ISSN 1179-3597

ISSUE 25 | NOVEMBER 2017

NZMSJ

New Zealand Medical Student Journal
Te Hautaka o ngā Akongā Rongoā

SHOULD ALL DOCTORS BE ACADEMIC CLINICIANS?

The Medical Student Scientist and Academic

STUDENT PUBLICATIONS IN THE NEW ZEALAND MEDICAL STUDENT JOURNAL

Fourteen year analysis

BACHELOR OF MEDICAL SCIENCE (HONOURS)

Research Abstracts

HOW TO GET THE JOB YOU WANT

EDITORIALARTICLES EDUCATIONALARTICLES ACADEMICARTICLES FEATUREDPIECES REVIEWS

CONTENTS

NEW ZEALAND MEDICAL STUDENT JOURNAL

Thanks to:
University of Otago Medical School, University of Otago
Faculty of Medical and Health Sciences, University of Auckland
Royal Australasian College of Surgeons
Royal Australasian College of Physicians
Royal New Zealand College of General Practitioners
New Zealand Medical Journal
New Zealand Medical Association
MAS
Format Print

Editorial office:
Website: www.nzmsj.com
Email: nzmsj@nzmsj.com
Facebook: www.facebook.com/NZMSJ/
All other correspondence to: New Zealand Medical Student Journal
c/- Medical Education Group Dunedin school of Medicine
PO Box 56, Dunedin 9054, New Zealand

International Standard Serial Number: 1179-3597 (online) | 1176-5178 (print)

EDITOR'S WELCOME

Cheyaanthan Haran
Editor-in-Chief, NZMSJ

Aleksandra Turp
Deputy Editor, NZMSJ

Welcome to Issue 25 of the New Zealand Medical Student Journal (NZMSJ)! This issue delivers an exceptional calibre of articles from students and clinicians. The focus is on the clinician academic and scientist. We are grateful for the contribution of three prominent professors who are selflessly involved in the advancement of medical education via research, teaching and leadership.

Professor John Windsor, past chair of the Section of Academic Surgery, is an academic surgeon actively involved in improving the entire clinical academic workforce in New Zealand and Australia. He highlights the importance of obtaining foundations of research competency and explains why research should be thought of as being a practical aspect of surgery.

Professor David Murdoch, the Dean of the University of Otago, Christchurch and a clinical microbiologist, describes his fascinating path into research in the area of infectious diseases. He outlines some of the research opportunities that exist within medicine, in New Zealand and abroad, and encourages trainee doctors to become involved in research irrespective of whether they plan to make research a central part of their clinical duties.

Professor Felicity Goodyear-Smith, Head of the Department of General Practice and Primary Healthcare at Auckland University, writes about the relatively young area of academic general practice. She describes her unexpected path into academia and how grassroots research by a GP can practically benefit local and wider communities.

Although these three individuals work within very different areas of medicine and academia, they each convey the multitude of pathways into a career in medical research and highlight its numerous benefits. Indeed, research provides flexibility, variety, opportunity to travel and immense satisfaction for those who harbour intrinsic curiosity.

The Editorial Board invited a student perspective on this theme. Cam Bringans identifies how "Medical Student Scientists" have advanced medicine and why they should continue to do so. With the same twist, the NZMSJ editorial looks at the importance of addressing the clinician academic shortfall with "Medical Student Academics" and how a student journal, such as the NZMSJ, may play a role.

Original research conducted by Cameron Wells analyses the publication and editorial trends of the past 14 years of the NZMSJ; it is one of the longest-running peer-reviewed academic medical journals for students. Some students are unsure of the different research pathways and opportunities, and Ibrahim Al Busaidi aimed to address this in his review of academic opportunities currently available to New Zealand students. Leina Tucker-Masters examines the literature on anxiety and depression in Pacific Youth. Her submission is based on a summer studentship; this should be an encouragement for students with unpublished summer studentship projects. Cameron Castle, along with other final year medical students at the University of Otago, audits the glycaemic control in Otago children with type 1 diabetes. In two case reports, Dr Sarah Correa discusses the treatment for Lupus Nephritis, and Dr Maria Brand evaluates the clinical picture of typhoid fever in a returned traveller from Samoa. Finally, in a precedented first for the NZMSJ, we welcome the publication of all the Auckland Bachelor of Medical Science (Honours) abstracts – thank you Dr Ali Mirjalili. Congratulations to all the BMedSc(Hons) student researchers! Student readers will enjoy reading the fruitful academic and scientific work carried out by their peers. We look forward to submissions from the University of Otago programme in 2018.

