

DEPARTMENT OF MEDICAL PHYSICS, ROYAL PERTH HOSPITAL (1959 - 2002)

The Department of Medical Physics, RPH was formed in 1959 with the foundation appointment of Mr.R.W.Stanford a medical physicist from Guys Hospital, London in the United Kingdom.

The Department was founded on the developing use of radioisotopes and radiopharmaceuticals in the diagnosis and treatment of disease; the forerunners of the medical physics, radiotherapy and nuclear medicine specialties. The evolving use of and need for scientific computing in the early 1970s, in relation to both medical physics and other medical activities around the hospital, focussed the attention of a number of medical physicists who developed to be identified as the Scientific Computing Division within the Department.

Bioengineering was introduced in 1969 in support of the orthopaedic, surgery and rehabilitation specialties. The development of the Bioengineering specialty was prompted by successful academic programs in the UK but its implementation, with direct service responsibility to clinicians in a hospital environment, was innovative and remains to be relatively unique to WA.

In 1974 the Instrument Workshop, under the supervision of Mr. Len Young and managed by medical administration was transferred into the Department and combined with a small electronics maintenance and development group to form what is now called the Technical Services Division.

In 1978 and through the 1980s the Bioengineering Division, strongly supported by Sir George Bedbrook the senior Orthopaedic Surgeon in charge of the Spinal Unit, developed a range of special services at RP(R)H concentrating on rehabilitation engineering and in particular the use of technology to assist persons with a severe disability resulting from spinal cord injury. This evolved to include the specialties of Orthotics, Prosthetics and Augmentative Communications which form the Rehabilitation Technology Unit, currently providing clinical services at Shenton park.

In 1989 the Department at RPH was co-located for the first time and was transferred from premises in the old colonial hospital building on Murray Street and from behind Ainslie House, into purpose built facilities on Level 1 of the new North Block linked to the hospital on the north side of Wellington St.

This formed the basis of the current entity that was re-named the Department of Medical Engineering and Physics in 2002, to more appropriately reflect the range of hospital and State wide services provided at the RPH Wellington Street and Shenton Park Campuses.

DEPARTMENT OF MEDICAL ENGINEERING & PHYSICS, RPH (2002 – 2011)

DESCRIPTION OF OPERATIONS AT RPH:

The Department of Medical Engineering & Physics at RPH is organised into four (4) main Divisions which include: Clinical Physics, Bioengineering, Technical Services and Scientific Computing and Management. The activities of the Department include the implementation, repair and maintenance of medical equipment¹, the design and manufacturing of devices, implants, orthotics, and prosthetics, the provision of scientific services to nuclear medicine as well as assistance with scientific computing and management. Many of the specialised areas of the Department are unique and as such provide a State Service (eg. biomaterials and custom implant services, including tracking, retrieval and analysis, adult orthotics and interim prosthetics, augmentative communications and rehabilitation engineering).

¹ All with the exception of complex imaging equipment.

Medical Engineering & Physics: RPH

Management & Administrative Support Services

Scientific Computing

Clinical Physics

Diagnostic Imaging & Radiochemistry

- Compliance Testing of Diagnostic Xray equipment
- Quality Assurance testing of Nuclear Medicine equipment
- Provision of Radionuclides to RPH and other services
- Doppler Ultrasound assessment for Vascular Surgery
- Photodermatology & skin sensitivity testing
- Training re use of ionising and non-ionising radiation

Radiation Safety & Health Physics

- RPH Radiation Safety Officer
- Thermoluminescent dosimetry (TLD) services
- Provision of personal dosimetry services (film badges)
- Room surveys and protection design
- Radioactive waste management and disposal

Bioengineering

Implant Technology & Biomaterials

- Custom Implant Design & Manufacture
- Implant Device Tracking, Retrieval & Analysis
- Tissue Engineering

Rehabilitation Technology Unit

Rehabilitation Engineering Clinic

- Pressure Management & Soft Tissue Injury Prevention
- Wheelchair Prescription and Provision (Electric & Manual)
- Specialised and Custom Seating for Function
- Wheelchair Service and Maintenance
- Custom Assistive Devices

Orthotics & Prosthetic Services

- Interim Prosthetic Services & Rigid Removable Dressing
- Adult Orthotic Services (incl. specialised footwear)
- Specialised Spinal Bracing

