2015-2016 Summer Research Projects
Project 1: Histomorphometry of the human aorta with age

SUPERVISORS: PROF ALBERTO AVOLIO AND DR MARK BUTLIN

DEPARTMENT: BIOMEDICAL SCIENCES

SUBJECT AREA: VASCULAR SCIENCE AND CARDIOLOGY

The composition and arrangement of components within the large arteries of the body changes with age and contributes to high blood pressure and cardiovascular disease. Understanding how the composition and structure of these arteries changes will help us understand the development of these diseases. This project involves a detailed analysis of the structure of human arteries to quantify age related changes. This is possible as we hold a unique physical data base of human aorta samples across a range of ages. The study involves quantitative morphometry measurements of prepared aortic slices to correlate these with the physical attributes of those arteries.

Contact: alberto.avolio@mq.edu.au or mark.butlin@mq.edu.au

Project 2: A comparison of commercial biomedical devices measuring arterial stiffness

SUPERVISORS: PROF ALBERTO AVOLIO AND DR MARK BUTLIN

DEPARTMENT: BIOMEDICAL SCIENCES

SUBJECT AREA: VASCULAR SCIENCE AND CARDIOLOGY

Arterial stiffness is now recognised as an important clinical marker of the development of cardiovascular disease. In response to this, an increasing number of biomedical companies are introducing new devices on the market to measure arterial stiffness. Devices use different techniques to measure arterial stiffness. We wish to compare a new device against a gold standard approach of measuring arterial stiffness under a range of conditions. This would involve taking blood pressure and arterial stiffness measurements in a group of people under different cardiovascular states (normal blood pressure, and an induced increase or decrease in blood pressure).

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Project 3: How accurate are automatic blood pressure monitors? Do measurement errors cost lives?

SUPERVISORS: DR MARTIN TURNER AND PROF ALBERT AVOLIO
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: VASCULAR SCIENCE AND CARDIOLOGY

High blood pressure is the biggest single cause of death in the developed world. Use of automatic oscillometric sphygmomanometers (sphygs) is increasing as mercury sphygs are phased out. Oscillometric sphygs use empirical, proprietary software to estimate systolic and diastolic blood pressures from heart-induced pulsations in the cuff as it deflates. The algorithms often do not estimate blood pressure accurately. A number of protocols have been developed for validating oscillometric sphygs experimentally against human experts using mercury sphygs. Validation studies are performed using 30-90 human volunteers with a wide range of blood pressures. Many validations are published in peer-reviewed literature and Bland-Altman plots of differences between automatic and manual measurements are readily available. In this project we propose to review several validation studies and digitise the errors in oscillometric sphygs to facilitate statistical analysis. We will calculate an aggregated histogram of blood pressure measurement errors representative of most validated oscillometric sphygs. This analysis will facilitate estimation of the effects of measurement errors by validated oscillometric sphygs on the detection and treatment of high blood pressure in the population.

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Project 4: Modulators of melanoma cell sensitivity to therapy

SUPERVISORS: PROF HELEN RIZOS
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: CANCER TREATMENT AND DETECTION

INTRODUCTION: Patients with advanced melanoma show overall survival benefit when treated with selective kinase inhibitors or immunotherapies. Despite this activity, 50% of patients treated with kinase inhibitors develop disease progression within seven months, and 50% of patients treated with immunotherapies will not respond. This project will examine biomarkers that may predict patient response and provide a rational choice of therapy combinations for better treatment of melanoma.

AIM: Examine the role of pre-existing gene mutations in melanoma responses to selective kinase inhibitors and immunotherapies

RESEARCH: A series of gene variants will be introduced into a series of melanoma cell lines. The effect of these genes on the proliferation, migration, signaling and survival of cells exposed to selective inhibitors will be explored. Methods include western immunoblotting, FLOW cytometry, viability assays, DNA cloning and mammalian cell culture.

EXPECTED OUTCOMES: Genetic alterations identified in pre-therapy melanomas can modulate initial responses to therapies. Identification of genetic modulators can be used to predict patient responses and determine optimum first line therapies.