The NZMSJ is an excellent avenue to disseminate medical education. Dr Azri Yasin discusses the clinical application and scientific principles of radiotherapy. As per improving student engagement and increasing the readership of the NZMSJ, Dr Sam Hazledine's invited article, 'How to get the job you want', highlights the essential considerations when preparing for a first job interview. Having children while studying for a medical degree is no easy feat, and Dr Tara King, mother of four, shares her personal experience and offers invaluable tips for getting through medical school. In the first of two conference reports, Roshit Bothara reflects on the International Association for Medical Education Europe Conference, and Karen Chung highlights the events at the 2017 New Zealand Medical Students; Association (NZMSA) conference in Tauranga. The media reviews section presents a thought-provoking review by Robin Page, Time to Care by Robin Youngson. Cam Bringans, in a combined book review, outlines the life of Neurosurgeon Henry Marsh in his recent two best sellers, Do No Harm and Admission. Finally, Ye Li reviews the Waikato Cardiothoracic Unit Mitral Valve Workshop, with her review 'How to Fix a Broken Heart'. We welcome the Issue 25 partnership with the NZMSA. NZMSA President, Kieran Bunn, outlines the fantastic work the association has undertaken in 2017 to unite, empower and represent the medical students of Aotearoa. Earlier this year it was raised that medical students need a forum to convey their creative writing skills and for the NZMSA to present a taonga when meeting with dignitaries. The NZMSA Creative Writing section in this issue highlights the talent of medical students.

On the journal front, in keeping with the changing landscape of medical publishing, the journal has pushed the international social media boundaries. It now has an engaging Twitter page, dynamic Facebook page and LinkedIn page that are interacting with national and international organisations; retweets by many including the EiC of the Medical Journal of Australia, Professor Nicholas Talley! NZMSJ, just like other mainstream international journals, has introduced Visual Abstracts to promote the academic and research work of students. Examples of our Visual abstracts can be found on the NZMSJ Twitter and Facebook pages. Finally, the journal editorial team has worked exceptionally well over the 2017 academic year, and via our new academic journal management system, Scholastica, the average submission to decision period is now at a record low of 27 days.

Finally, this issue would not have been possible without the academic mentorship and financial support from the University of Otago, University of Auckland, New Zealand Medical Journal and New Zealand Medical Association. We welcome a returning sponsor, Medical Assurance Society (MAS). They have been very supportive, and it is great to see them back the print copy of the journal for all students in New Zealand. We hope you find lots of interesting material to read in Issue 25, which will further your love for medical literature and research. Our final congratulations to the authors who have published for their very first time and to our returning authors.

My tenure as Editor-in-Chief of the New Zealand Medical Student Journal has ended. I would like to thank my fabulous team of reviewers, editors, designers and production staff for their excellent work and tireless commitment. And to our readers, it has been a joy to publish this journal, and I hope you enjoy reading it.

For more information about how to submit your work, see our website www.nzmsj.com/for-authors

EDITORIAL

The Medical Student Academic: Are Medical Student Journals an answer?

Cheyaanthan Haran
Editor-in-Chief, NZMSJ

Chey is a final year medical student at Auckland City Hospital. He has been an editor for the NZMSJ for the past eight issues. Next year, as an Advisory Board member, he aims to continue improving the standing of the NZMSJ.

The clinician academic brings a much needed research-focused approach to the diagnosis and management of patients. However, this breed of doctors is in danger. The National Institutes of Health Physician-Scientist Working Group found that only 1.5% of all physicians in 2012 reported research as their primary activity; a statistically significant decline since 2003 ($P<0.0001$).[1] Clinical academic training pathways such as the Academic Foundation Programme provided by the UK National Health Service (NHS), may help address the growing problem.[2] In New Zealand, sustainable training pathways are a possible solution, and some models already exist in a few Australasian institutions.[3] To tackle this problem earlier, the medical education needs to give birth to the "Medical Student Academic"; one who is actively involved in clinical work/study, research, teaching and leadership. Medical Student Journals (MSJs) may be an answer.

Where possible, students completing research should be encouraged to publish in international journals. Yet, only 33% of all BMedSc(Hons) theses and 32% of all summer studentships are published.[4,5] Students with unpublished research should consider submitting their work to MSJs. The New Zealand Medical Student Journal (NZMSJ), like most MSJs, aim to bridge students from writing for medical school to publishing in international journals, ultimately promoting academic research and publishing. The benefits of publishing in MSJs are well recognised, including but not limited to, improving academic writing skills and familiarising students with the submission and peer-review process. Most MSJs (including the NZMSJ) involve expert peer-reviewers, who are senior academics and clinicians to ensure only manuscripts to the highest standard are published. Research supervisors should encourage promising Medical Student Academics to publish in MSJs.