Communication and Assistive Technology (CATS)

Community based (CAEP) Services in each specialty

Technical Services (TSD)

Medical Equipment Management & Procurement

Bio-Medical Electronics

- Medical Equipment ICT Design and Support Services
- Electromedical Equipment Service and Maintenance
- Electronic Design and Development

Medical Instrumentation Services

- Instrument Service and Maintenance
- Medical Equipment: Design & Development Services
- Advanced modelling and manufacturing

Legend: Management Unit

Specialist Service

Defined program

State Service

responsibility Shenton Park

Campus

The scope of services provided by the Department is summarised in the preceding diagram and includes;

CLINICAL PHYSICS

Prime Relationships: *Imaging Services incl Nuclear Medicine, Radiation Oncology, Vascular Services, Radiochemistry Radiation Safety (Wards, Laboratories, University Departments), Dermatology, Breast Clinic*

The Clinical Physics Division provides scientific services in diagnostic radiology, nuclear medicine, vascular services, radiochemistry and radiation oncology. The responsible Senior Physicist also acts as the Hospital's Health Physics and Radiation Safety Officer across all hospital sites. The Division employs 11 professional and 4 technical staff.

In addition to servicing RPH and Shenton Park Campus (SPC) the division also currently provides services to Fremantle and Kaleeya Hospitals, Princess Margaret Hospital (PMH), King Edward Memorial Hospital (KEMH).²

Clinical Physics provides a variety of services³ to several departments and divisions at RPH and SPC some of which will be relocated at FSH. Those departments/divisions include: Nuclear Medicine, Clinical Oncology, Rehabilitation Services, Imaging Services, Ophthalmology, Vascular Surgery, Dermatology and Laboratory Services. The maintenance of clinical physics at RPH will enable the provision of the following services across the whole SMAHS and offer savings in terms of manpower and equipment.⁴ These services include X-ray Compliance testing, Health Physics, Radiation protection, Radionuclide and Counting Services as well as Radiotherapy. (refer: HTMU Services)

BIOENGINEERING

Prime Relationships: *Orthopaedics: Elective and Trauma, Rehabilitation, Theatres, Spinal Unit, Amputee Services, Vascular Surgery, CSSD / TSSU, Neurology, Neurosurgery, Research facilities, Cardiac Catheter Laboratories*

State responsibilities: *Implant Device Tracking, Retrieval and Analysis, Rehabilitation Technology Services (in accord with the State Rehabilitation Plan), Custom Implant Design and Manufacture.*

² Services are also provided to other public and private hospitals and clinics on a fee for service basis.

³ Examples of services provided to those departments include: Radiotherapy, Diagnostic Radiology, Nuclear Medicine, Vascular Assessment, Photodermatology and Radionuclide and Counting Service

⁴ As advised by David A. Causer, Physicist I/C Clinical Physics

The Bioengineering Division provides specialised engineering services in biomaterials and implant technology, implant device tracking, retrieval and analysis as well as rehabilitation technology services⁵. The majority of the rehabilitation technology support is currently located at Shenton Park Campus (SPC) and includes the Rehabilitation Engineering Clinic (REC) and Assistive Technology Services, and the provision (incl. design and manufacturing) of prosthetics and orthotics. Augmentative and Alternative Communication Services (AAC) are currently located at WSC because of a required interface with acute services and because of a lack of suitable accommodation at SPC, despite the need for a close working arrangement with the REC. A team of 40 people (10 of whom are based at WSC) hold a wide range of roles in the technical, clinical, operational and medical aspects of bioengineering.

The provision of the State requirement for specialised Rehabilitation Technology Services (Rehabilitation Engineering, AAC, Orthotics and Prosthetic Services) is detailed in the proposal for a State Tertiary Rehabilitation Service, planned to be co-located on the Murdoch campus.

The Division provides treatment support and complex technology for patients with severe disability and special needs within the Shenton Park Hospital and supports the technology needs of people in the community and undergoing treatment in secondary facilities by means of an outreach program, resourced from and supported by the tertiary centre. It is envisaged that a similar support relationship between the tertiary facility and FSH will develop as per the current relationship with RPH and SPC. A level of centralisation will be necessary in order to develop and maintain a highly specialised and multi-disciplinary workforce, with requirements for career development and particular training needs

In addition to RPH and SPC, the Division also provides statewide services to other public and private hospitals on a fee for services model.

