

RESEARCH

ON THE ROYAL CHILDREN'S HOSPITAL CAMPUS

2010

**World-class campus
partners working together
to improve children's health**

THE ROYAL CHILDREN'S HOSPITAL CAMPUS VISION

A world-class children's hospital campus incorporating clinical care, research and teaching.

The Royal Children's Hospital (RCH) Campus will fulfil its purpose by being a major contributor to the creation of knowledge for disease prevention and treatment, by educating health professionals and the community, and by applying the knowledge clinically and through appropriate population interventions. The environment will attract and retain the most talented and highly motivated staff to give effect to this vision.

THE ROYAL CHILDREN'S HOSPITAL VISION

A GREAT children's hospital, leading the way

UNIVERSITY OF MELBOURNE DEPARTMENT OF PAEDIATRICS VISION

To be a nationally and internationally renowned multidisciplinary department providing leadership, excellence and opportunity in paediatric teaching, research and clinical practice; a department at the forefront of child and adolescent health

MURDOCH CHILDRENS RESEARCH INSTITUTE VISION

To be a major global contributor to the creation of knowledge that leads to improved child health



FRONT COVER Eliza, with the Murdoch Childrens Research Institute 3T scanner, a major investment for research and clinical care on the RCH Campus. Used by 18 research groups producing around 1,500 scans per year, this is one example of platform technology investments that have made our Campus globally competitive.



Executive Letter	2
Governance	3
Campus Partners	4
The New Royal Children's Hospital Campus	6
Research Framework	9
Strategic Appointments	10
Honours and Awards	11
Research Highlights	12
Collaborations Around the World	20
External Research Funding	24
Commercialisation	26
Publications	27
Clinical Trials	28
Students	29
Training Future Leaders	30
Ethics Committees	32
Campus Research Week	32

OPPOSITE PAGE The new RCH Campus will open its doors in November 2011 next to the current site in Parkville, bringing together six levels of clinical, research and education facilities over 200,000m².

Executive Letter

Welcome to our annual research report, which highlights some of the translational outcomes and other achievements of The Royal Children’s Hospital (RCH) Campus in 2010.

In an environment where every dollar is critical, investment in research provides the facilities, tools and support to capitalise on opportunities that will strengthen our Campus, enhance research productivity, and contribute to the generation of scientific knowledge and ultimately the well-being of children and their families.

The importance of high-level research in an academic hospital campus cannot be under-estimated. Research effectively integrated within clinical domains attracts the best clinicians and trainees and supports evidence-based practice within hospital departments — both of which improve clinical care and inform education and training.

A confluence of factors is needed for a hospital campus to be successful: a global reputation for excellence, strong governance, a plan that leads the campus forward, and opportunity. The RCH Campus excelled in all four of these areas this past year. The consequence of this was the highest volume of external funding and the highest number of research publications in the history of our Campus, together with high-level recruitment and the opportunity to reshape our strategies in preparation for the move to new facilities in 2011.

While 2010 was a successful year for the Campus, we also have a clear vision of the future, and Campus Council implemented a number of key initiatives in 2010 to support this vision.

The annual Campus Research Week was launched in 2010, which showcased the multidisciplinary and interdisciplinary research conducted on site and which has already resulted in many new interactions across Campus. This initiative will be further supported in 2011 by Campus Education Week, an opportunity to embrace innovation and best practice in our Campus teaching and learning environment, bringing together our staff with world-class educators and providing an opportunity to share best practice through presentations and practical workshops.

In 2010 the RCH Campus was successful in recruiting outstanding scientific staff, bringing external expertise to the Campus to increase our critical mass in key areas. Several of these appointments are profiled within this Report.

A scientific review in 2010 of the Campus research partner — Murdoch Childrens Research Institute — led to a restructure of the six research Themes established in 2005. The Themes are gradually evolving, evidenced by a sharpened focus on research driven by clinical questions to complement the outstanding basic research that has long been the backbone of our Campus.

Together these initiatives support future growth in core competencies and critical mass to help answer key research questions and to make an impact on the health and well-being of children.

CAMPUS EXECUTIVE LEADERS
Professor Terry Dwyer AO Murdoch Childrens Research Institute
Professor Christine Kilpatrick The Royal Children’s Hospital
Professor Paul Monagle Department of Paediatrics, The University of Melbourne

Supporting
scientists
and clinicians
conducting
world-class
research to
improve the
health and
well-being
of children.

Governance

Since 2007, Campus Council has worked to develop sustainable agreements, systems and structures that enhance and advance collaboration between the Campus partners to achieve a shared vision.

The Council comprises an independent Chair, and two representatives of each of the three Campus partners and The Royal Children’s Hospital Foundation, the fundraising arm of the hospital. The Council has established research and education committees across Campus to align strategies and foster collaborations, and has made significant progress with harmonisation of branding and human resources.

Campus Council has been a catalyst in important initiatives launched in 2010, such as the publication of this report, and the annual Campus Research Week organised by the campus Research Committee and Campus Education Week organised by the campus Education Steering Committee.

The Campus Research Committee is responsible to Campus Council. The Committee comprises the executive leaders and two nominated researchers from each of the three Campus partners. In 2011 the newly appointed Director of Clinical Research, A/Professor Andrew Davidson, will join the Committee. Membership is balanced to include clinical, public health and laboratory research disciplines. Its purpose is to maximise Campus health research outcomes. It develops a Campus-wide research agenda and research performance measures; identifies high-level strategic research and recruitment priorities for the consideration of Campus Council; convenes and considers input from a broad-reaching Research Advisory Forum; and encourages effective collaboration between researchers and clinicians.

CAMPUS COUNCIL 2010

Hon Rob Knowles AO Chair	
Professor James Angus AO Dean, Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne	
Mr Tony Beddison AO Chair, The Royal Children’s Hospital	
Mr Julian Clarke Chair, The Royal Children’s Hospital Foundation	
Mr Leigh Clifford AO Chair, Murdoch Childrens Research Institute	
Professor Terry Dwyer AO Director, Murdoch Childrens Research Institute; Professorial Fellow, Department of Paediatrics, The University of Melbourne	
Professor Christine Kilpatrick Chief Executive Officer, The Royal Children’s Hospital; Professorial Fellow, Department of Paediatrics, The University of Melbourne	
Ms Sue Hunt Executive Director, The Royal Children’s Hospital Foundation	
Professor Paul Monagle Stevenson Professor and Head, Department of Paediatrics, The University of Melbourne; Director of Haematology, The Royal Children’s Hospital; Group Leader, Haematology Research, Murdoch Childrens Research Institute	

Governance

CAMPUS RESEARCH COMMITTEE 2010

Professor Terry Dwyer AO Director, Murdoch Childrens Research Institute; Professorial Fellow, Department of Paediatrics, The University of Melbourne	
Professor Christine Kilpatrick Chief Executive Officer, The Royal Children's Hospital; Professorial Fellow, Department of Paediatrics, The University of Melbourne	
Dr Peter McDougall Executive Director Medical Services, The Royal Children's Hospital	
Professor Paul Monagle Stevenson Professor and Head, Department of Paediatrics, The University of Melbourne; Director of Haematology, The Royal Children's Hospital; Group Leader, Haematology Research, Murdoch Childrens Research Institute	
Professor Terry Nolan Head, School of Population Health, The University of Melbourne; Group Leader, Immunisation Research, Murdoch Childrens Research Institute	
Professor Sheena Reilly Associate Director, and Group Leader, Hearing, Language and Literacy, Murdoch Childrens Research Institute; Director of Speech Pathology, The Royal Children's Hospital; Professor of Paediatric Speech Pathology, Department of Paediatrics, The University of Melbourne	
Professor Roy Robins-Browne Head, Department of Microbiology and Immunology, The University of Melbourne; Group Leader, Infectious Diseases and Microbiology, Murdoch Childrens Research Institute	
Professor Andrew Sinclair Associate Director, and Group Leader, Molecular Development, Murdoch Childrens Research Institute; Professorial Fellow, Department of Paediatrics, The University of Melbourne	
Professor George Werther Director, Centre for Hormone Research, and Group Leader, Hormone Research, Murdoch Childrens Research Institute; Professorial Fellow, Department of Paediatrics, The University of Melbourne	

Campus Partners



The Royal Children's Hospital (RCH) Campus is a partnership delivering integrated research, education and clinical services of national and global distinction. Research on Campus is embedded within the Murdoch Childrens Research Institute, strongly linked to The Royal Children's Hospital clinical departments, underpinned by the teaching and research of The University of Melbourne Department of Paediatrics, and supported by The Royal Children's Hospital Foundation, the fundraising arm of the hospital. Sharing of clinical, research and academic appointments strengthens the partnership by attracting outstanding clinicians and researchers, encouraging evidence-based practice within hospital departments and ultimately improving clinical care. Our hospital, research institute and university all have world-class strengths. Some notable external awards and accomplishments in 2010 are presented.

EXCELLENCE IN HEALTHCARE

The Royal Children's Hospital was recognised in 2010 for its outstanding achievement in providing healthcare to children in Victoria and Australia.

The hospital was a finalist in five Victorian Public Healthcare Awards, and won three awards, including both of the Premier's Excellence Awards, one for improving cancer care in Victoria and another for tackling chronic disease and improving public health.

Accreditation is an important requirement of all public hospitals and demonstrates to the community the appropriate standards of care and involvement in continuous quality improvement. In 2010 the hospital was accredited by the Australian Council on Healthcare Standards program EQuIP following an Organisational Wide Survey. Research and governance on Campus was awarded "Outstanding Achievement".

The accreditation team noted that the Campus research portfolio is outstanding, demonstrates extensive contribution to knowledge, a broad-based multidisciplinary research competency, adheres to best practice governance standards, and actively fosters education and support for scholarship to aspiring and existing researchers.

"The healthcare awards acknowledge remarkable and innovative work"

Professor Christine Kilpatrick,
Chief Executive Officer, The Royal Children's Hospital

EXCELLENCE IN RESEARCH

Research performance is measured annually by the Murdoch Childrens Research Institute across three broad categories: knowledge creation (publications), inputs to research (grants, students), and translational outcomes (commercialisation, clinical and public health outcomes, policy adoption). This annual evaluation is a powerful tool for assessing the Institute's progress towards achieving its strategic goals, and is a key driver for research excellence.

