format of Accounts prescribed by Ministry of Finance for autonomous bodies, fixed assets are to clarified in eleven sub-heads as mentioned in Notes and Instructions appended to Schedule 8

Audit however observed that SCTIMST created a new sub-head 'other fixed assets' booking varies items for which repective sub-heads already exists in the said schedule. Items booked under sub-head 'other fixed assets' are required to be booked in respective sub-heads of fixed assets.

B.2 Non reconciliation of broad sheet of Schedule 3 with Schedule 3 to Balance Sheet

Comparison of 'Schedule 3: Earmarked/Endowment Funds' to Balance Sheet for the year 2015-16 with its broadsheets and closing balance of the previous year schedules and broadsheets revealed the following:

- SCTIMST did not show the opening balance of, addition to this fund and expenditure towards objective of Earmarked/Endowments funds under schedule 3 to the balance sheet.
- The closing balance of the year 2014-15 was Rs.21,17,42,527 however the opening balance of the broadsheet for the year 2015-16 was mentions as Rs.92444636.28.
- Under the Broadsheet relating to schedule 3 for the year 2015+-16 the opening balance towards ledger codes 1014,1301,1075,1078,1080 and 1081 were not included.
- The closing balance against the ledger code 7380 Networking services-NTC building was nil for the period 2014-15 however in the opening balance against this ledger account for the year 2015-16 was indicated Rs.149380. This needs to be reconciled.

B.3 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 2016, 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 and 2015-16. However, confirmation of the balance has not been obtained.

B.4 Plan and non Plan categorization

According to Rule 209 6(xiii) of GFR, 2005, Central Autonomous Organizations which receive Plan as well as Non-plan Grants, should account for expenditure (Capital and Revenue) separately under plan and non-plan heads. The central autonomous bodies are required to compile their accounts in the common formats of accounts and prescribed by the Government of India, Ministry of Finance. It was however observed that though SCTIMST receive plan and non-plan grants separately, the accounts did not reflect grants and expenditure separately for plan and non-plan category.

SCTIMST is required to take immediate action.

B.5 Grant in aid

Grant of Rs.116.04 crore (20.26 crore + 93.78 crore + 2.00 crore) was received and utilized during the current year viz. 2015-16.

(C) Management letter

Deficiencies which have not been included in the Separate Audit Report have been brought to the notice of the SCTIMST through a management letter issued separately for remedial/ corrective action.

v. 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.

vi. 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 31st March 2016; and

b. In so far as it relates to Income & Expenditure Account of the deficit for the year ended on that date.

For and on behalf of the C & AG of India

Place: New Delhi
Date : 28.09.2016

Principal Director of Audit,
Scientific Departments

Reply to Separate Audit Report of the Comptroller & Auditor General of India on the Accounts of Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum for the year ended 31 March 2016

Heading	Audit Para No. & reference	Audit Observations	Reply
(A) Balance Sheet	A.1 Current liabilities and provisions (Schedule-7) Rs.38.75 crore	According to Notes and Instructions for compilation of financial statements framed by Ministry of Finance (MoF) for the Central Autonomous Bodies liability payable towards Gratuity, Superannuation and Accumulated Leave Encashment needs to be accounted on accrual basis and provided upto the year end under Schedule-7 Current Liabilities and Provisions. As per para 8 of Schedule 24 significant Accounting Policies, retirement benefits are being accounted for on cash basis. As per the actuarial valuation liability of SCTIMST towards gratuity, pension and accumulated leave encashment was Rs.19.71 Crore, Rs.96.87 crore and Rs.25.42 crore respectively by year ending March 2016. Against this Institute has created pension fund amounting to Rs.11.14 crore only as on 31 march 2016. This has resulted into understatement of Current Liabilities and provisions and overstatements of Capital Fund by Rs.130.86 Crore (Rs.142 crore – Rs.11.14 crore) each.	The liability in respect of Gratuity, Pension and Leave Encashment is disclosed in para 11 of Schedule No. 25-Notes forming part of accounts. Governing Body of the Institute in its meeting held on 30.07.2016 discussed the need for creation of a separate fund for Gratuity, Pension and Leave Encashment and transfer required contribution to that funds so as to comply with the requirements of Accounting Standards 15. However, considering the present financial position of the Institute, it was decided to continue the existing practice of settling the payments on cash basis and creation of funds be considered once the financial position improves.