The Bioengineering Division comprises the following sections or services;

BIOMATERIALS AND IMPLANT TECHNOLOGY

The Bioengineering Division has the skills and experience required to handle all design aspects of custom implants for cases referred from Orthopaedics, Neurosurgery, Plastics and related disciplines (e.g. hip, skull, knee, etc.). The design and manufacture of such devices is in accord with regulatory framework of the Therapeutic Goods Administration (TGA) and requires close co-operation between the Division and the Development Sections of the Technical Services Division (TSD) of the Department, with the latter providing advanced manufacturing capability in support of the process.⁶ ⁷ The Section also provides specialised investigations in respect of biomaterials and in support of evaluations conducted in relation to Health Supply (ie.HCN) tenders for implant devices and specialised clinical equipment. Close working proximity to TSD facilities, CSSD and the relevant clinical departments including Theatres, is important

IMPLANT DEVICE TRACKING, RETRIEVAL AND ANALYSIS PROGRAM

This service operates within the Biomaterials Laboratory and is an established mode of practice for routine surveillance of all implant components removed in the major public hospitals. The service

⁵ Biomedical and assistive technologies are relevant domains in the current context and associated problems of an ageing population.

⁶ As an example, bioengineering was instrumental in the development of Iontophoresis (a 'bone' implant that contains and distributes antibiotics, reducing the risk of infection).

⁷ Instrumental in the development and manufacture of custom cranioplasty (developed at RPH and mainly delivered to SCGH neurosurgery practices)

operates in collaboration with the Joint Replacement Assessment Clinic.⁸ The implant program consists of tracking and retrieving all explanted and faulty implants in order to analyse them and identify the nature and reasons for common success or failure modes.⁹ The Hospital supports the principle that all removals should be investigated and that any failures should be subject to professional analysis and should be fully documented by the Hospital (for the Hospital and the patient) prior to being released to a third party for investigation (eg. the supplier or manufacturer) if requested. Operational Directive issued by the HDWA requires that all explanted devices are evaluated/investigated by the Bioengineering Division prior to release to the patient, if requested

⁸ For more details on the JRAC program, refer to the Rehabilitation and Elective Orthopaedics.

⁹ There is mandatory reporting of all implants. The department processes 15-20 implants a week.

REHABILITATION ENGINEERING & ASSISTIVE TECHNOLOGY SERVICES

The Rehabilitation Engineering Clinic (REC) at SPC employs a multi-disciplinary team (eg. Engineers, Technologists, Nurses, Occupational Therapists and Speech Pathologist), working in the rehabilitation setting. The REC provides a variety of specialised services including the provision and modification of wheelchairs, customised and postural seating fabrication and adjustments¹⁰, programming of electric wheelchairs, customised wheelchair design and manufacturing¹¹, general repair and maintenance of wheelchairs on permanent and / or temporary loan to the patient. Timely preparation and provision of temporary loan wheelchairs is imperative for early discharge of non ambulatory patients.

The service is supported by a human movement laboratory that requires additional resources and upgrading, to reflect contemporary practices.¹² Close collaboration between the physiotherapists, prosthetists, biomechanicists is envisaged for the purposes of routine investigations, quality management and research.

The REC provides tertiary services for the rehabilitation and ongoing care in the community (eg. CAEP) of patients with severe disability (eg. SCI, tetraplegics, head injury (ABI), MND and MS patients) requiring complex and integrated technology solutions. The REC provides inpatient, outpatient and home based services with approximately 2585 direct patient service contacts per annum. Wheelchair services are in addition to this. Close proximity with the clinical units responsible for rehabilitation in these areas is highly desirable and special facilities related to client need (eg. transport) will be essential. This requirement is referenced in the Clinical Services plan for Rehabilitation^{13 14}, with the inclusion of the REC and rehabilitation technology as part of the State Tertiary Rehabilitation Service planned for co-location on the Murdoch campus

ORTHOTICS AND PROSTHETICS

The Orthotics and Prosthetics Service at SPC provides a State service for adult patients in acute care, rehabilitation and for the ongoing support of the disabled patient. The Service is responsible for the design specification, manufacture, fitting and provision of custom orthotic appliances (including specialised footwear) and interim prostheses and for the comprehensive management of the patient from initial assessment to their support in the community.