Demonstrating excellence in the translation of research to clinical and public health outcomes is an integral part of the performance evaluation. Highlighted in this report are a number of examples of research programs that have impacted clinical outcomes and changed clinical practice at local and state levels, with some adopted nationally and internationally.

Grants from government and external funding bodies are awarded based on the quality and significance of research and are an external measure of research excellence.

In 2010 Campus researchers were awarded a record \$28.8 million from NHMRC and \$0.8 million from ARC for new research initiatives commencing in 2011. The number of Campus publications also increased, from 684 in 2009 to 819 in 2010, with many of these in the world's highest ranked journals.

EXCELLENCE IN EDUCATION

The University of Melbourne has established itself as the leading research university in Australia, topping the key indicators in the 2010 Excellence in Research for Australia report. The report by the Australian Research Council (ARC) gave Australia, for the first time, the capacity to rigorously measure its achievements against its peers around the world, drawing together rich information about discipline-specific research activity, as well as information about contribution to the national landscape of each discipline. Whilst the assessment exercise was limited to universities, much of the collaborative research efforts of the Campus partners were also captured.

The report shows the University had the highest number of research disciplines ranked at the maximum possible score of five. Of 102 research areas assessed by the ARC over a six year period, 42 had the highest rating. Another 40 were rated above world standard and 20 at world standard; overall, 88 research areas were above the national average. The maximum possible rating of five (well above world standard) for research in the field of Biomedical and Clinical Health Sciences, and a rating of four (above world standard) for research in the field of Public and Allied Health Sciences) provided further validation of the Campus's research program and achievements and its vision of undertaking world-class research.

"This recognition of our outstanding research accomplishments underscores our ability to provide world-class education"

Professor Peter Rathjen,
Deputy Vice Chancellor (Research) The University of Melbourne

The New Royal Children's Hospital Campus

EXPANDED RESEARCH FACILITIES

The new RCH Campus boasts double the research space of the current site, increasing our research capacity. The design is flexible, allowing us to respond to emerging research trends and evolving collaborations. Important to the translation of research into clinical outcomes, the close proximity of researchers and clinicians will facilitate improved communication and collaboration. In addition, dedicated clinical research areas and an outpatient clinical trials area have been embedded into the hospital. An electronic patient data system will enable increased opportunities for clinical research.

WORLD CLASS EDUCATION AND TRAINING

The Health Education and Learning precinct features a variety of teaching and learning spaces and a large auditorium, all equipped with the latest technology for training, education sessions and videoconferences. These facilities will attract many national and international conferences and symposia. Break-out areas feature throughout the precinct, alongside an expanded and modern library, offering a range of environments to engage with both digital and print media.

Simulation training is now recognised as effective and efficient in improving clinical, bedside and communication skills in medical, nursing and allied health trainees, particularly at a post-graduate level. The Simulation Centre will be able to facilitate different scenarios such as an emergency trauma bay and a theatre, bedside consultation, nursing procedures, and clinical assessment and management by all disciplines. Training scenarios can be recorded and then reviewed in debriefing sessions to inform the learning experience, enabling the development of critical thinking and decision-making skills in a safe clinical learning environment.

The Clinical Skills Laboratory, part of the new centre, will also facilitate safe and controlled training in a wet laboratory environment. The centre will set a benchmark for paediatric training in Australia and will also assist in the development of best practice guidelines.

21ST CENTURY HEALTHCARE

The new RCH incorporates the latest in evidence-based design concepts to provide modern, family-focussed healthcare that will improve patient outcomes and also facilitate research into healthcare delivery.

THE NEW ROYAL CHILDREN'S HOSPITAL CAMPUS, SITUATED IN PARKLAND ADJACENT TO OUR CURRENT SITE IN PARKVILLE, WILL OPEN IN LATE 2011. THE CAMPUS PARTNERS HAVE DESIGNED NEW CLINICAL, RESEARCH AND EDUCATION FACILITIES SUPPORTING OUR VISION AS A GREAT CHILDREN'S HOSPITAL, LEADING THE WAY. THE FACILITIES FEATURE SEVERAL WORLD-FIRSTS, ENHANCING OUR ABILITY TO ATTRACT, TRAIN AND RETAIN THE HIGHEST QUALITY STAFF.



The new RCH will be the first paediatric hospital in Australia to offer intraoperative magnetic resonance imaging (MRI), changing the face of neurosurgery and cardiac procedures for Australian children.

The RCH Foundation purchased the \$12 m IMRIS intraoperative MRI system, enabling surgeons to perform MRI scans during surgery without the need to leave theatre or move the patient, enhancing patient safety. With this technology researchers can translate real-time functional images into better-informed surgery and practice guidelines. The three-room IMRIS suite will also include an interventional theatre for cardiac procedures and a diagnostic centre — an Australian-first and a paediatric world-first.

Modern, family-focussed clinical facilities, expanded research space and an innovative teaching and learning precinct will support the RCH Campus in providing the best healthcare, producing high impact research, and leading the way in education.

LEFT Main Street, on the new RCH Campus connects the clinical, education and research facilities.

The new RCH will be the first paediatric hospital in Australia to offer intraoperative MRI enabling researchers to translate real-time images into better-informed surgery and practice guidelines.





Research Framework

THE RESEARCH FRAMEWORK ON CAMPUS UNDERPINS A RICH WEB OF INTERACTIONS AND SYNERGIES THAT CROSS THE HOSPITAL, THE UNIVERSITY AND THE RESEARCH INSTITUTE.

RESEARCH STRUCTURE

As the research leader on Campus, Murdoch Childrens Research Institute has the primary role in establishing a structure to support integrated research. The Institute has six

Themes covering biomedical, clinical and public health research, each promoting a multidisciplinary approach to collaborations. The restructure of Themes during 2010 reflects the constantly evolving research strengths of the Institute and the high-level strategic research directions identified by Campus governance. Affinity Groups are also being created to further drive collaboration between research groups, Themes and Campus partners in priority areas. The Affinity Groups will encourage individuals and groups with interests or a skill set relevant to the priority area to work together on key projects, develop funding proposals and further build success in these areas.

RESEARCH TRANSLATION

A strong link between laboratory science and clinical research is critical to translational outcomes.

The new Director of Clinical Research will help support clinician researchers with initiatives to promote training and integration across the Campus. Research is conducted not only within the Institute laboratories, centres and offices, but also within hospital clinical departments. Many of our researchers have double or triple appointments across the Campus partners which helps address research into clinical questions and then move the evidence-based research back to the clinic. With the setting of Campus strategic priorities we are moving towards alignment of our hospital clinical departments with Institute research groups. These research-clinical links will be further supported by Affinity Groups in 2011.

Some of our researchers are also based at Bio21 in Parkville and at departments of The University of Melbourne external to this Campus, expanding our collaborative connections.

RESEARCHER SUPPORT

Given the increasing complexities of conducting research and the advance of technology towards next generation data systems and complex statistical techniques, our Campus has established a strong research directorate to support and co-ordinate research activities. Our core facilities provide expertise in areas such as research design and protocol development, ethical standards and research integrity, bioinformatics, biobanking, flow cytometry, cell and genomic technologies, disease models, and clinical trials. We provide extensive support for researchers seeking grant funding; identify and protect commercial applications of research outputs; promote research results to the community; and evaluate research performance to inform our strategic plan. We also mentor students and researchers at different career stages and provide training and skills-building sessions to support career development. The overall effect and underpinning the success of the RCH Campus is a professional research environment.

A framework to build on the already outstanding achievements of our Campus.

Strategic Appointments

THE RCH CAMPUS IS COMMITTED TO ITS VISION AS A WORLD-CLASS CHILDREN'S HOSPITAL CAMPUS. A NUMBER OF KEY APPOINTMENTS WERE MADE IN 2010 TO STRENGTHEN AREAS OF STRATEGIC IMPORTANCE TO THE CAMPUS. A SELECTION OF THESE APPOINTMENTS IS PRESENTED.

Professor Fiona Stanley AC

An internationally distinguished researcher, Professor Stanley is founding Director of the Telethon Institute for Child Health Research, UNICEF Australia's Ambassador for Early Child Development and serves on several prestigious Federal government advisory boards.

In her role as consultant she brings to the Campus her experience in fostering collaborative, multidisciplinary approaches to research, particularly in the mentoring of early career researchers, and in supporting clinical effectiveness research.

Professor Katrina Williams

Professor Williams is a recognised authority in autism research, including its risk factors, prognosis, treatment, diagnosis and epidemiology.

With the generous assistance of the Apex Foundation and RCH Foundation, Professor Williams joined this Campus as the foundation Apex Chair in Developmental Medicine.

This and her hospital role as Head of Department of Developmental Medicine and her research role within the Developmental Disability and Rehabilitation Group will strengthen our national and international leadership in this area.

Professor Dinah Reddihough AO

Professor Reddihough has a distinguished track record as a researcher focused on the causes and outcomes of disability in childhood, particularly cerebral palsy and intellectual disability, and as a clinician and child advocate.

Special funding from The University of Melbourne Vice Chancellor has enabled her to take up a half-time research role.

Her appointment strengthens Campus leadership in developmental medicine, particularly in translational research and policy development in this area.

A/Professor Andrew Davidson

A/Professor Davidson graduated in medicine and undertook anaesthesia training in Melbourne, the UK, The Netherlands and the US.

He has a diploma of biostatistics and Doctorate of Medicine (MD), and has an appointment with each of the three Campus partners.

As Director of Clinical Research, a newly created position funded by the RCH Foundation, A/Professor Davidson will support clinicians to increase their research capacity and ensure governance of Campus-based clinical research.



Dr Alicia Oshlack

Dr Oshlack completed a PhD in astrophysics and then joined the Bioinformatics Division at the Walter and Eliza Hall Institute.

She brings to the RCH Campus expertise in developing and applying new statistical and computational analysis methods for gene expression to investigate cell development and function, and to understand the changes that lead to disease.

As Head of the Bioinformatics Unit she will play an active role in collaboration across Campus as well as developing further expertise in the analysis of high-throughput sequencing data.