	A.2 Current Assets Loans and Advances – Rs.155.39 crore	As per Schedule 11 appended to Financial statement for the year 2015-16 an amount of Rs.46.30 lakh received in advance from M/s Kerala Social Security Mission-Thaalolam (General Ledger Code-1324) which was to be shown under sundry creditors in Schedule 07-Current Liabilities and Provision, however it was shown as (-) Rs.46.30 lakh under sundry debtors account. Thus both Assets and Liabilities in Financial Statement were understated by an amount of Rs.46.30 lakh.	Correction will be done in the financial statement for the year 2016-17.
(B) General	B.1 Classification of Fixed Assets	According to Uniform Format of Accounts prescribed by Ministry of Finance for autonomous bodies, fixed assets are to clarified in eleven sub-heads as mentioned in Notes and Instructions appended to Schedule 8 Audit however observed that SCTIMST created a new sub-head 'other fixed assets' booking varies items for which repective sub-heads already exists in the said schedule. Items booked under sub-head 'other fixed assets' are required to be booked in respective sub-heads of fixed assets.	The audit observation regarding regrouping of assets is noted for future guidance and shall be accordingly changed.

	B.2 Non reconciliation of broad sheet of Schedule 3 with schedule 3 to Balance Sheet	Comparison of 'Schedule 3: Earmarked/ Endowment Funds' to Balance Sheet for the year 2015-16 with its broadsheets and closing balance of the previous year schedules and broadsheets revealed the following: • SCTIMST did not show the opening balance of, addition to this fund and expenditure towards objective of Earmarked/Endowments funds under schedule 3 to the balance sheet. • The closing balance of the year 2014-15 was Rs.21,17,42,527 however the opening balance of the broadsheet for the year 2015-16 was mentioned as Rs.92444636.28. • Under the Broadsheet relating to schedule 3 for the year 2015-16 the opening balance towards ledger codes 1014,1301,1075,1078,1080 and 1081 were not included. • The closing balance against the ledger code 7380 Networking services-NTC building was nil for the period 2014-15 however in the opening balance against this ledger account for the year 2015-16 was indicated Rs.149380. This needs to be reconciled.	As observed by audit by audit, the figures have been rectified and corrected statement was submitted to audit. The figures do not affect any figures of Balance Sheet and Income and Expenditure account.
	B.3 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 2016, 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 and 2015-16. However, confirmation of the balance has not been obtained.	Institute had requested EPF authorities to confirm the balance in the previous years. No reply has been received so far. It is being followed up.

.	B.4 Plan and non Plan categorization	According to Rule 209 6(xiii) of GFR, 2005, Central Autonomous Organizations which receive Plan as well as Non-plan Grants, should account for expenditure (Capital and Revenue) separately under plan and non-plan heads. The central autonomous bodies are required to compile their accounts in the common formats of accounts prescribed by the Government of India, Ministry of Finance. It was however observed that though SCTIMST receive plan and non-plan grants separately, the accounts did not reflect grants and expenditure separately for plan and non-plan category. SCTIMST is required to take immediate action.	Annual accounts of Institute was drawn in the uniform format of accounts for Central Autonomous Bodies (non profit making Organisations and similar Institutions) as per the Guide lines of DST right from the year 2000. During the year funds received from DST towards salary, general expenditure and non plan funds has been reflected in the income and expenditure account – Schedule 13 and funds received towards fixed assets has been reflected in Schedule 1 – Capital fund. Disclosure of the same has been made in the I & E Account and Note 9 of Schedule 25. The audit point has been noted and for the year 2016-17 the inclusion of the non plan grant received from DST would be suitably disclosed under the relevant accounting head.
	B.5 Grant in aid	Grant of Rs. 116.04 crore (20.26 crore + 93.78 crore + 2.00 crore) was received and utilized during the current year viz. 2015-16.	Noted.
(C) Management letter		Deficiencies which have not been included in the Separate Audit Report have been brought to the notice of the SCTIMST through a management letter issued separately for remedial/ corrective action.	Noted.