Contact: helen.rizos@mq.edu.au or 9850 2762
Project 5: Connectomic mapping of neurons that control breathing

SUPERVISORS: DR SIMON MCMULLAN
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: NEUROSCIENCE, RESPIRATORY PHYSIOLOGY

In this project we will use a combination of recombinant viral vectors, fluorescence imaging and 3d reconstruction to map the distribution of neurons in the rat brain that control breathing. Candidates will get an opportunity to assist with small animal surgery, perform immunohistochemistry, and use state of the art imaging and computer aided neurocartography to reconstruct respiratory circuits in the brainstem. Please arrange an interview to discuss the details of this project.

Contact: simon.mcmullan@mq.edu.au

Project 6: Are mitochondria changed in hypertension?

SUPERVISORS: A/PROF ANN GOODCHILD AND PROF JACQUELINE PHILLIPS
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: NEUROBIOLOGY OF VITAL SYSTEMS

A large amount of energy is required to maintain the activity of neurons in the central nervous system. Mitochondria provide the energy for neurons as the brain has very low levels of stored energy and are highly dynamic structures. Mitochondrial dynamics are regulated by many processes and change in response to physiological challenge. There is some evidence to suggest that mitochondrial dysfunction, possibly due to hypoxia in brain regions important in cardiovascular control, may contribute to hypertension (high blood pressure). In this project we will study two different forms of hypertension using a rat model of renovascular hypertension, the Lewis polycystic kidney disease rat and a rat model of essential hypertension, the spontaneously hypertensive rat and compare finding to the control rat strains Lewis and Sprague Dawley which have normal levels of blood pressure. The objective of the study will be to investigate mitochondria in two regions of the brain important in the control of blood pressure: the rostral ventrolateral medulla and the paraventricular nucleus. The study will entail investigating the distribution, number and morphology of mitochondria using immunohistochemistry, microscopy and sophisticated imaging techniques.

Contact: ann.goodchild@mq.edu.au
Project 7: DECT in orthopaedic applications

SUPERVISORS: A/PROF RICHARD APPLEYARD AND DR DANÈ TURNER
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: ORTHOPAEDIC BIOMECHANICS

Conventional computed tomography (CT) has played an important role in orthopaedics; however, due to its use of polychromatic x-ray beams, it is prone to metal-induced artefacts. Dual Energy CT (DECT) uses 2 energy spectra to scan and then reconstruct into monochromatic images, which at higher energy levels have shown to reduce metal artefacts.

This project will involve scanning and analysing a variety of different orthopaedic metals in a variety of configurations, to better understand how images are prone to metal artefacts.

This project is suited to a Mechanical Engineering student.

Contact: richard.appleyard@mq.edu.au and/or daneh.turner@mq.edu.au

Project 8: Automation of Data Presentation From Gait Analysis

SUPERVISORS: A/PROF RICHARD APPLEYARD AND DR DANÈ TURNER
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: ORTHOPAEDIC BIOMECHANICS

Gait analysis is commonly used to better understand the biomechanics of the musculoskeletal system. Optical markers are placed on specific sites of the body and patients are asked to undergo different physical movements. Cameras collect three-dimensional motion of the markers, which provide information regarding the person’s kinematics. This study will use gait analysis data to calculate the joint angles, moments and forces using the OpenSim software. This project also has the option for writing a program to automate data analysis.

This project is suited to a Mechanical or Software Engineering student.

Contact: richard.appleyard@mq.edu.au and/or daneh.turner@mq.edu.au
Project 9: Knee Kinematics Modelling

SUPERVISORS: A/PROF RICHARD APPELYARD AND DR DANÈ TURNER
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: ORTHOPAEDIC BIOMECHANICS

Total knee replacements are designed to best mimic the intact knee kinematics. However, there is still contention over the ideal implant design. This study will involve finite element (FE) modelling of a total knee replacement in order to better understand factors affecting the motion of a knee joint with a total knee implant.

This project is suited to a Mechanical Engineering student

Contact: richard.appleyard@mq.edu.au and/or daneh.turner@mq.edu.au

Project 10: Understanding Current Pathways in Microelectrode Arrays for use in Electrical Stimulation

SUPERVISORS: A/PROF RICHARD APPELYARD AND DR DANÈ TURNER
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: ORTHOPAEDIC BIOMECHANICS

Electrical stimulation has been used effectively for many years to treat many debilitating diseases and conditions. The technology has been applied to many applications such as: cochlear implants for hearing loss, spinal cord stimulation for pain relief, deep brain stimulation for Parkinson’s disease and bionic eye for blindness.