Apart from submitting and publishing in MSJs, involvement in MSJs, as a student peer-reviewer or editor may improve academic skills. Doctors are expected to critically evaluate the evidence behind medical practice, present at journal club meetings, actively peer-review colleague manuscripts or make manuscript decisions for international journals. The undergraduate medical curriculum now incorporates evidence-based practice and critical appraisal which is a fundamental skill for a practising doctor. At the University of Auckland, clinical students critically appraise research articles based on a self-formulated case-based clinical question.[6] Similar assignments, such as the Clinical Question Project, also exist at the University of Otago. Applying these skills to appraise and critique fellow student colleagues' submissions will further develop skills in critical appraisal and peer-review. Medical students need these skills sooner rather than later, and MSJs can facilitate earlier development.

Medical students have a rich diversity of backgrounds, and some students can share skills gained during academic training. Two current NZMSJ team members completed a PhD before starting their medical training, and one student is in the process of their MBChB-PhD programme at the University of Otago. Two students have completed a BMedSc(Hons) year while three students are near completion. Two student peer-reviewers will start their BMedSc(Hons) next year. Further, all NZMSJ student reviewers receive thorough guidelines and are sent the blinded reviews of other student and expert peer-reviewers. Some editors and reviewers are actively reviewing for international MSJs. NZMSJ editors report the experience they obtained as a student peer-reviewer has been incredibly useful when reviewing for mainstream international journals. Regardless of reviewing experience, MSJs are a supportive environment for the ambitious clinician academic. Just like most academic clinicians sit on multiple journals as peer-reviewers, Medical Student Academics should also peer-review for MSJs.

Being on the editorial board for an MSJ is no different to an international journal. In fact, small editorial teams manage MSJs. Apart from evaluating multiple reviews and making publication decisions on manuscripts, editors learn other valuable skills. They handle challenging administrative tasks, manage manuscripts through the peer-review process, engage in the commercial aspects of the journal, and liaise with the designer and printer. The involvement in an MSJ as an editor gives a better understanding of the number of gears involved in a large-scale international journal. After participation in an MSJ, stepping up to an editorship position in an international journal may provide contextual benefit.

MSJs provide students with opportunities to get involved in submitting, publishing, critical appraisal, peer review, and editorship. Early involvement in this area of academia may help medical students evolve into clinician academics. However, the real impact of an MSJ in today's undergraduate medical education needs more research. In New Zealand, is the NZMSJ a solution to increase the number of Clinician Academics?

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INVITED ARTICLE

Is an Academic Career for you?

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You probably have some important questions about your career. Like which clinical specialty best matches your interests and provides the best work-life balance? But I want to pose the question about what part research, teaching and leadership should play in your career. Medical school rightly focusses on preparing you for clinical practice, and while it looks to provide opportunities for those who want to develop an academic career, it is a road less travelled.

Medical students receive an outstanding science education from some of the best medical researchers in the country. Their scientific literacy is contextual and thorough, but often fades during the clinical years of medical school and can suffocate under the weight of administration during the early post-graduate years. For those doing vocational training in surgery there is a second bite at the cherry, an opportunity to sharpen scientific literacy with the entry Part 1 examination, but little of this is required for the exit Part 2 examination where the focus is on fitness for surgical practice.

The practice of surgery is becoming increasingly sophisticated. In writing about the relevance and rigor of medical education, Professor Julie Dienstag stated 'we should expect a high standard from our (trainees) who wish to pursue their career in an era in which genomics and informatics will revolutionise biomedical science and healthcare. To fulfil expectations, (training) needs to foster scholastic rigor, analytical thinking, quantitative assessment and analysis of complex systems in human biology. Our goal should be to help trainees acquire a different, more molecularly orientated and scientifically sophisticated knowledge base'.[1]

The purpose of this article is to promote your thinking about the possibility of an academic career. Please note that while I necessarily write from a surgical perspective, much of what follows is germane to all branches of medicine.