The facility services both inpatients and outpatients of the Hospital (SPC and WSC) and provides an outreach service to tertiary, secondary and regional hospitals, institutions and nursing homes across the State. Services are provided by inpatient visits to Wards and Clinics of the referring hospital and by direct outpatient referral to the Service. Private patient referrals include eligible patients referred under the DSC Service Agreement in relation to CAEP. The majority of the patients are seen on an outpatient basis for a service that often requires several visits (e.g. fitting, adjustments and modifications). Important links exist with all outpatient clinics, allied health, orthopaedic surgery, scoliosis services, radiology, theatres, amputee rehabilitation and rehabilitation medicine.

The Service requires consultation and manufacturing facilities for orthotic and prosthetic appliances, including specialised spinal bracing, adult interim prostheses, orthotic softgoods and surgical footwear. Workshop facilities require a combination of dirty processing (eg. moulding, casting, machining and welding) and clean work rooms, for both manufacture and assembly and will utilise a range of machinery including lathes, milling machines, specialised routers and finishers etc..

¹⁰ Pressure sores management is an important issue with wheel chairs' users and maintains levels of secondary admission for the treatment of pressure sores which are in the order of 2-3% of SCI patients in the community, compared with US and European figures which are in the order of 15 – 25 % p.a..

¹¹ For people with specific and out of the ordinary levels of disability.

¹² gait analysis allows the measurements of human movement and related loads. It is used for example to measure and optimize the quality of prosthetics and orthotics.

¹³ Draft Clinical Services Plan for Rehabilitation Services SMAHS

¹⁴ Rehabilitation: A Plan for Selected Services in WA

Planning should provide for the introduction of contemporary technologies such as CAD/CAM and numerical machining facilities in the immediate future.

COMMUNICATION AND ASSISTIVE TECHNOLOGY SERVICES (CATS)

The Augmentative and Alternative Communication (AAC) Service or CATS, provides a range of specialised services to the patient consisting of the assessment for, the design and production of customised aids for non-speaking severely disabled people.¹⁵ The basic device can be a commercial electronic or computer based product that needs to be adapted or customised to enable the person to construct written messages or to communicate through synthesised speech output.

The CATS is specified as a Specialist provider under the CAEP Service Agreement, providing services in the Hospital and the community. A multi-disciplinary team is comprised of speech pathologists, rehabilitation engineers, rehabilitation technicians, occupational therapists and nurses. There needs to be close working access to the REC and other departmental groups to ensure that integrated technology solutions (eg. an electric wheelchair with communication aid and environmental control system) and custom adaptations can be provided efficiently and effectively to the patient or client.

TECHNICAL SERVICES (OR CLINICAL ENGINEERING)

Prime Relationships: *All Wards and Services, Critical Care (ICU), Cardiology, Emergency Services, Theatres, Laboratories, Renal Dialysis, Imaging, Neuro-sciences*

State responsibilities: *Advanced medical equipment and device design and manufacture*

The Technical Services Division of the Department provides a comprehensive clinical engineering service covering all areas of the Hospital. Increasingly, the Division is required to represent technology issues on senior clinical committees and planning groups and advises widely to hospitals in the Area and across the State. Clinical engineering services are provided in support of electronic, computer based, mechanical and surgical instrumentation used across the Hospital (including Shenton Park Campus). The Division comprises thirty (33) professional and technical staff. Services include technology management, routine repair, service and maintenance and the specialised design, development and manufacture of clinical equipment.

The role of the Division accords with the recommendations of a review of clinical engineering services (conducted as a consequence of the Reid Review in 2004)¹⁶ and employs a combination of in-house and supervised contractual services, based on a cost effectiveness and outcomes based evaluation.

Importantly, this arrangement provides a strong clinical and administrative support role, conducive to the sound representation of technology issues in clinical decision making and facilitates development and research investigations in support of the research and teaching role of the Hospital. Estimates conducted at the time of the review indicated BME operating costs to be in the ratio 2.2:1 (RPH: Fremantle) compared with the ratio of hospital budgets which was in the order 2.24:1 at that time.¹⁷ It is advised that as a first estimate, budgets would reflect medical activity levels and case severity, both of which would drive the level of BME support required.

¹⁵ People having suffered a stroke, with progressive neurological disorder, head injury, trauma, etc...

