The Centre for Molecular and Medical Research (C-MMR) represents a collaboration between the School of Medicine in the Faculty of Health and the School of Life Environmental Sciences in the Faculty of Science, Engineering & Built Environment and extending to our key partners, Barwon Health and CSIRO(AAHL).

The C-MMR employs an interdisciplinary approach to research, using sophisticated cell and animal models, buttressed with molecular and clinical studies, including phenomic, metabolic and genomic analysis to investigate the molecular basis of health and disease.
Professor Ken Walder’s cutting edge research investigating how genome-wide gene expression profiling can be used in drug discovery has been acknowledged with the award of an NH&MRC Project Grant which commenced in 2015. The project focuses on the discovery of new drugs for bipolar disorder, and was developed in collaboration with Professor Michael Berk (IMPACT), Prof Craig Olsson (Centre for Mental Health and Wellbeing Research), Professor Marion Leboyer (INSERM, Paris) and Professor Brian Dean (University of Melbourne).

The project will utilise technology developed by Prof. Walder to successfully repurpose a drug previously used to treat glaucoma as a new insulin sensitising agent with efficacy in patients with type 2 diabetes (Konstantopoulos N et al., Physiol Genomics, 2011, 43: 110-20; Konstantopoulos N et al., Diabetes, 2012, 61: 2146-54; Simpson RW et al., Diabetes Care, 2014, 37:3121-3). In this project, the team will generate gene expression profiles from cultured human neuronal cells and rat brains treated with a cocktail of drugs currently used to treat bipolar disorder. Bayesian statistical analysis will identify a “Gene Expression Signature”, or ‘GES’, which best defines the overall effects of the drugs. The potential GES will then be refined using data from human post-mortem brains and peripheral blood mononuclear cells from patients with bipolar disorder to ensure that the final GES has relevance to human bipolar disorder. The GES will then be used to screen compound libraries to identify potential new drugs to treat bipolar disorder.

The project has also aroused interest from pharmaceutical companies including Janssen and Pfizer, who are interested in the possibility of screening some of their proprietary compounds using this technology to identify potential new drugs for bipolar disorder.

Fellow at the National Institutes of Health, Phoenix, Arizona, he returned to Deakin as Deputy Director, and later was appointed Director, of the Metabolic Research Unit. In 2011, Prof. Walder became the Chair of Metabolic Diseases in the School of Medicine. In addition to acting as the School of Medicine HDR Co-ordinator and serving on numerous committees at School, Faculty and University levels, he is a Theme Leader (Metabolic and Musculoskeletal Research) and Executive Member of the Centre for Molecular and Medical Research.
Reflecting its growing global influence, C-MMR has hosted two prestigious Endeavour Fellows. These are part of the Endeavour Awards, a globally-competitive, merit-based scholarship program funded by the Federal Government providing opportunities for high achieving individuals to increase their skills and enhance their global awareness by undertaking study, research and professional development in Australia.

Vidhula Ahire received her PhD in Basic Medical Science (Molecular Radiation Biology) under the supervision of Dr. KP. Mishra and Dr. Kulkarni, for a project that investigated the role of a herbal compound as an antioxidant, leading to the induction of oxidative stress in tumor cells that subsequently underwent apoptosis. This work was carried out as part of a collaboration involving University of Pune and India’s most renowned research laboratory RBHSD, Bhabha Atomic Research Center. Vidhula is currently an Endeavour Post-Doctoral Fellow with Prof. Leigh Ackland, the Director of the Center for Cellular and Molecular Biology. Her project focuses on understanding the contribution of the tumor microenvironment to breast and neuroendocrine cancers. Often the tumor microenvironment is well-defined at the invasive stage as delineated by specific tumour biomarkers. However, this work aims to understand what markers exist at the initial stage of tumor development and whether they have potential for use in diagnosis and prognosis. This project also utilizes a breast cell culture model system, PMC42, investigating the role that endothelial cells of the vasculature (cultured HUVEC cells) have on migration and invasion of PMC42 cells and how this endothelial cell microenvironment could mediate epithelial to mesenchymal transition via analysis of an array of protein biomarkers found at various stages of tumor progression, invasion and metastasis.

Daniel Dlugolenski is completing his PhD under the supervision of Prof. Ralph Tripp at the University of Georgia with a thesis focused on elucidating mechanisms of influenza reassortment and pathogenicity. Daniel recently completed an Endeavour Fellowship under the direction of A/Prof. John Stambas and Prof. Alister Ward while based at CSIRO AAHL. His research project aimed to contribute to the development of therapeutics against highly pathogenic avian influenza (HPAI) viruses. HPAI causes a highly contagious systemic disease in poultry, leading to decimation of poultry farms affected, with the only current way to mitigate a disaster being through culling. Human infections of HPAI have been limited but with increased numbers of poultry outbreaks the zoonotic potential of HPAI is also increased. His project sought to use miRNAs to generate self-adjuvanting vaccines to increase influenza vaccine production in ovo and generate a more robust antibody response to increase vaccine efficacy. This research used reverse genetics to develop influenza viruses expressing miR-29b, which have been characterized for their viral replication to underpin the enhanced generation of vaccines, necessary to provide an effective means for preventing the spread and dissemination of HPAI viruses in the wake of an outbreak, benefitting both human health and the poultry industry. Daniel also completed research on Hendra virus, as well as presenting his research at several leading research institutes.
Background