A/Professor Michael Coory

A/Professor Coory is a public health physician with a PhD in biostatistics. He was formerly a medical epidemiologist with Queensland Health and a researcher with the University of Queensland. He is currently statistical advisor to several Federal government committees and Senior Research Fellow in Clinical Epidemiology with Cancer Council Victoria.

He will establish the Health Services Research Group on Campus investigating technology, knowledge translation and quality improvement to strengthen implementation science on Campus.

FROM TOP Introducing three new faces to the RCH Campus in 2010:
Dr Alicia Oshlack, A/Professor Michael Coory, Professor Katrina Williams.

Honours and Awards

EACH YEAR, MANY CAMPUS STAFF MEMBERS RECEIVE PROFESSIONAL AWARDS AND RECOGNITION. OTHERS HAVE RECEIVED LESS FANFARE, BUT QUIETLY AND EFFICIENTLY HAVE MADE SIGNIFICANT CONTRIBUTIONS. ALL HELPED MOVE SCIENTIFIC DISCOVERY, CLINICAL CARE AND OUR CAMPUS FORWARD. PRESENTED BELOW IS A SELECTION OF HONOURS AND AWARDS FROM 2010.



Professor James Angus AO was awarded an Officer in the General Division of the Order of Australia for distinguished service to biomedical research, particularly in the fields of pharmacology and cardiovascular disease, as a leading academic and medical educator, and as a contributor to advisory boards and professional organisations.

Dr Eileen Dunne was awarded a Fellowship from the American Australian Association enabling her to undertake post-doctoral studies at this Campus on the effects of pneumococcal vaccination on children in developing countries.

Dr Ian Hopkins OAM formerly RCH Director of Neurology, was awarded a Medal of the Order of Australia in the General Division for service to medicine as a paediatric neurologist and through professional improvement.

Dr Vera Ignjatovic received a prestigious Australian Academy of Science Scientific Visit to Europe award, recognising her research in blood proteomics and enabling her to work alongside leaders in platelet proteomics at the University of Santiago de Compostela in Spain.

Dr Angela Morgan received the prestigious NHMRC Achievement Award in 2010 to recognise her contribution to Australian medical research. Dr Morgan is investigating the genetic factors influencing childhood speech and swallowing disorders. Dr Morgan was also one of nine young researchers to receive a 2010 Young Tall Poppy Science Award recognised for outstanding work and a passion for communicating science to the wider community.

Professor Frank Shann AM was awarded a Member of the General Division of the Order of Australia for service to medicine as a paediatrician, particularly as a leader in intensive care for children, through contributions to the WHO and to rural medicine, and as an advocate for child health.

Professor Garry Warne AM was awarded a Member of the General Division of the Order of Australia for service to medicine in the field of paediatric endocrinology, and to the improvement of child health care and infrastructure in developing countries.

“The awards are great recognition for research accomplished as part of a team working to translate findings into better outcomes for children.”

Dr Angela Morgan

Research Highlights

OUR MULTIDISCIPLINARY TEAMS OF CLINICIANS, SCIENTISTS, NURSES AND ALLIED HEALTH SPECIALISTS ARE COMMITTED TO MAKING DISCOVERIES THAT WILL IMPROVE THE LIVES OF CHILDREN AND THEIR FAMILIES.

Promoting and accelerating research translation into improved benefits for patients and for a self-improving health system is a national priority for the Australian government.

The RCH Campus, with its integrative research-clinical-education focus is conducting translational research to improve clinical practice and inform government policies. Across the campus, the hospital is involved in research, working in collaboration with university and research institute staff.

We are investigating the genetic and environmental causes of more than 100 diseases, as well as developing improved treatments and prevention strategies, and considering the long-term social, behavioural and physical impacts of disease.

We present here a selection of research projects to show both the breadth and excellence of research across disciplines.

The numerous translational outcomes highlighted demonstrate the research excellence, collaborative gain and depth of our research.

Genetic Technology Breakthrough

Professor David Thorburn, Dr Alison Compton, Ms Elena Tucker

Inherited diseases affecting mitochondrial energy generation are individually rare but collectively cause morbidity or mortality in at least one in 5,000 children.

Mitochondrial disorders can be caused by mutations in any one of potentially hundreds of nuclear genes or in the 37 genes encoded by mitochondrial DNA, which we inherit only from our mothers. The proportion of mutant mitochondrial DNA can vary between siblings from 0% to 100%, and some children with mutant mitochondria will not develop mitochondrial disease, which complicates genetic counselling for affected families.

In a groundbreaking study published in *Nature Genetics*, researchers on Campus with scientists from the Broad Institute of MIT and Harvard, USA, successfully trialled 'next generation' DNA sequencing to test 103 genes simultaneously from individuals with the most common mitochondrial biochemical diagnosis. Unlike current

tests, which test one gene at a time, or biopsies, which are invasive, this technology allows screening of many genes simultaneously to establish a diagnosis quickly and cost effectively. The study established genetic diagnoses in 13 of 60 previously unsolved cases and found two new disease genes not previously linked to mitochondrial disease.

While a definitive molecular diagnosis is comforting, there are no effective treatments for these disorders other than optimising mitochondrial efficiency and controlling symptoms. However, our work on understanding the genetics of mitochondrial diseases has defined internationally the approach to genetic counselling and prevention of these diseases by prenatal diagnosis and through reproductive options such as IVF with pre-implantation genetic diagnosis or IVF using donor eggs. The team is also working on new approaches for effective therapy and has generated two mouse models of mitochondrial disease.

"Our study shows that next generation DNA sequencing methods can transform the diagnosis of genetic diseases"

Professor David Thorburn

THIS PAGE A human skin fibroblast cell with mitochondria in red and DNA in green (located in the nucleus but also in small mitochondrial genomes spaced throughout the mitochondrial network). Photo: Dr Ann Frazier, Mitochondrial Research Group.

Infant Sleep Interventions

Dr Harriet Hiscock, Dr Jordana Bayer, Dr Lisa Gold, Dr Obioha Ukoumunne, Ms Anna Price, Professor Melissa Wake

More than 40% of infants aged 6–12 months have sleep problems, and their mothers have double the risk of postnatal depression, which can affect bonding with the child. Poor infant sleep patterns have also been linked to childhood obesity.

Working with the Maternal and Child Health Service, our researchers recruited 328 mothers and their infants with sleep problems to a randomised controlled trial to explore the link between poor sleep patterns and maternal depression, and to trial an intervention to help manage both in the critical first year of a child's life.

The trial was successful in improving infant sleep patterns, and reducing postnatal depression symptoms for mothers by one-third during the infant's first two years of life, and was cost-effective. Maternal and Child Health nurses throughout Victoria are now trained to identify sleep issues and the Infant Sleep Study Training Program is included in the Key Age and Stage visits for eight-month check ups.

The program was winner of the 2010 Minister for Children and Early Childhood Development's Award (Partnerships with Families and Communities) and has been recognised internationally as bringing significant health benefits to the community, with new studies underway in Canada. The Victorian government funded translation of program materials into eight languages and a pilot GP training program for 2011.

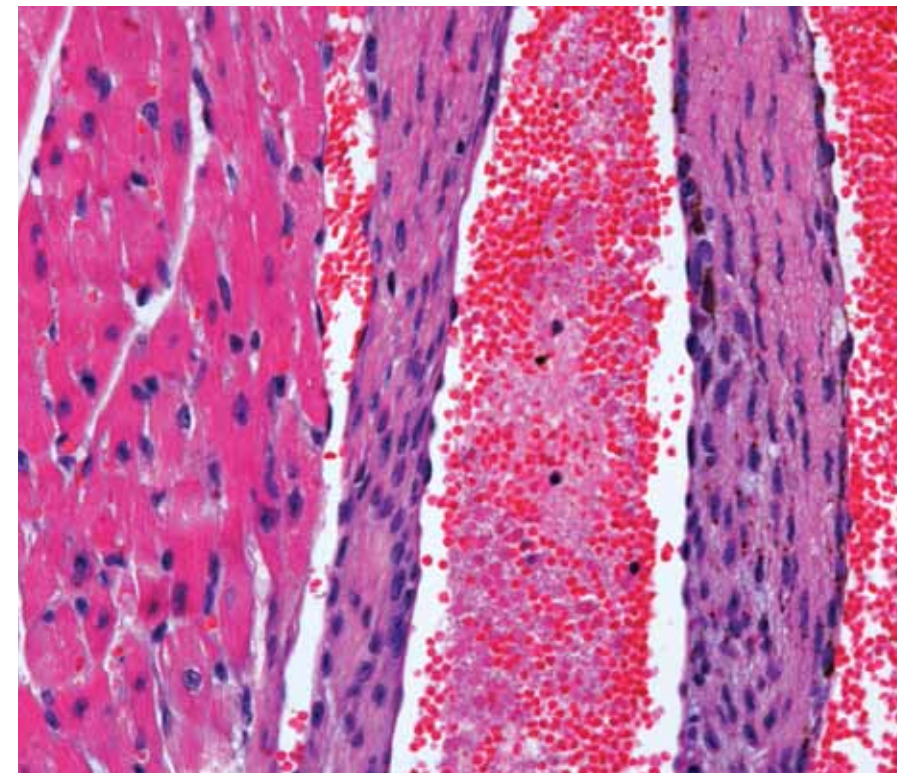
Researcher Anna Price recently followed up the children at age six years to investigate whether the original sleep intervention has long-term effects on their emotional, behavioural and physical well-being, stress levels, obesity and activity levels, and the well-being of parents and the family. This new research on 225 of these children has shown that using behavioural techniques including 'controlled comforting' to help infants sleep does not lead to later emotional and behavioural problems. These findings can reassure parents and health professionals of the immediate benefits of infant sleep interventions.



More than 40% of infants aged 6–12 months have sleep problems, and their mothers have double the risk of post-natal depression, which can affect bonding with the child.

Bleeding and Clotting Disorders

Professor Paul Monagle, Dr Vera Ignjatovic, Ms Robyn Summerhayes, Ms Chantal Attard, Dr Fiona Newall (with RCH surgical and anaesthetic departments and RWH neonatal unit)



Understanding the normal reference range for children as their haemostatic system evolves throughout childhood is critical for managing haemostatic disorders. Evaluation of these disorders in children requires an understanding of the physiological age-dependent changes. Without correct reference ranges up to 30% of children investigated can be misdiagnosed. In addition, coagulation tests are used to monitor blood-thinning drugs such as heparin. Up to 15% of children in paediatric hospitals receive heparin, and hence accurate monitoring of heparin is critical. Inaccurate diagnosis and mismanagement of neonates and children with suspected bleeding or clotting disorders has serious health, social and economic implications.