A major impediment to better clinical performance of such devices is a limited number of stimulating electrodes. A recent generation of neurostimulating devices improves efficiency through construction of “virtual electrodes” i.e. simultaneous use of multiple electrical contacts to modulate electrical field in locations where physical electrodes are absent. This methodology has offered limited benefits due to lack of understanding how the electrical current from multiple sources affects target tissue.

This project will involve using finite element modelling to analyse different electrode configurations.

This project is suited to an Electrical Engineering student.

Contact: richard.appleyard@mq.edu.au and/or daneh.turner@mq.edu.au
Project 11: Arteriovenous Malformation (AVM), a Computational Study

SUPERVISORS: PROF ITSU SEN
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: BIOMECHANICS

Arteriovenous Malfunction denotes a tangle in the blood vessels where the blood from the arteries is bypassed to the veins. This can happen in the brain leading to what are called Brain AVMs. The consequences of AVM could be intracranial haemorrhage, seizures, headache and difficulty with movement, speech and vision. There is also a 25% chance of brain damage and stroke.

The flow of blood from arteries to veins, bypassing the intervening capillary network, occurs because of the fistulous connections established. Though the medical community is trying to gain an understanding of the AVMs many fundamental questions remain unanswered. One of these is - when does a clinically silent lesion declare its presence? Is it by haemorrhage? Or is it by a neurological manifestation suggestive of deprivation of blood to normal areas of brain (called Steal Phenomenon)?

It is observed that the consequences of AVM cannot be explained adequately in terms of pressures and flow rates alone. Sizes of fistulas seem to have considerable influence, which are not easily determined.

It is proposed to search for answers to these questions using the computational techniques. Available software ANSYS will be employed for the purpose. Participating student will be using this software extensively.

The challenge exists in the generation of a suitable mesh for real patient geometries. Some modifications and simplifications of the geometry may have to be made. Application of the software then will generate vast amounts of data which are to be analysed.

The project will be an ideal one for any enterprising student who wishes to expand their learning experience into biomedical engineering.

Contact: yi.qian@mq.edu.au
Project 12: Surgical Training

SUPERVISORS: PROF ITSU SEN
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: BIOMECHANICS

Surgical training follows an ‘apprenticeship’ model that has been essentially unchanged for decades, if not centuries. Each trainee observes a senior surgeon: what the trainee learns, how they learn it, and how much practice they get, can vary significantly from one mentor or institution to another. The ultimate proof of surgical efficacy is in patient outcomes; however, trainees need feedback on their skill level before reaching this stage. Due to limits on the opportunities to perform surgeries (or surgical procedures) on live animals, human cadavers, or human patients, we propose an increasing the use of surgical simulation technologies. Surgical simulation technologies may be cheaper than other options, and do not face the same ethical concerns. Moreover, there is scope to rigorously measure each small detail of the trainee’s performance and provide both an overall ‘skill score’, along with specific and quantitative feedback on individual elements of the task. We propose that this objective and quantitative feedback will allow surgical trainees to learn faster, and perhaps reach a higher level of skill.

The project will be an ideal one for any enterprising student who wishes to learn data/signal measurement and analysis by using electric sensors and simulation technologies.

Contact: yi.qian@mq.edu.au
Project 13: Topical antimicrobial therapy for the treatment of chronic wounds: an in vitro study

SUPERVISORS: A/PROF KAREN VICKERY; DR HELEN HU AND DR SHAMAILA TAHIR

DEPARTMENT: BIOMEDICAL SCIENCES

SUBJECT AREA: ANTIBACTERIAL THERAPY

Chronic wounds are a growing cause of patient morbidity and contribute significantly to healthcare costs. In Australia it is estimated that 400,000 people suffer from chronic wounds at any one time with costs of wound management exceeding $3 billion annually. Infection contributes to non-healing but bacteria colonising chronic wounds are present as highly persistent, polymicrobial biofilms. Biofilm associated infections are rarely resolved by immune defences and are highly resistant to current systemic and topical antimicrobial therapies. Antimicrobial strategies targeting the organisation of the bacterial membrane bilayer directly are one of the most promising therapeutic approaches for the treatment of slow-growing/dormant biofilm infections. We will test Amphipathic medium chain (C8-C12) vicinal diols in our in vitro wound model in the presence of topical negative pressure wound therapy to determine if synergy exists between these 2 treatments and results in improved bacterial killing.