Dr Michael Cater is a Movember Young Investigator and heads the Metals in Medicine Laboratory within the Centre for Cellular and Molecular Biology (CCMB). Michael’s career focus in metals has expanded into the fields of general physiology, neuroscience and cancer research. Michael completed his PhD at Deakin University (2005) investigating metal-homeostatic mechanisms in the body, under the supervision of geneticist Prof. Julian Mercer. This research focused on determining the molecular basis behind the hepatic copper accumulation seen in Wilson’s disease patients. He continued to pursue metals research into his first post-doc position at the Mental Health Research Institute (MHRI) (University of Melbourne), but in relation to Alzheimer’s disease treatment and neuronal function. This position provided invaluable exposure to pharmacological studies, testing metal-based compounds as an intervention for Alzheimer’s disease. While at MHRI, Michael realized the potential for copper-based compounds to be used in the treatment of cancer. He therefore switched research focus to the cancer field and relocated to the Peter MacCallum Cancer Centre in 2010. Michael was the recipient of a prestigious NHMRC Biomedical Training Fellowship and more recently was awarded as CI-A an NHMRC Project Grant, a Prostate Cancer Foundation of Australia (PCFA) grant and several philanthropic grants (e.g. CASS). In 2013, Michael established his research group, the Metals in Medicine Laboratory at CCMB, which has now grown to include a post-doc, 3 PhD students and one Honours student. He is also an Honorary Fellow at the University of Melbourne (Department of Pathology).

Current research interests

Copper-ionophores as a treatment for cancer?
Elevated copper in both malignant tissue and serum is emerging as a genuine ‘universal feature’ of certain cancers. This research builds upon our discovery that copper-ionophores can selectively target and rapidly destroy cancerous cells without harming primary (normal) cells. An ionophore transports specific metal(s) into cells often allowing them to become bioavailable. We are evaluating the therapeutic potential of copper-ionophores in the treatment of mouse models of human cancer.

Can copper be used to selectively kill prostate cancer cells?
The primary aim of this research is to understand the cellular mechanisms and pathways leading to copper accumulation and copper-ionophore sensitivity in prostate cancer. We hypothesize that: (i) cancerous prostate cells accumulate intracellular copper early during their development; (ii) aberrations in the expression profile of copper-homeostasis proteins underpins copper accumulation and (iii) our custom-made copper-ionophores can selectively and effectively kill actual human prostate cancer tissue.

Investigating metal aberrations in senescence: from basic science to therapeutic enquiry.
We are also developing molecular approaches to exploit metal aberrations to selectively target and destroy senescent cells without harming primary (normal) cells. The main aims of this research are to understand the cellular mechanisms and pathways leading to divergent metal accumulation during senescence and to evaluate metal-complexes as selective therapies for the clearance of senescent cells and hence mitigate age-related pathologies.

Recent key publications:


Background
Peter is a paediatrician at the University Hospital Geelong and has recently been appointed as an Associate Professor in the Deakin University School of Medicine. His research is focused on identifying and modifying factors in the modern environment and lifestyle associated with early life immune dysregulation and related diseases. He endeavours to place mechanistic, laboratory-based studies in a population-based epidemiological framework. Peter founded the Child Health Research Unit at Barwon Health (CHERUB) and has led the development and implementation of the Barwon Infant Study (BIS). BIS is a population derived birth cohort study (n = 1,074) designed to investigate the early life origins of a range of non-communicable diseases in the modern world. The BIS Cohort Profile has recently been published in the International Journal of Epidemiology (http://ije.oxfordjournals.org/content/early/2015/03/30/ije.dyv026.short).

Current research interests
BIS has been awarded over 4 million dollars in competitive grants, including 6 NHMRC Project Grants and 1 NHMRC Partnership Grant. The most recent of these, awarded in 2014, was entitled ‘Maternal and infant and dietary intake of fermentable fibre, the gut microbiome and its metabolites, and asthma and allergy.’ This study will provide the first systematic investigation of the hypotheses that the epidemic of allergic disease and asthma via changes in the large bowel microbiome and the production of short chain fatty acids (SCFAs), which in turn, have clearly delineated effects on the local and systemic immune system. BIS is uniquely suited to address the relevance of these findings to humans. It is the only population-derived birth cohort study in the world to combine: (a) detailed maternal and infant dietary data, (b) collection of fecal and blood samples at regular intervals during the antenatal and postnatal periods (c) determination of food allergy status by formal food challenge (the gold standard measure), and (d) measurement of lung function (and respiratory health) during early infancy and childhood. Epidemiological associations will be investigated in the complete BIS cohort, and underlying biological mechanisms will be investigated in nested case-cohort studies. A world-class multidisciplinary team has been assembled to conduct this investigation, and the outcomes are likely to be of substantial public importance.

Recent key publications:


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A world-class medical research grouping with a unique research profile that will enhance Deakin’s reputation nationally and internationally