A research collaboration led by Professor Paul Monagle has collected data defining the coagulation profiles in healthy children from birth to adulthood, and also children's response to anti-coagulation therapy and the changes that occur in monitoring tests.

These data have generated reference ranges for numerous haemostatic tests in children, with 5,000 Paediatric Haemostatic Reference Range cards containing normative data for children distributed to haematology laboratories worldwide. The data have been converted into clinical guidelines adopted nationally and internationally. Research is now underway to develop new guidelines for management of unfractionated heparin therapy for use in Australia and internationally.

ABOVE Image shows blood interacting with the endothelium of blood vessels.
Photo: Louise Pontell, Australian Phenomics Network: Histopathology and Organ Pathology Service, The University of Melbourne.

TRANSITION TO ADULT HEALTHCARE

Transfer from paediatric to adult health services can be stressful for the family and for the young person who needs to manage their own healthcare and adjust to a very different clinical setting.

Supporting young people and their parents through this significant event requires a planned transition, which includes the transfer event, and takes place over many years involving preparation, skill acquisition, support and follow up after entering the adult service. The Adolescent Transition Program was developed following extensive stakeholder feedback and continues to be informed by a collaborative study with the Centre for Adolescent Health involving over 85 young adults and 150 parents/carers from 15 chronic illness groups.

A resource and education package was developed for both young people and parents/carers, to complement a pilot program initially established in Rheumatology in 2010 and now being rolled out to other departments. The pilot has a robust evaluation framework with pre- and post-evaluation questionnaires for the paediatric and adult service multidisciplinary team, the young person and the parent/carer. This innovative program will be one of the first organisational-wide implementations of a transition model of care in Australia. Ongoing research will evaluate its success in supporting the transition process.

Sarah MacNee and RCH Adolescent Transition Team

WORKING WITH GPs ON OBESITY

AROUND 25% OF ALL CHILDREN ARE OVERWEIGHT OR OBESE AND GPs SEE VIRTUALLY ALL OF THESE CHILDREN.

Providing GPs with effective techniques that are transferable to the real work environment, cost-effective and time-efficient would be a major advance. This study involved 139 families participating in a randomised controlled trial, and used actors trained to simulate a patient's condition in a standardized way to help doctors master new counselling and motivational skills to improve family lifestyle and the child's obesity. Doctors, parents and simulated patients reported on each GP's performance. The simulated patient ratings predicted actual improvements in real patient clinical outcomes. Results suggest that simulated patients are a valuable training tool which GPs find useful and can help determine when GPs are ready to implement behaviour change techniques.

Ms Bibi Gerner, Dr Obioha Ukoumunne, Ms Lucy Rogers, Dr Zoë McCallum, Professor Melissa Wake and the LEAP2 team

Improving Care for Juvenile Arthritis

Dr Jane Munro

Juvenile idiopathic arthritis affects around 5,000 children in Australia.

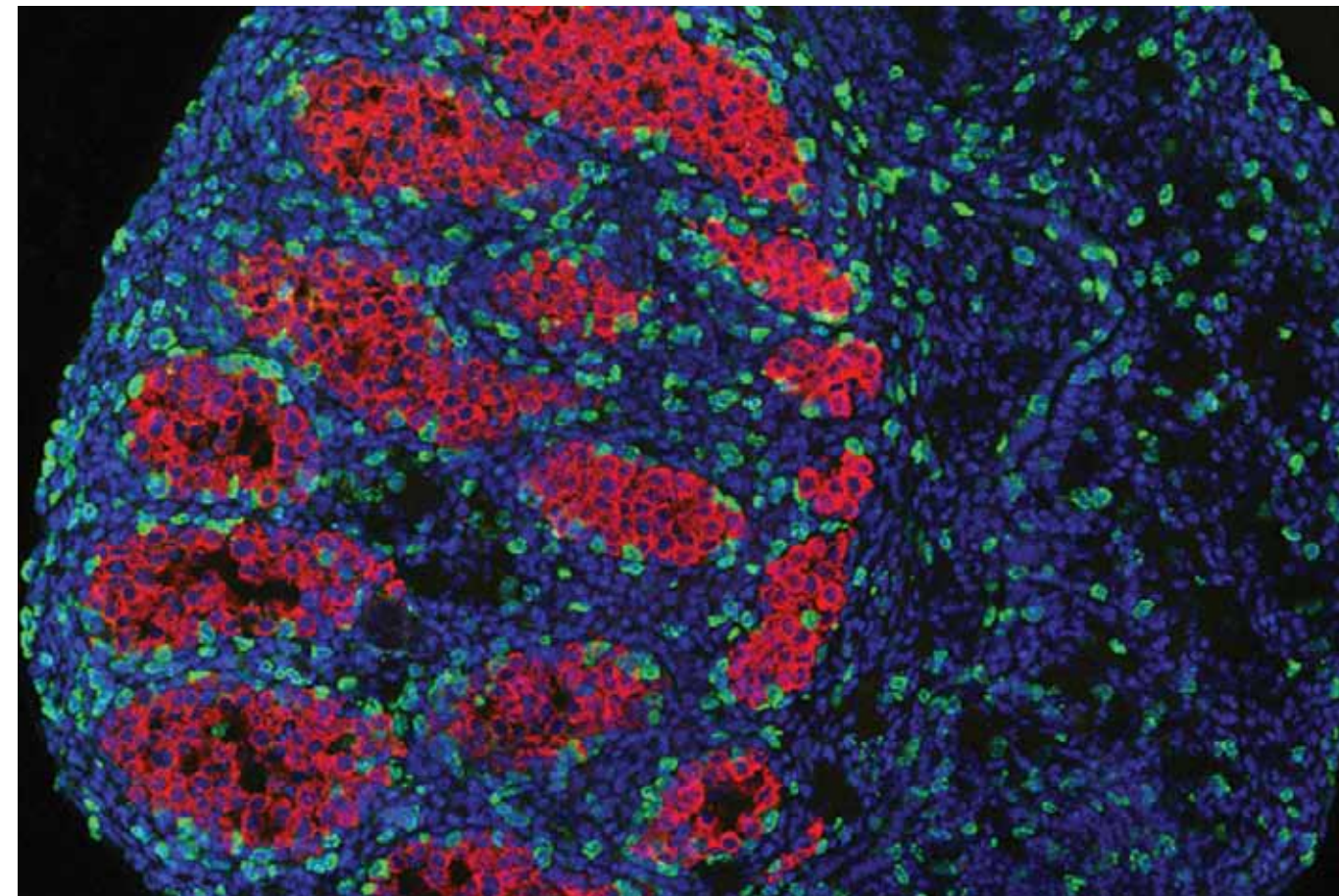
Treatment requires long-term care from a range of health disciplines including medicine, nursing, psychology, physiotherapy and occupational therapy, and can be stressful on patients and their families. The Victorian Paediatric Rheumatology Best Practice Consortium, established by the RCH Campus in collaboration with Monash Medical Centre and Arthritis Victoria has developed a best practice model to address the considerable gaps between evidence and practice across multiple disciplines and to promote a collaborative and systematic approach to care.

The model now implemented at the two major Victorian treatment centres is based on four components: disease management and physical therapy, patient and family preventative education, psychosocial support and timely intervention, and community liaison. A rheumatology database has been established to track the global assessment of disease activity and progression, medication and pathology tests for each patient visit. The database protocol will be extended to paediatric rheumatology clinicians around Australia. In addition Consortium members were involved in the development of the NHMRC guidelines for GPs and paediatricians on management of juvenile arthritis.

The expected health outcomes of this model include improved family-centred, child-focussed patient care, better adherence to medications, fewer emergency hospital visits, improved treatment coordination by medical and allied health staff, and a better understanding of the disease by affected children and their families. Economic benefits are also anticipated, as families are encouraged to rely on ambulatory care and day stay rather than hospital admission.

Sex Development Disorders

Professor Andrew Sinclair, Professor Garry Warne, A/Professor Sonia Grover, A/Professor Sylvia Metcalfe, Dr Jacky Hewitt



ABOVE Confocal microscope image of a mouse embryonic testis showing male germ cells within a testis cord stained red with blue nuclei. Surrounding Leydig and myoid cells of the testis are stained blue. Cells stained green are actively dividing. This image showing cellular interactions within the testis helps us understand disorders of sex development. Photo: Dr Denise Miles, Molecular Development Group.

One in 4,500 children is estimated to have a disorder of sexual development (DSD), with surgical intervention sometimes associated with gender identity disorder. A multidisciplinary team on Campus involving nine hospital departments and patient advocacy groups documented the psychosocial and psychosexual outcomes of young adults treated with surgery in infancy over the previous 25 years.

The study suggests that early surgery as part of a multidisciplinary approach including family and social support results in positive psychosocial and general health, although some problems with body image and sexual activity were reported. With risk and litigation associated with surgical intervention for DSD this research is contributing to the establishment of national and international clinical management guidelines. A website is currently under preparation aimed at families and children with DSD. Our researchers are also establishing

'DSD Network', an international consortium of hospitals and research institutes, currently with an emphasis on Australasia. A separate portal for clinicians and researchers to exchange patient information and research involved in DSD research and clinical management has been developed to facilitate interactions.

To date only a small number of genes is known to be involved in gonad development and many DSD patients cannot be given an accurate diagnosis. In world-first genetic research led by Professor Andrew Sinclair and published in the *American Journal of Human Genetics* and the *Journal of Clinical Investigation*, two key genes have been identified that explain previously undiagnosed DSD cases. These translational breakthroughs in identifying genes important for testis development and discovering how they contribute to DSDs will improve diagnosis and guide clinical management of patients.

Egg Allergy Prevention

A/Professor Katie Allen, Dr Jennifer Koplin

Food allergy often develops early in infancy and impacts the child and their family's quality of life.