¹⁶ "A Review of Clinical Engineering Services in Public Hospitals in WA": R.Wilkins, February 2004

¹⁷ "Review of capital Equipment Funding Strategy for WA Public Hospitals" Monash University Centre for Biomedical Engineering (Tender No.HSWA 502A/2003.) June 2004

The Division, as a consequence of its operation which relies primarily on a combination of in-house and contractual servicing, has the expertise to support clinical service development, emergency planning and response capacity, research, etc.. This is in contrast to other facilities that rely primarily on contractual and third party service provision.

In addition to its advisory role, the Division is directly responsible for;

- the specification, evaluation, procurement and ongoing management and service support for all medical equipment^{18, 19} with the exception of complex imaging equipment which is under external servicing contracts. Currently two biomedical engineering staff are employed specifically in Imaging Services at RPH
- the risk management of clinical equipment and systems including recall of equipment and investigation of failures and incidents involving patient or staff safety.
- the design, implementation and support of the medical LAN providing system integration and data interconnectivity related to electromedical equipment, in accord with Hospital policy²⁰
- the provision of electronic design capability providing for the interfacing, data analysis and data presentation of medical and research equipment.
- the manufacture of custom implant devices for patients across the State. The Instrument development Section works closely with Bioengineering in this area of specialised service, collaborating on design aspects and providing the advanced manufacturing skills and resources conforming with the regulatory and quality requirements

The service has access to a central workshop (level 1) in addition to three (3) satellite workshops which are located adjacent to Theatres, ICU, Cardiology²¹ and at SPC. These workshops need to be maintained but there may be benefit from the integration of the SPC and WSC facilities on the FSH site, providing both economy and improved resource utilisation, etc..

SCIENTIFIC COMPUTING AND MANAGEMENT

Prime Relationships: *All services, ME&P, Research*

The Management Section of the Department comprises 7 FTE, (4 at WSC, 3 at SPC) provides logistic support including office services, Finance, HR and personnel management for 107 staff across the two campuses. The devolution of administrative functions to HCN and procedural changes prior to this move have had a significant effect on the responsibilities and workload on this group, with the immediate need for an additional staff member and resources to cover personnel issues.

The Scientific Computing Group (3FTE) provides specialised mathematic, statistics and computing services to the Department and the Hospital in general. This includes;

- the provision of statistical and mathematical expertise to support the departmental operations,
- the use of advanced techniques for the interpretation of clinical data,
- the analysis of surveys or investigations,
- the assessment of proposed analytic protocols and as a consultancy service to clinical trial research and studies (quantitative analysis).

¹⁸ Examples of medical equipment include ultrasound, cardiology system, anaesthetics systems, ICU systems, IV pumps, monitors, ventilators, etc...

¹⁹ The department considers that in-house services can add value to the sole repair and maintenance functions by customising and enhancing products and systems

²⁰ Memorandum to Exec,Dir 2/9/04, "Endorsement of Medical LAN Practices"

²¹ There is a tight involvement with Cardiac Transplant service.

The service is accessible to all hospital clinicians and practitioners (eg. Laboratories and Allied Health, etc.) and also provides computing support for many dedicated internal systems and specialised technical software beyond the remit of corporate IT support, architects special computing packages, resolves programming issues, manages the storage and reticulation of intra-departmental data and acts as the first point of contact for computing problems. There is strong liaison and significant mutual assistance with the corporate IT support group, specifically with respect to maintenance, upgrading and policy implementation issues.

DEPARTMENT OF MEDICAL ENGINEERING & PHYSICS, RPH (2011 – current)

The process whereby the Department of Medical Engineering & Physics (RPH) was transferred to report directly to SMHS through Corporate Operations and its re-organisation under the newly formed Health Technology Management Unit (HTMU) was completed in June 2012 and was formally endorsed by the SMHS Area Executive Group on 15/6/2012.

The formation of the Health Technology Management Unit followed a number of representations made to the Executive and to the Clinical Divisions of the Hospital, addressing concerns as to the role of the Department following devolution of services to the Fiona Stanley Hospital, the downsizing of RPH and its future as a tertiary hospital. An integrated service approach was advocated and was finally triggered by the initiative taken at SMHS to re-align all biomedical engineering budgets to the central responsibility of SMHS Corporate Operations.

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