Contact: helen.hu@mq.edu.au or shamaila.tahir@students.mq.edu.au
Project 14: Study Protein phosphorylation in neurons in response to neuroprotective treatments

SUPERVISORS: PROF STUART GRAHAM AND DR VIVEK GUPTA
DEPARTMENT: BIOMEDICAL SCIENCES
SUBJECT AREA: OPHTHALMOLOGY AND VISION SCIENCES

Protein kinases and phosphatases work independently and in a balance to regulate the function of proteins. Reversible protein phosphorylation, principally on serine, threonine or tyrosine residues, is one of the most important and well-studied post-translational modifications. It plays critical roles in the regulation of many cellular processes including cell cycle, membrane excitability, neuronal secretory processes, cytoskeletal organization, neuronal morphology and signal transduction pathways. This project will involve comprehensive examination of the phosphorylation changes in various neuronal cells and tissues in response to pharmacological and gene therapy mediated neuroprotective treatments. Students will get exposure to a range of biochemical, cell biology and basic immunological techniques. This project will elucidate intricate functional relationships between many of the neuronal protein phosphorylation systems, which allow "cross-talk" between distinct pathways to take place in various brain and retinal cells.

Contact: stuart.graham@mq.edu.au or vivek.gupta@mq.edu.au
Project 15: Genetic and cellular biology studies of motor neuron disease (MND)

SUPERVISOR: A/PROF IAN BLAIR

DEPARTMENT: BIOMEDICAL SCIENCES

SUBJECT AREA: MOTOR NEURON DISEASE

The motor neurons are nerves that extend from the brain to the spinal cord and muscles and provide the stimulus through which we move, breathe, eat and drink. Unlike other cells of the body, motor neurons are not replaced when they die. Motor neuron disease (MND, also known as amyotrophic lateral sclerosis, ALS) is a rapidly progressive disease that causes the death of motor neurons leading to paralysis and death. MND is a devastating illness with appalling prognosis. Median survival is around two years. There is a desperate need to develop more effective diagnostic tools and treatments. The only proven causes of MND are gene mutations that lead to motor neuron death. Current insights have been insufficient to develop effective treatments in humans, despite the promise shown in existing animal models. Identification of the genes that cause or predispose to MND will lead to the unravelling of the underlying molecular mechanisms as a prerequisite to effective disease diagnosis, treatment and prevention. But known MND genes only account for 10% of cases. Our research aims to identify gene mutations that cause MND and investigate the biological effects of those mutations using cell biology techniques in the laboratory. We have found mutations in new disease genes among MND patients and work is now underway to determine how these mutations lead to motor neuron death.

The aim of this project is to use molecular, bioinformatic and cell biology techniques to identify and investigate gene mutations that cause MND.

Contact: ian.blair@mq.edu.au
Project 16: Genetic and cellular biology studies of motor neuron disease (MND)

SUPERVISOR: A/PROF JULIE ATKINS

DEPARTMENT: BIOMEDICAL SCIENCES

SUBJECT AREA: MOTOR NEURON DISEASE

Amyotrophic lateral sclerosis is a rapidly progressive and fatal neurodegenerative disorder which results in paralysis of voluntary muscles. While the cause of majority (95%) of ALS cases that arise sporadically remains unknown, about 10 % of ALS cases are inherited and caused by genetic mutations (familial ALS). However, similar to other neurodegenerative disorders, an important pathogenic feature of both sporadic and familial ALS, is protein misfolding and the accumulation of aggregated proteins in affected motor neurons. Chaperones are specialised proteins which correct misfolding in proteins, by facilitating their refolding into normal conformation. Protein disulphide isomerase (PDI) is an important molecular chaperone which aids the refolding of misfolded proteins. Our group has previously demonstrated that overexpression of PDI is protective against ALS-mutant protein and rescues ALS pathology. However, we also found that in disease, PDI is abnormally modified by S-nitrosylation and hence is functionally inactive, which would prevent its normal protective function. The aim of this project is to identify novel substrates and interacting proteins for PDI and other chaperones belonging to PDI protein family.

In this summer internship, the student will transfect SH-SY5Y human neuronal cells with DNA plasmids expressing PDI, ErP57 and ErP72 protein chaperones, collect the cell lysates and perform immunoprecipitation using respective antibodies to precipitate PDI, ErP57 and ErP72. Western blotting will then be performed to confirm the co-precipitation of these proteins with their known interacting proteins. After successful immunoprecipitation the samples would then be sent for Mass spectrometry analysis to identify novel interacting proteins of PDI, ErP57 and ErP72.