Egg allergy is the most common food allergy in infants and toddlers and can result in hives, vomiting and diarrhoea. Until recently international guidelines recommended that infants with a family history of allergy delay introducing foods such as egg, peanut and nuts until up to two to three years of age.

A world-first study published in the *Journal of Allergy and Clinical Immunology* involving more than 2,500 Victorian infants found that early introduction of egg could reduce the risk of babies developing egg allergy. Infants introduced to egg after 12 months of age had triple the risk of egg allergy at 14–18 months of age than those given egg at four to six months, irrespective of whether they had a family history of allergy. Giving babies cooked egg proved more protective against allergy than egg baked in cakes or biscuits. The study found no link between egg allergy and the duration of breastfeeding or timing of introduction of first solids.

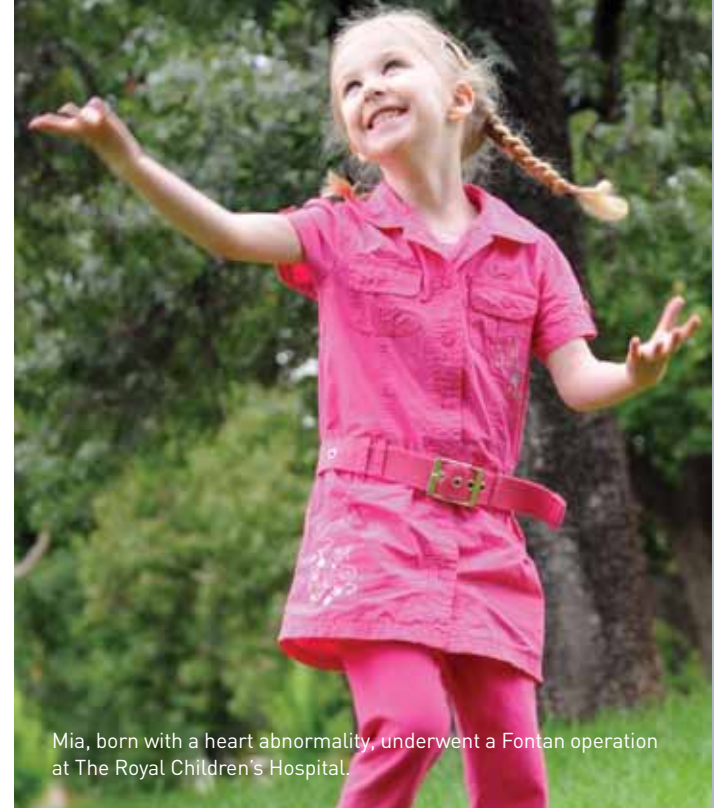
This research adds to growing evidence showing early introduction of allergenic foods is safe and may even protect against food allergy, which is becoming increasingly prevalent in Australian children. Although children normally outgrow egg allergy, they remain at increased risk of related conditions such as asthma and allergic rhinitis in later life, as well as peanut and tree nut allergy which persist into adult life.

This research forms part of a wider study led by A/Professor Allen to track food allergy prevalence and causes, including further research to determine if the study findings could also be true for other allergenic foods.

“Delaying the introduction of egg to infants is unlikely to help prevent allergy and may be doing more harm than good” Dr Jennifer Koplin

HEART OF THE MATTER

IN AUSTRALIA MORE THAN 2,015 CHILDREN ARE BORN EACH YEAR WITH A HEART ABNORMALITY, WITH MANY REQUIRING COMPLEX SURGERY.



Mia, born with a heart abnormality, underwent a Fontan operation at The Royal Children's Hospital.

Separation of mother and baby at birth, invasive and painful medical procedures and hospitalisation for weeks may affect the critical mother-infant relationship.

Our team of social work, psychology, surgery and cardiology researchers explored the impact of surgery on 97 infants who had cardiac surgery in the first three months of life. Three-quarters of mothers reported that the surgery had impacted on their relationship with their baby, with 19% of mothers experiencing anxiety and fear two months after discharge. In addition, 30% experienced symptoms of postnatal depression one year later. Increased bonding problems were associated with prenatal diagnosis of the cardiac defect. High rates of feeding, sleeping and excessive crying problems in infants after discharge were found. Many mothers described negative impacts on siblings, and 14% of fathers had signs of depression.

For some mothers there were positive aspects — protective feelings, feeling that their baby was precious, that uninterrupted time in hospital led to a closer relationship, being less bothered by the trials of parenting a newborn. Further research is planned to pilot a psychosocial model of care focussing on the infant's emotional functioning, stress response and mental health, as well as family relationships.

A/Professor Brigid Jordan, Dr Candice Franich Ray, Professor Vicki Anderson, A/Professor Elisabeth Northam



Collaboration Around the World

INTERNATIONAL KAWASAKI DISEASE GENETICS CONSORTIUM

Australia, Singapore, The Netherlands, UK, USA, Spain, France, Italy, Canada, The Philippines

Kawasaki disease is a leading cause of heart disease acquired in childhood, with heart problems often persisting into adulthood. It is likely that Kawasaki disease is caused by an infection children are commonly exposed to, but which causes the condition in a genetically susceptible minority. The consortium is studying genetic factors in over 2,000 children with the disease, including publishing the first study to look at the whole genome in an infectious disease. Genes involved in the immune response to infection and cardiovascular health have been identified.

EVALUATION TOOLS FOR FUNCTIONAL ABILITY

Australia, Sweden

Occupational therapists on Campus are contributing to research and development of internationally accepted measurement tools. Our researchers, together with Karolinska Institute and La Trobe University, are developing the Baby Assisting Hand Assessment, for use with children aged 1.5–12 years with cerebral palsy or obstetric brachial plexus palsy who have a unilateral disability. In other work

with Karolinska, Campus clinicians have provided input to the development, testing and refinement of the Manual Ability Classification System, which assesses function, ability and movement in the upper limb for children with cerebral palsy. Recent research with La Trobe University has developed the Melbourne Assessment 2, which measures upper limb function of children aged 2.5–15 years with cerebral palsy.

ABORIGINAL CHILDHOOD INFECTION AND HEART DISEASE

Australia

Atherosclerosis, an inflammatory disease and the cause of heart attacks and stroke, may be linked to childhood infection. The Aboriginal Birth Cohort, established in 1987 by researchers from the Menzies School of Health Research, Darwin, is based on the principle that susceptibility to adult disease begins in utero and continues over the life course. This cohort with 686 members recruited from birth is now recognised as one of the longest and largest Indigenous cohorts in the world. Indigenous Australians have a high incidence of both childhood infection and cardiovascular disease. Our researchers are investigating the relationship between childhood infections and markers of atherosclerosis and cardiovascular health in members of this cohort now aged 20 years.



OUR RESEARCH GROUPS ARE STRUCTURED TO MAKE THE MOST OF INTERDISCIPLINARY AND MULTIDISCIPLINARY COLLABORATION ON CAMPUS. THEIR COLLABORATIONS EXTEND BEYOND PHYSICAL LOCATIONS ENABLING THEM TO PROGRESS FASTER THROUGH EACH RESEARCH STAGE BY ACCESSING KNOWLEDGE, SHARED RESOURCES, UNIQUE POPULATIONS, AND NEW CONCEPTS AND PERSPECTIVES. WE CURRENTLY WORK WITH RESEARCHERS FROM OVER 70 COUNTRIES AND HIGHLIGHT HERE A SELECTION OF OUR NATIONAL AND INTERNATIONAL COLLABORATIONS.

ALTERNATIVE PNEUMOCOCCAL VACCINATION SCHEDULES

Australia, Fiji, Singapore, UK, USA, Vietnam

Streptococcus pneumoniae is the most common cause of bacterial pneumonia in children worldwide. While a new generation of vaccines is available they are expensive and generally protect against the narrow range of serotypes prevalent in developed countries. Our researchers have been collaborating with international researchers and groups to determine the burden of pneumococcal disease in developing countries such as Fiji and to identify an optimal vaccination strategy suitable for these countries in terms of serotype coverage, flexibility, and affordability to protect children against this disease. The findings are contributing to a WHO review on optimal pneumococcal immunisation schedules.

LONGITUDINAL STUDY OF AUSTRALIAN CHILDREN

Australia

The Longitudinal Study of Australian Children is following the development of 10,000 children and families across Australia. Led by the Department of Families, Housing, Community Services and Indigenous Affairs with the involvement of other government departments and researchers from around Australia, the study commenced in 2004 with families with children aged zero to one years and four to five years.



We currently work with researchers from over 70 countries worldwide.

The multidisciplinary study is investigating the contribution of children's social, economic and cultural environments to their wellbeing. The study has already made major advances in identifying early intervention and prevention strategies to inform government policy. As the study children grow up, further valuable information about middle childhood and adolescence will be generated.

EARLY LIFE DISEASE DETERMINANTS

Australia

The Barwon Infant Study is an unselected birth cohort of 1,250 babies recruited antenatally from the Geelong region in collaboration with Barwon Health. The project aims to evaluate the early life determinants of immune, respiratory and cardiovascular systems through examination of the infant's modern environment. Biological samples and measurements from both mothers and babies, together with factors in the first year of life such as sunlight exposure, diet, sleep, illness history, antibiotic usage, and contact with microbes will be considered. A link between the impact of the modern environment on babies' physical development and the development of common health problems such as allergy, autoimmune disease, asthma and cardiovascular disease could provide an opportunity for future disease prevention.





INTERNATIONAL YOUTH DEVELOPMENT STUDY

Australia, USA

The International Youth Development Study is a longitudinal study of 5,769 students from Washington State (USA) and Victoria (Australia) recruited from grades five, seven and nine in 2002. The study examines whether or not differences in Australian and American cultures and schools affect youth development. Issues such as mental health, substance abuse, binge drinking, bullying, violence and other deleterious youth behaviour have been investigated. All Victorian participants were surveyed in 2010, with further surveys planned for 2012 and 2014 as part of the ongoing study. Collaborators include researchers from the University of Washington, Deakin University and the University of Queensland. The group has published extensively and has had a significant impact on community awareness and government policies on preventative approaches to problem youth behaviour.