Outcome: This internship would provide the opportunity to learn important biochemical and cell biology techniques such as mammalian cell culture, DNA transfections, immunoprecipitation, SDS-PAGE and western blotting. This project would identify novel substrates for ALS disease linked molecular chaperones, which will help identify how these proteins are protective in ALS.

Contact: julie.atkins@mq.edu.au
Autism is a developmental and learning disorder that affects some 120,000 Australians from an early age, yet it is still poorly understood and difficult to diagnose and treat. Early intervention can greatly improve autistic children’s development, and so significantly reduce the massive social and economic burden of this mental illness globally. Hence, monitoring of healthy development in autism is of the utmost importance, and having a reliable prognostic biomarker would provide a means to monitor the condition and keep symptoms at bay.

Despite concrete evidence of serotonin’s involvement in autism and other psychiatric disorders, therapeutic targets remain modest. This is because serotonin is only a subset of the tryptophan metabolism that can be affected by the kynurenine pathway (KP) in autism, especially during inflammation. Recent discoveries by our team and others are giving a better understanding of the pivotal role played by the KP in psychiatric disorders such as depression, suicide and autism. This project therefore will focus on mapping the changes to the KP during progression of autism, using our expertise in this field. Our study of tryptophan metabolomics in this condition will reveal the complex interaction with environmental factors and provide new understanding of the pathogenesis of autism (Fig.1), working towards establishing a potential new therapeutic avenues.

**Project objectives:**

1. Determine the role of quinolinic acid excitotoxicity in autism using the 16p11.2 mutation as a model of impaired quinolinic acid degradation.

2. Test the efficacy of inhibiting quinolinic acid production and activity as a possible therapeutic regimen in autism.
Project tasks:

- Cell culture techniques to grow primary fibroblast derived from children with autism spectrum disorder and 16p11.2 mutation in comparison to healthy fibroblast.
- Characterize the KP profiles especially quinolinic acid in the 16p11.2 deletion in fibroblasts during physiological and patho-physiological (inflammatory) conditions.
- Determine the relation between quinolinic acid levels and excitotoxicity in the abnormal 16p11.2 fibroblast.
- Provide proof of concept to the use of NMDA antagonist to attenuate quinolinic acid-induced excitotoxicity as a potential novel therapeutic in 16p11.2 mutation.

Contact: gilles.guillemin@mq.edu.au
Project 18: Mobile App for People Recovering from Rotator Cuff Repair Surgery

SUPERVISOR: DR ANNIE LAU
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

Rotator cuff repair is a type of surgery that repairs a torn tendon in the shoulder. People need to wear a "sling" after this surgery but a majority of them develop complications after the sling is removed. Part of the reason is that people do not know how to look after their shoulder properly after the surgery.

In this study, we propose to design a mobile app that supports people during the recovery stage after their rotator cuff surgery. Throughout this project, students will have an opportunity to work with surgeons, nurses, surgical team members, and patients to find out the needs of the recovery process and to design the app.

Students will participate in the following activities and learn how to:

- Conduct an analysis of mobile apps on AppStore and GooglePlay, designed for people recovering from surgery, to identify their usefulness and design gaps.
- Interview surgical team members to understand the needs of the post-operative shoulder recovery process.
- Design a prototype of a mobile app for people recovering from rotator cuff repair, to help them adhere to the rehabilitation protocol and stay in touch with their healthcare team.

Prerequisites: Suitable for students studying health sciences, psychology, computer science, or other related disciplines, with interests in patient self-management, mobile apps and surgery. Experience in qualitative research, mobile app design and report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 19: Mining Electronic Health Records to Inform Patients about their Risks of Developing Complications after Surgery

SUPERVISOR: DR ANNIE LAU
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

When undergoing surgery, patients often do not have a true picture of the risks of experiencing adverse events during or after the operation. For example, what are their chances of acquiring an infection, or developing cardiac arrest, as a result of the operation? What are the chances such complications would require re-operation or re-admission?

In parallel, our healthcare system is increasingly using large-scale electronic health records to collect data and monitor its performance. Although trends and aggregated findings are being extracted from these records, surgeons rarely make use of this new source of information, and patients do not readily have access to it, and do not understand how known risks apply to them. This project investigates whether we can extract information from these large datasets in a way that is meaningful for patients. We will focus on surgical events, where we will examine the risks of developing complications, such as cardiac arrest, ICU admission, re-operation, re-admission, and death. Other adverse events will also be examined.

In this project, students will participate in the following activities:

- First-hand experience of analysing large-scale electronic health record data that is routinely collected in NSW hospitals.
- Conduct statistical analyses across multiple large-scale datasets.
- Write up a report, with an emphasis on presenting findings in a patient-friendly manner.

Prerequisites: Suitable for students studying statistics, computer science, or other related disciplines, with interests in large-scale data analysis and electronic health records. Experience in statistics, quantitative data analysis, data mining, or machine learning is essential.

Contact: annie.lau@mq.edu.au
Project 20: Surgical Informatics: what is the role of informatics for surgeons and their patients?

SUPERVISOR: DR ANNIE LAU

DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION

SUBJECT AREA: HEALTH INFORMATICS

Surgical practice, unlike other health specialties, has its own unique needs. Can advances in informatics help support surgeons and their patients?

Surgeons and patients have specific needs across different stages of surgical care (e.g. preoperative, during the operation, and post-operative). How can we assist surgeons and their patients across organ systems, procedures and practice types, and support their needs well and within the workflow of surgical practice?

This project involves reviewing the field of surgical informatics, the needs of surgical clinicians and patients, and the innovations and research gaps across the spectrum of surgical care. Students will have an opportunity to work with surgeons, nurses, other surgical team members and patients in this project.

In this project, students will participate in the following activities:

- Conduct a literature review on surgical informatics across the spectrum of surgical care (i.e. preoperative, during the operation, and post-operative), examining the needs the perspective of patients and the surgical team.
- Highlight gaps, innovations, and areas of research that need further investigation.
- Write up a brief report summarising the findings.

Prerequisites: Suitable for students from all disciplines with interests in patients, surgical practice, health informatics and innovations. Experience in report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 21: Mobile App for People with Type 1 Diabetes Mellitus who have Stopped Engaging with Health Services

SUPERVISOR: DR ANNIE LAU
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

People with type 1 diabetes mellitus (T1DM) have high needs to manage their condition. It is important for them to maintain contact with healthcare professionals. However, studies have shown many of them are not managing their condition properly nor being in regular contact with their healthcare team.

In this study, we propose to design a mobile app to support the needs of those with T1DM, who have stopped seeing their doctor, to stay aware of their condition and engage with their healthcare team at critical time points. Throughout the project, students will have an opportunity to work with a team of software engineers, medical doctors, and patients with T1DM.

In this project, students will participate in the following activities:

- Conduct an analysis of mobile apps on AppStore and GooglePlay, designed for people with type 1 diabetes mellitus, to identify their usefulness and design gaps.
- Design a prototype of a mobile app for people with T1DM, to help them manage their condition and stay in touch with their healthcare team.
- Conduct pilot study to elicit participants’ feedback to improve the app design.

Prerequisites: Suitable for students studying health sciences, psychology computer science, or other related disciplines, with interests in patient self-management, mobile apps and chronic diseases. Experience in qualitative research, mobile app design and report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 22: Can Social Networks Help us Become Healthier?

SUPERVISOR: DR ANNIE LAU
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

Studies have shown that social networks (e.g. friends, families) influence our health. In fact, past studies have shown that if we are surrounded by people who are overweight or obese, we are more likely to experience weight gain too. Can we ask our social networks to help us become healthier? How can we design mobile apps and social media applications that help us achieve our desirable health outcomes? This study will examine how we can achieve these aims.

In this project, students will participate in the following activities:

- Develop mobile apps that involve social network manipulation to help people achieve their ideal health status (e.g. body mass index)
- Learn about social network analysis, and mechanisms of social influence on health behaviours
- Examine how social media can be used in social network interventions for health
- Participate in pilot studies that involve quantitative and qualitative methods

Prerequisites: Suitable for students studying health sciences, psychology, computer science, or other related disciplines, with interests in social networks, social media, and diet/lifestyle management. Experience in qualitative research, quantitative research and report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 23: Investigating the Role of Competing Demands on our Health

SUPERVISOR: DR ANNIE LAU

DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION

SUBJECT AREA: HEALTH INFORMATICS

Studies have shown that patients with multiple health problems (e.g. diabetes, heart disease, mental health) are less likely to receive optimal health care. E.g. they are less likely to receive a timely diagnosis of breast cancer, and less likely to receive optimal care for their diabetes. Were our doctors too busy looking after our existing health problems that they have overlooked other health concerns? Were we too occupied with other life priorities that we have neglected our health and wellbeing? How does having other priorities in life pull us away from what we should be focusing on? This project investigates how competing demands affect our health actions and decisions.