PREMATURE BABIES AND DEVELOPMENTAL ABILITY

Australia

The Victorian Infant Collaborative Study, a State-wide group involving four major Victorian hospitals, has followed the progress of all extremely premature babies born in Victoria over three decades. While the survival rate of infants born at <28 weeks gestation or of extremely low birthweight has increased threefold, these children have more health problems in multiple areas than children born on time, and the rates of these problems are not improving. Several clinical trials designed to improve long-term health for these babies have shown some benefit, including giving magnesium sulphate to women likely to deliver before 30 weeks gestation, and giving caffeine to preterm babies in the early weeks after birth.



Networks

RESEARCHERS AT THE RCH CAMPUS HAVE BEEN INSTRUMENTAL IN LAUNCHING TWO NETWORKS TO BUILD CONNECTIONS BETWEEN RESEARCHERS, DISCIPLINES, ORGANISATIONS AND COUNTRIES, HELPING OUR BEST MINDS TO EXCHANGE IDEAS AND COLLABORATE FOR THE BENEFIT OF AUSTRALIA'S CHILDREN.

The Australian Paediatric Research Network (APRN)

launched in 2010 brings together 380 paediatricians keen to contribute to new research relevant to both public and private practice. Research priorities include optimal management of obesity, long-term outcomes of Attention Deficit Disorder and management of food allergy. The network builds research capacity by involving more clinicians in research activities and enhancing recruitment for community-based research projects.

“We have an exciting opportunity to improve the quality and quantity of research into common but chronic childhood illnesses managed outside of hospital settings.”

Dr Harriet Hiscock, Co-founder APRN

Paediatric Research in Emergency Departments International Collaborative (PREDICT)

is a research network established in 2004 of nine paediatric emergency departments and four large mixed emergency departments in Australia and New Zealand with combined annual visits of >450,000 children. The network is expanding its membership and is involved in several major national and international studies. PREDICT is addressing important clinical questions in paediatric emergency medicine and improving clinical care by establishing an evidence base. A/Professor Franz Babl, founding chair of PREDICT said, “While single centre studies can answer some questions, multicentre research is needed where there is a lack of evidence involving the severe end of the disease spectrum, as well as rare outcomes. Multicentre research has a higher likelihood of finding a more reliable answer to some questions and the findings are often more widely applicable than with single centre studies.”

Research Outputs at a Glance

Our research program, publications and competitive funding continue to grow year on year, enabling us to attract world-class researchers and students from around the globe.

Currently the RCH Campus has 70 research groups comprising more than 1,300 staff and students, many with double or triple appointments across the Campus partners. Our researchers are based predominantly at the Murdoch Childrens Research Institute, but also at RCH centres and departments and at The University of Melbourne and at Bio21 in Parkville.

The following pages highlight the research achievements on our Campus in 2010, encompassing competitive grant funding, commercialisation and IP activity, publications, clinical trials, and student completions.

External Research Funding

External funding from government funding bodies and other agencies is awarded following a rigorous selection process based on scientific quality and significance and applicant track record.

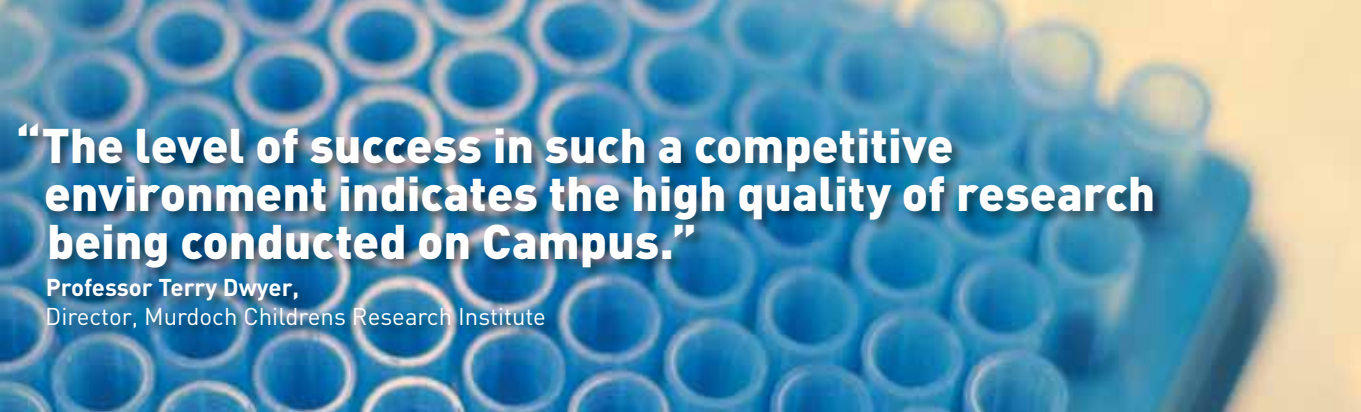
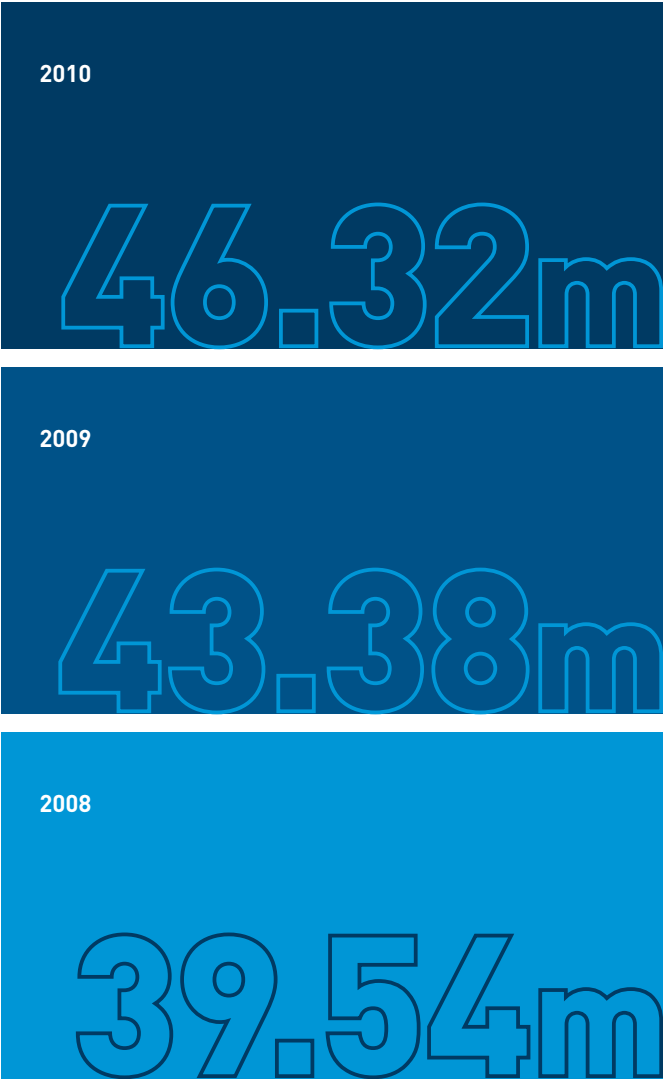
In addition to a wide range of internally funded projects, many of which have benefited from initial seed funding from donations and other philanthropic support, Campus researchers generated a marked increase in peer-reviewed competitive funding in 2010 for 2011 research initiatives. Our increase in competitive external grants awarded in 2010 during a climate of flat-line funding reflects the past successes of the Campus and the outstanding ability of its researchers. Our Campus received its largest-ever number of project grants from the National Health and Medical Research Council (NHMRC) in 2010 with 29 successful applications for projects starting in 2011.

In addition, 17 researchers were awarded NHMRC research and training fellowships. The total NHMRC funding received for projects, fellowships and scholarships at the RCH Campus in 2010 was \$28.8 million. Funding from the Australian Research Council (ARC) included three Discovery Project grants and a Future Fellowship – a total of \$0.8 million. The largest single project grant (\$2.2 million) awarded to a Murdoch Childrens Research Institute or The University of Melbourne researcher was received by a group led by Professor Julie Bines to develop a human neonatal rotavirus vaccine in Indonesia.

Other key projects include \$1.6 million to investigate food allergy in children led by A/Professor Katie Allen, \$1.5 million to study adolescent mental health and behaviour led by Professor George Patton, and \$1.3 million to examine the impact of low and moderate alcohol consumption during pregnancy led by A/Professor Jane Halliday.

Researchers from Austin Health and Professor Ingrid Scheffer of this Campus were awarded an NHMRC Program Grant worth \$16.45 million to investigate the neurobiology of epilepsy.

GOVERNMENT AND PEER-REVIEWED FUNDING (\$ millions)



“The level of success in such a competitive environment indicates the high quality of research being conducted on Campus.”

Professor Terry Dwyer,
Director, Murdoch Childrens Research Institute

FELLOWSHIPS AND AWARDS ANNOUNCED IN 2010, WITH FUNDING COMMENCING IN 2011

NHMRC Senior Research Fellowships
Professor John Bateman – Molecular mechanisms of inherited and acquired musculoskeletal disease
A/Professor Amanda Fosang – Cartilage biology in health and disease
Professor Andrew Giraud – Understanding and preventing inflammatory pathology of the gut
Professor Anne Louise Ponsonby – Role of early life environment in the development of immune function and allergic and autoimmune disease
NHMRC Practitioner Fellowship
Professor Ingrid Scheffer – Genetics of epilepsy
ARC Future Fellowship
Dr Craig Smith – Understanding gonadal development and disease using the avian embryo model system
NHMRC Career Development Awards
A/Professor Craig Fry – Ethical guidelines and resources for e-health research and practice
Dr John Heath – Genetic link between childhood leukaemia, parental age and other cancers occurring in family members
Dr Tim Silk – Genetic imaging: interactions of genotype and medication on attention in ADHD
Dr Louise Judd – Inflammation of the gastrointestinal gut
NHMRC Training Fellowships
Ms Jennifer Dawson – Using pulse oximetry to improve neonatal outcomes in the delivery room
Dr Paul Licciardi – Use of probiotics as pneumococcal vaccine adjuvants
Dr Jonathan Mynard – Assessment and prediction of blood flow in congenital aortic abnormalities
Dr Matthew Sabin – Improving the care of obese youth to minimise long-term burden of disease
Dr Freya Sheeran – Cellular metabolism and signalling in the paediatric heart
Dr Andrew Steer – Innovative control strategies for rheumatic heart disease and impetigo in the developing world
Dr Cong Sun – Lifecourse investigation of obesity and adverse cardiometabolic health outcomes
Dr Deanne Thompson – Understanding brain development in premature children
Cottrell Fellowship
Dr Fiona Russell – Assist in the establishment of the Research Institute of the National Hospital of Pediatrics, Hanoi, Vietnam

NHMRC SENIOR RESEARCH FELLOWSHIPS: prestigious awards for researchers conducting work of major significance. Recipients are generally in the top 10% of their field and are ‘pushing the boundaries’ of research. NHMRC PRACTITIONER FELLOWSHIPS: for high performing mid-career clinicians to maximise translation into policy or practice. Recipients are generally in the top 10% of their field of research. ARC FUTURE FELLOWSHIPS: prestigious awards for outstanding mid-career researchers to conduct their research in Australia in areas of critical national importance. NHMRC CAREER DEVELOPMENT AWARDS: for outstanding early career researchers to develop their capacity for original independent research and research leadership. NHMRC TRAINING FELLOWSHIPS: for researchers of outstanding ability to undertake further research training. COTTRELL FELLOWSHIP: for Fellows or Advanced Trainees of the RACP for research or training relating to Asia Pacific.