In this project, students will participate in the following activities:

- Conduct a literature review on the role of competing demands from health analytics perspective.
- Analyse patient data to examine how competing priorities influence our health actions.
- Write up a brief report summarising the findings.

Prerequisites: Suitable for students studying statistics, health sciences, psychology, computer science, or other related disciplines, with interests in data analysis and health behaviours. Experience in data analysis and report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 24: Why are some systems more “sticky” than others?

SUPERVISOR: DR ANNIE LAU
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

Often we download mobile apps or visit websites but never use them again. Why is it that some apps/websites we use again and again, but some we tend to forget?

This project involves examining why some systems are more “sticky” than others. In particular, we will focus on the health and wellbeing domain, where we will examine how patients use e-Health systems across a range of health conditions (e.g. asthma, sexual health, mental health etc), identify which features are frequently used by patients, and which features are associated with positive health outcomes.

In this project, students will participate in the following activities:

- Conduct a review on attributes that make a website or an app useful and popular. Sources of the review will involve literature, website/app reviews, and statistical information on Google Play and AppStore.
- Analyse log usage to examine how patients use eHealth systems and identify which features are associated with positive health outcomes.
- Write up a brief report summarising the findings.

Prerequisites: Suitable for students studying computer science, statistics, or other related disciplines, with interests in data analysis, user behaviours and information systems. Experience in data analysis and report writing is recommended.

Contact: annie.lau@mq.edu.au
Project 25: Are publicly-funded clinical trials being published faster and in more accessible ways than other trials in Australia?

SUPERVISORS: DR ADAM DUNN AND PROF ENRICO COIERA
DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTH INFORMATICS

To make sure that the benefits of publicly-funded clinical trials are maximised, it is important that they are fully reported to the public, and that all of the results and data are made available for re-analysis and meta-analysis. Problems related to the slow, missing, or hidden publishing of clinical trial reports are often associated with the dishonest and unethical practices of the pharmaceutical industry and have to blame for the approval and slow withdrawal of unsafe drugs that have caused widespread harm. In this project, you will select a drug class or condition, and undertake a retrospective observational study of clinical trial registries (ANZCTR and ClinicalTrials.gov) and bibliographic databases to construct a “trial survival analysis”, and find out if the results of publicly-funded clinical trials undertaken in Australia are being made available to the public in a timely manner.

Prerequisites: Undergraduate statistics; experience with evidence-based medicine or clinical epidemiology would be highly regarded.

Contact: adam.dunn@mq.edu.au or enrico.coiera@mq.edu.au
**Project 26: Supporting patient management decisions using EHR-based predictive models**

**SUPERVISORS:** BLANCA GALLEGO; ANNE MILLER; YASHAR MAALI  
**DEPARTMENT:** AUSTRALIAN INSTITUTE OF HEALTH INNOVATION  
**SUBJECT AREA:** HEALTH INFORMATICS

Decision making about hospital patients’ level of care and length of stay is highly risky. Being able to identify and manage patients at high risk of death is an immediate and ongoing concern. Discharging patients too early can increase risks that unidentified emergent complications result in readmission when treatment is more complex. On the other hand, delayed discharges can expose patients to a range of hospital-acquired conditions such as pressure ulcers or drug-resistant infections. Currently there is very little support for physicians who must make these decisions. Predictive models may be used to support critical patient management decisions. Researchers at the AIHI have already developed a preliminary predictive model. However, the adoption and uptake of these technologies by clinicians has proved difficult. Little is known about how, when and where to integrate predictive models into clinical work, and how to represent predictive risk in ways that can be easily interpreted and support appropriate action.