Commercialisation

NEW INVENTION DISCLOSURES

5

NEW PROVISIONAL PATENTS

7

NEW INTERNATIONAL
PATENT APPLICATIONS

10

Translational research has the potential to drive the advancement of findings in laboratory and clinical research more quickly and efficiently into medical practice.

Our aim is to improve care, enhance diagnoses, offer safer techniques and develop more targeted therapies resulting in meaningful physical, mental and social outcomes. The Commercial Translation office based at the Murdoch Childrens Research Institute and The University of Melbourne Commercial Ltd support investigators to protect their clinical, public health and commercial outcomes through appropriate patenting and commercialisation.

Our commercialisation activities include assisting researchers with product development plans and assessing new opportunities for commercial viability, market potential, competitors, patent and prior art searches, as well as determining threats and risks.

In 2010, we assisted researchers in the top five ranked priority projects on Campus to secure funding to develop the commercial potential of their research.

The Murdoch Childrens Research Institute has a portfolio of 18 patent families with four patents granted in 2010 and The University of Melbourne Commercial Ltd has one patent family on Campus. These patents cover a wide range of clinical and basic science research including: (i) a method for treating inflammatory based diseases; (ii) a device for treating constipation; (iii) a method for determining male/female status in birds; (iv) a rotavirus vaccine currently in phase I clinical trials, with phase II clinical trials to start in New Zealand and Indonesia in 2011; (v) a new diagnostic test for fragile X syndrome; and (vi) work on dental caries prevention.

Innovation is only achieved when the idea has been translated into community health benefits.

Commercialisation Activities	2008	2009	2010
Invention disclosures	6	5	5
New provisional patent applications	6	7	7
New and pre-existing PCT applications and individual jurisdictions – unlicensed	55	57	47

A patent family can include a number of patent applications filed in different jurisdictions or countries.

Publications



Research on the RCH Campus covers a broad spectrum of laboratory science, clinical and population health studies.

Our success in previous years of gaining competitive peer-reviewed grants for new research initiatives has yielded an impressive growth in publications for 2010.

Our researchers published 819 peer-reviewed research papers, with almost 150 of these published in the most highly cited journals, some of which have manuscript rejection rates at around 95%.

Our research has been responsible for a number of significant health developments in 2010, transforming clinical care and informing preventative healthcare.

Publication highlights include the results of major randomised clinical trials, identification of genes responsible for childhood disorders, longitudinal studies on the psychosocial outcomes of children with early onset disease, early life disease determinants, and the results of intervention studies. These studies were published in high impact and competitive journals such as *Journal of the American Medical Association*, *Nature Genetics*, *Blood*, *The Lancet*, *British Medical Journal*, *Circulation*, *Psychological Bulletin*, *Proceedings of the National Academy of Sciences of the USA*, *Journal of Clinical Oncology*, *Gastroenterology* and *Diabetes Care*, demonstrating the calibre of research excellence on the RCH Campus.

PUBLICATIONS

Includes refereed journal articles and reviews only. Note 2010 publications include 74 allied health and nursing papers, whereas 2009 and 2008 data did not capture all of these publications.

2010

819

2009

684

2008

670

Clinical Trials

CLINICAL TRIALS PROVIDE THE BEST EVIDENCE FOR HOW CHILDREN SHOULD BE TREATED AND HELP PATIENTS BENEFIT FROM THE LATEST TREATMENTS, WHICH ULTIMATELY LEAD TO BETTER HEALTH OUTCOMES FOR ALL CHILDREN.



The RCH Campus has 113 clinical trials currently underway and registered with a public trials registry.

In 2010, 38 clinical trials were approved by the Royal Children's Hospital Human Research Ethics Committee, an increase from 2009, when 25 new trials were approved. A selection of our major randomised trials is presented.

PAEDIATRIC INTRAVENOUS FLUID MAINTENANCE

Hospitalised children who can't eat and drink sufficiently often require fluid through an intravenous line. Despite being one of the most common medical interventions, the evidence for the composition of this fluid is very poor. The fluid currently recommended contains about half the concentration of sodium that the blood in the body naturally contains. For some sick children, this fluid 'dilutes' the blood, causing the blood sodium level to drop quickly. This drop can be dangerous and, in rare cases, leads to neurological impairment and death.

This randomised controlled trial involving 640 children compares an intravenous fluid containing 140 mmol/L of sodium (approximately the same concentration as contained in the blood) with a fluid containing 77 mmol/L of sodium (the currently recommended fluid) for maintenance hydration. To date, approximately 270 patients have been recruited, with the study due to finish in late 2012. The results of this study are expected to have an immediate and widespread impact on the clinical care of children requiring intravenous fluid.

COMPARING REHYDRATION THERAPY IN BRONCHIOLITIS

Bronchiolitis is the leading cause of hospitalisation during the first year of life and is a major cause of morbidity and mortality. Fluid replacement therapy is required in about 30% of children admitted with bronchiolitis. Two techniques are currently used – nasogastric and intravenous – without adequate evidence to determine the optimal route as both have advantages and disadvantages. The primary aim of this multicentre randomised trial involving 750 children across seven hospital sites in Australia and New Zealand will investigate whether the type of fluid replacement affects the duration of hospital admission in children aged 2–12 months. Secondary outcomes are an evaluation of economic benefits, patient complications, the need for ICU admission, and parental satisfaction. Patient recruitment is expected to be completed after the 2011 winter season.

PANDEMIC FLU VACCINE EVALUATION PROGRAM

Children are a primary source of illness in pandemic influenza with more severe complications, hospitalisations and deaths from this virus than usually seen for seasonal influenza. A clinical trial assessed the appropriate dosage and safety of two doses of a 2009 influenza A (H1N1) or swine flu vaccine in 370 healthy children aged six months to nine years. This study found that one dose of vaccine rather than the usually recommended 2-dose regimen may be well tolerated and effective to protect infants and children and reduce transmission of the H1N1 virus. These findings had positive public health implications for disease protection and reduced transmission of pandemic H1N1 in the wider population. The data were crucial for vaccine registration by the TGA, and for the Australian Government's deployment of vaccine throughout the country. A phase III controlled trial recruiting 6,000 children internationally to test the latest H1N1 influenza vaccine commenced early in 2010 and followed children over the winter to evaluate protection against influenza infection, with results expected by end 2011.



Students

The Campus student body includes students undertaking research at undergraduate and postgraduate levels.

Masters and doctoral level research higher degree students make up the vast majority of our research student body. There is also a significant number of undergraduate students completing Science and Biomedical Science Honours programs or Advanced Medical Science projects. In 2010 there were 350 students completing research higher degrees or other research programs on Campus.

Twenty-seven students successfully completed their research higher degrees in 2010, and 64 students successfully completed undergraduate research programs. While the majority of students on the RCH Campus are enrolled through The University of Melbourne, a significant number of students are also enrolled through La Trobe University, Monash University and Deakin University.

The number and diversity of these students, with backgrounds ranging from medicine, nursing, speech pathology, physiotherapy, psychology, public health, counselling, education to biochemistry, cell biology and genetics adds to the research vibrancy of the Campus.

STUDENTS

350

HIGHER DEGREE
COMPLETIONS

27

UNDERGRADUATE
RESEARCH COMPLETIONS

64



STUDENT ACCOMPLISHMENTS

Dr Stephanie Bannister was awarded one of four Vienna International Postdoctoral Fellowships enabling her to continue her studies on genetic pathways for reproductive organ development at the Max F. Perutz Laboratories in Vienna.

Dr Denise Miles was awarded one of six prestigious Victoria Fellowships in recognition of her research into testicular cancer. The Fellowship, awarded by the Victorian Government to young researchers with leadership potential and to support translational research, allowed Dr Miles to undertake research at a world leading laboratory in the Netherlands on the genes she identified during her PhD studies. Dr Miles was also one of 16 Australian PhD students selected to attend the 60th Nobel Laureate meeting in Germany in 2010 to meet Nobel Prize winners.

Dr Fiona Newall was awarded a 2010 Dean's Award for Excellence in a Thesis from the Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne for her research exploring the pharmacokinetics and monitoring of unfractionated heparin therapy in children. Dr Newall created history at the University as the first laboratory-based PhD graduate in nursing. Her supervisors on Campus were Professors Paul Monagle and Linda Johnson, and Dr Vera Ignjatovic.

Dr Anna Price was awarded second place at the inaugural The University of Melbourne 3 Minute Thesis Competition Final. Graduate researchers were required to explain their research topic in accessible and engaging terms to a lay audience. Dr Price was one of nine finalists, and presented her research on 'Letting sleepy babies lie: long term effects of an infant sleep program'. Her supervisors on Campus were Dr Harriet Hiscock and Professor Melissa Wake.

Dr Andrew Steer was awarded a 2010 Dean's Award for Excellence in a Thesis from the Faculty of Medicine, Dentistry and Health Sciences, The University of Melbourne for his research exploring the epidemiology of group A streptococcal disease and rheumatic heart disease in children in Fiji. His supervisors on Campus were Professors Jonathan Carapetis and Kim Mulholland.

Training Future Leaders

“My return to the RCH Campus was motivated not only by the excellent research facilities, but also because of inspiring research mentors. I hope in turn to support young clinicians in establishing their own successful clinical research careers” Dr Andrew Steer



Dr Andrew Steer is a paediatrician and paediatric infectious diseases physician who made the commitment to research early in his career with the encouragement and support of three senior researchers on Campus: Professors Terry Nolan, John Carlin and Frank Shann.

He first ventured into research in 1997 as part of his Bachelor of Medical Science. This work established his research direction in paediatric infectious diseases and confirmed for him the important link between clinical care and research.

After completing his medical training, he undertook a US NIH-funded project in 2005–07 investigating the epidemiology of group A streptococcal disease and rheumatic heart disease in Fiji, for which he was awarded a PhD from The University of Melbourne in 2009 under the supervision of Professors Jonathan Carapetis and Kim Mulholland. He received a 2010 Dean’s Award for Excellence in a PhD Thesis for this work. Dr Steer then completed his specialist fellowship training in paediatric infectious diseases at the British Columbia Children’s Hospital, Vancouver, in 2008–10. He also holds a Masters of Public Health from the University of Newcastle.

Dr Steer returned to the RCH Campus in 2010 as Senior Research Fellow at the Centre for International Child Health,

Director of Advanced Paediatric Training at the RCH, and Honorary Research Fellow at Murdoch Childrens Research Institute. He also works as a paediatrician and infectious diseases physician at the RCH.

As Director of Advanced Paediatric Training, a new position created to provide leadership for our Advanced Trainees, Dr Steer is working with colleagues to embed the Trainees’ research component into a Campus-wide structure, supported by a formal mentoring system.

In 2010 Dr Steer was awarded an NHMRC/National Heart Foundation post-doctoral fellowship. His current research focuses on new ways to combat diseases caused by group A streptococcal disease, which is a major cause of death and disability particularly in developing countries and among Indigenous Australians.

Assistant Professor Denise Harrison has made an exceptional contribution to nursing practice and research since starting at the RCH 23 years ago. She worked in many roles in the neonatal unit including Associate Unit Manager and Clinical Nurse Educator, and piloted the Neonatal Nurse Practitioner role. She completed her PhD at The University of Melbourne’s School of Nursing in 2007, supervised by Professor Linda Johnston.

The supportive mentorship provided by Professor Johnston and also by Professor Graeme Barnes from this Campus was invaluable in guiding her research and career path.

“The training, support and mentorship I received throughout my Masters and PhD had a large impact on my success as a developing independent researcher”

A/Professor Denise Harrison

THE RCH CAMPUS ATTRACTS AND TRAINS OUTSTANDING STUDENTS IN A WIDE RANGE OF SCIENTIFIC DISCIPLINES, EMBEDDING THEM WITHIN A RICH RESEARCH AND CLINICAL COMMUNITY. THE STANDARD OF RESEARCH EXCELLENCE ON CAMPUS, THE DEPTH AND QUALITY OF THE TRAINING PROVIDED, THE MULTI-DISCIPLINARY COLLABORATIVE ENVIRONMENT, AND THE SKILLS AND KNOWLEDGE TRANSFERRED TO OUR STUDENTS IS AN INVESTMENT IN THE FUTURE HEALTH AND WELL-BEING OF CHILDREN. THE CAMPUS PARTNERS HAVE A LONG TRADITION OF MENTORING CLINICAL AND RESEARCH LEADERS AND WE ARE PROUD TO PROFILE HERE A SELECTION OF CAMPUS ALUMNI WHO EMBARKED ON THEIR RESEARCH AND CLINICAL CAREERS AT THE RCH CAMPUS AND WHO, AS EMERGING LEADERS, HAVE ALREADY HAD AN IMPACT NOT ONLY ON THIS CAMPUS BUT BEYOND.

A/Professor Harrison later took up a post-doctoral research fellowship at Toronto’s Hospital for Sick Children and the Lawrence S. Bloomberg Faculty of Nursing at the University of Toronto. She was recently appointed as the inaugural Research Chair in Nursing Care of Children, Youth and Their Families for the Children’s Hospital of Eastern Ontario and University of Ottawa.

She is currently Honorary Fellow at the Murdoch Childrens Research Institute and Senior Fellow at The University of Melbourne.

With expertise in pain management in babies, A/Professor Harrison spearheaded the neonatal nursing research agenda on Campus and more broadly beyond this Campus through planning, conducting and translating findings into clinical practice that has led to reducing pain in infants.

A/Professor Harrison is a mentor and role model who challenges her nursing colleagues to understand and use research to improve clinical practice. She was recently awarded the inaugural Neonatal Nurse Excellence Emerging Leader Award by the Australian College of Neonatal Nurses, is a past president of the Australian College of Neonatal Nurses and is currently Associate Editor of the *Neonatal Paediatric Child Health Nursing Journal*.



“Exposure to first class clinical and diagnostic services on Campus together with smiling children in the Campus cafeteria inspired me to focus my research on malaria, which is a major problem affecting millions of children around the world” Dr Alyssa Barry

Dr Alyssa Barry is a molecular epidemiologist using genetic techniques to investigate malaria transmission and naturally acquired immunity. The technical expertise she gained in Professor Andy Choo’s laboratory while undertaking her doctoral studies, combined with exposure on this Campus to real life problems provided a springboard to her future career in malaria research.

After completing her PhD in 1999 investigating the genomic structure of the first described human neocentromere, she underwent postdoctoral training at the University of Oxford, UK, and the New York University School of Medicine, USA. On returning to Australia in 2006 she joined the Burnet Institute as Senior Research Officer and then Senior Research Fellow.

Dr Barry is currently a Laboratory Head in the Immunity and Infection Division at the Walter and Eliza Hall Institute of Medical Research. She is also Adjunct Senior Lecturer at Monash University and a VESKI Innovation Fellow. She has published in *Nature Genetics*, *Science*, *Human Molecular Genetics* and other high impact journals, and leads a research team using genomic, bioinformatic and population genetic tools to understand malaria epidemiology.

Dr Barry has very fond memories of her training in the vibrant research and clinical environment of the RCH Campus, which gave her an opportunity to understand the importance of laboratory research leading to practical outcomes.

Ethics Committees

THE RCH CAMPUS IS COMMITTED TO RESEARCH BEING CONDUCTED TO THE HIGHEST ETHICAL STANDARDS, PROTECTING THE WELFARE OF PARTICIPANTS AND RESPECTING THEIR RIGHTS, SAFETY, CONFIDENTIALITY AND DIGNITY. RESEARCH CONDUCTED ON THE RCH CAMPUS MUST BE APPROVED BY THE APPROPRIATE CAMPUS ETHICS COMMITTEE PRIOR TO COMMENCEMENT.

HUMAN RESEARCH ETHICS COMMITTEE

A number of changes to the human ethics and governance review process on Campus were implemented in 2010, including a pre-submission peer review, a monitoring and auditing program and a risk-based review process. A new fast track process was introduced in 2010 where scientifically reviewed projects progress straight to ethical review. These changes have been reflected in a 15% decrease in the time to approval for new projects and 25% decrease for project modifications. In 2010 the Committee approved 245 new projects.

In 2010 the Victorian Government established a streamlined system for single ethical review of multisite clinical trials to improve the timeliness and efficiency required for ethical review, and to speed up product development and delivery of new research treatments to patients. With accreditation of the RCH Human Research Ethics Committee in 2010, Campus researchers can now submit multisite ethics applications using this new system.

ANIMAL ETHICS COMMITTEE

Activities of the Animal Ethics Committee in 2010 focussed on skills training for researchers working with animals. The new animal facility was completed in 2010 and will greatly enhance our research capabilities and complement our expanded increased research facilities in the new hospital. In particular the Animal Facility has greater space capacity and an improved environment for animals, and better staff facilities. In 2010 the Committee approved 19 new projects.

NEW PROJECT APPROVALS

HUMAN ETHICS

245

ANIMAL ETHICS

19

Campus Research Week

Campus Research Week — an initiative of the Campus Research Committee — was launched in 2010, showcasing our multidisciplinary and interdisciplinary research. The Week celebrated and recognized the depth and breadth of research, bringing together researchers and students of diverse interests, experience and skills. Exposure to such a wide range of presentations has already resulted in new research links both within the Campus and beyond.

Stories of research success and visions of what lies ahead were presented by our own Campus investigators. Invited speakers such as Professor Warwick Anderson, CEO of the NHMRC, Professor Fiona Stanley from Telethon Institute for Child Health, Professor Suellen Walker from UCL Institute of Child Health and A/Professor Denise Harrison, trained on this Campus, visiting from Toronto's Hospital for Sick Children, also shared their insights.

Campus Research Week is now an annual event based on the success of the 2010, with new sessions planned for 2011 covering Careers in Research, Beyond the Walls, and Campus Collaborations.

This initiative will be further supported in 2011 by Campus Education Week — an initiative of Campus Education Steering Committee — bringing together our staff with world-class educators and providing an opportunity to share best practice through presentations and practical workshops.

The inaugural Campus Research Report was also launched at Campus Research Week. This report presented for the first time the unified research vision and highlighted the joint achievements of the Campus partners.

The report was extremely well received and has already been used as an exemplar throughout The University of Melbourne as best practice for institutional collaboration.

THIS PAGE Micrograph of neural crest stem cells migrating and forming neuronal networks in cell culture. All stem cells are labelled green, with nuclei in blue. Red indicates nerve fibres of stem cells that have developed into nerve cells. Photo: Mr Lincon Stamp, Embryology Group and Department of Anatomy and Cell Biology, University of Melbourne.

The Royal Children's Hospital Campus

50 Flemington Road Parkville
Victoria 3052 Australia

MURDOCH CHILDRENS RESEARCH INSTITUTE

Telephone +61 3 8341 6200
www.mcric.edu.au

THE ROYAL CHILDREN'S HOSPITAL

Telephone + 61 3 9345 5522
www.rch.org.au

THE UNIVERSITY OF MELBOURNE DEPARTMENT OF PAEDIATRICS

Telephone +61 3 9345 4090
www.paediatrics.unimelb.edu.au