The purposes of this project are to:
1) Improve our knowledge of hospital length of stay, readmission and death predictors by reviewing literature and by observing and interviewing clinicians.
2) Determine which role(s) and clinical decision-making points could be best targeted for presenting predictions about discharge date, readmission and death
3) Design and evaluate at least two predictive model presentation solutions. This will involve designing low-fidelity user interface (computer screen) designs that can be presented to and evaluated with representative users.

Students will: review the relevant literature; assist in developing and undertaking structured interviews; and/or participate in the design and evaluation of predictive model prototype representations using user-centered design approaches.

The student will acquire:
1) skills in qualitative data collection and analysis, and understanding about how qualitative research approaches fit into broader research and development initiatives;  
2) exposure to leading-edge Electronic Health Record development projects, especially as related to clinical decision support and predictive modeling;  
3) experience in the design of clinical decision support user interfaces from a user-centered design perspective;  
4) insight into the joys and difficulties of working with highly inter-disciplinary research and development teams.

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Project 27: Behaviour change for the detection and management of Lynch syndrome

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DEPARTMENT: AUSTRALIAN INSTITUTE OF HEALTH INNOVATION
SUBJECT AREA: HEALTHCARE RESILIENCE AND IMPLEMENTATION SCIENCE

Each year, approximately 15,000 Australians are diagnosed with bowel cancer, leading to 4,000-5,000 deaths. Although different things can contribute to bowel cancer development, one known cause is Lynch syndrome. Lynch syndrome is inherited through families and can cause various cancers, often at a young age. It is believed to affect tens-of-thousands of Australians, but is extremely underdiagnosed.

Cancer patients identified as being at high risk of Lynch syndrome can take a genetic test. This enables carriers to engage in effective screening protocols, detect and treat cancer early, and educate relatives. Early diagnosis is therefore critical to extending and saving lives. Yet of those NSW bowel cancer patients at high risk of Lynch syndrome, less than half are currently referred for genetic testing. Unidentified carriers remain unaware of their greater cancer risk or the need for ongoing screening. Relatives may also miss the opportunity to discover if they have Lynch syndrome. These delays in detecting and managing cancer may lead to loss of life.

Low referral rates for screening patients at high risk of Lynch syndrome are not unique to Australia, yet there is little research informing improvement in referral practices. Our project aims to address this unmet need and fix this problem. Using psychology and healthcare research evidence, we have developed and successfully tested a cost-effective method for helping healthcare professionals to improve their practice. We will use this method in NSW hospitals to assist healthcare professionals in overcoming barriers to referring high-risk Lynch syndrome patients, improve referral for genetic testing practices and, ultimately, increase cancer survival outcomes.

We are using the Theoretical Domains Framework Implementation (TDFI) approach in two NSW hospitals to: 1) form healthcare practitioner implementation teams and process map LS referrals; 2) conduct baseline audits of colorectal cancer surgery patients and LS genetic testing referrals to identify target behaviours for change; 3) use a validated questionnaire, and undertake TDFI-guided interviews/focus groups with healthcare practitioners to identify referral barriers (e.g., knowledge, environment/resources, memory, emotion); 4) co-design interventions with HCPs using evidence-based strategies to address key barriers; 5) co-implement interventions; 6) evaluate effectiveness using audit and questionnaire data to assess practice and culture change.

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Project 28: Do electronic discharge summaries improve medication information for high risk medicines?

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SUBJECT AREA: HEALTH SYSTEMS AND SAFETY RESEARCH

Being discharged from hospital to another facility or home carries with it many risks. In particular, changes to medication regimes during admission can lead to medication errors if the information is not conveyed in a timely and complete manner to patients, carers and clinicians. Discharge summaries contain all the required information about a patient’s admission, including medication, and are provided from the hospital to the patient’s general practitioner. Many hospitals are now implementing electronic discharge summary systems to facilitate this process. This study will build on our previous evaluation of medication information contained in electronic discharge summaries as compared with paper discharge summaries.

The aims are:

1. To examine the types of medications with incomplete orders in electronic vs. paper discharge summaries.
2. To examine which types of medications are more likely to have changes during admission explained in electronic vs. paper discharge summaries.
3. To examine whether electronic discharge summaries improved medication information for high risk medicines.

The study will involve using our existing dataset to:

- Code medications according to World Health Organisation’s Anatomical Therapeutic Chemical Classification System (ATC)
- Run basic frequencies and cross-tabulations using Excel or SPSS to examine patterns among individual medications, high risk medications, and therapeutic classes.

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