Oxymoron

It is not surprising that only 5-10% of graduates become 'clinical academics' or 'clinician scientists' given the rather inconsistent scientific training. While some of these medical graduates will end up in University employment, it is not always so. There are many examples of those who have made telling contributions to surgery from clinical practice. They too are clinical academics, although they may not be as comfortable with such a description. During my own surgical training the appellation 'academic' was often used in a pejorative manner, especially when applied to surgeons. It was said by some that an academic surgeon was someone who could not operate and was encouraged to do research. In 1996 the editor of The Lancet, Richard Horton referred to surgical research as an 'oxymoron'.[2] While there may have been some truth in that, there was also some prejudice which could be traced back to the days when surgeons were derided by physicians, trained on the streets rather than in the cloisters, craftsmen rather than intellectuals, gathering in guilds rather than Universities. Sir Robert Platt, Oxford University, expressed it this way back in 1963: 'Surgeons I suspect, see themselves in a setting of glamour, conquering disease by the bold strokes of sheer technical skill. Physicians quietly remember that they were educated gentlemen, centuries ago, when surgeons were tradesmen'.

What is an academic?

The term 'academic' needs to be unpacked. One dictionary states that an academic is someone who is 'theoretical, not practical, realistic or directly useful', and who is 'scholarly but lacking in worldliness, common sense or practicality'. No surgeon would want such a description, because practical skills and common-sense are essential to good surgical practice. And there is an important place for the 'theoretical' and the 'scholarly' in surgery. Academic surgery combines both academic rigor and surgical finesse, and are not mutually exclusive or an oxymoron (Figure 1).

Recognising some difficulties with the term 'academic', the Section of Academic Surgery in the RACS has provided a useful definition: 'an academic surgeon is somebody who has chosen to acquire specific training and experience in research and/or education and/or leadership, and to make this a significant part of their professional career'.[3] Note that being an academic surgeon is not determined by your employment contract or your place of work.

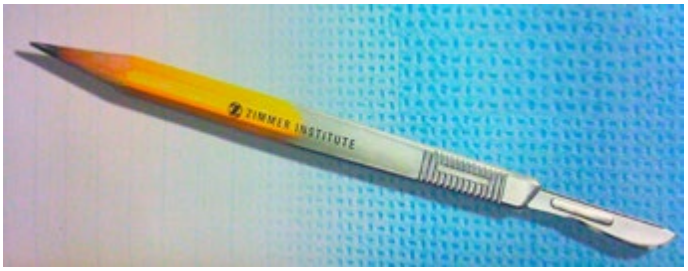

Figure 1. Academic surgery: the blending of academic rigor and surgical finesse

Intertwined elements

All of this might sound a bit dry, but it really isn't, for in practice a career in academic surgery is an exciting weave of four elements: clinical practice, research, teaching and leadership. These are about the application, acquisition, dissemination and continuance of surgical knowledge and skills, respectively. They comprise the ecosystem of academic surgery, sustaining it and taking it forward. The first, the application of evidence-based, cutting-edge surgical care (literally) is an exciting privilege. Within the daily practice of surgery there is the opportunity to challenge orthodoxy, introduce new approaches, shift boundaries and leave the process and results of care better than when we started. Reflecting on the daily practice of surgery highlights gaps in knowledge, historic assumptions, unanswered questions and areas where improved outcomes are needed. Often these questions arise from a sort of cognitive dissonance, where observations don't fit with our knowledge framework. Pausing to recognise this and then to frame a question or hypothesis is at the very heart of academic surgery.

Francis Moore, one of the doyens of academic surgery, said that 'the surgical investigator must be a bridge tender, channeling knowledge from biological science to the patient's bedside and back again. He traces his origins from both ends of the bridge'.[4] In this way, an academic surgeon needs to be bicultural and bilingual, understanding the culture and the language of both the clinical and scientific settings. She is able to shuttle

questions and potential answers in both directions, and thus contribute to the advancement of knowledge.

No two academic surgical careers are alike. The relative importance of the four elements of academic surgery differ between individuals and change through the years. For instance, during surgical training, the focus must be on gaining mastery of clinical surgery. During the middle years of busy clinical practice there are tremendous opportunities to help train the next generation of surgeons, spending more time on the other side of the operating table. While conducting studies and publishing is something that might wax and wane through an academic career, it is common to see this become a stronger element over time. With increasing experience and influence, more opportunities to make contributions through leadership occur in the second half of one's career. But not always.

Academic training

The knowledge, attitudes and skills of academic surgery are not an automatic by-product of surgical training. The Royal Australasian College of Surgeons was founded to promote two pillars – surgical training and surgical research.[5] Historically, it has done extremely well with the former, but it has been somewhat inconsistent with the latter. It recognises this now, and has defined 'scholar and teacher' within their competency framework, but this is a work in progress, seeking to improve our understanding of what this means and how best to train for these competencies. The RACS has largely devolved surgical training to the different Specialty Associations and Societies, and the requirements for research training during vocational training is quite variable between them. There is even less emphasis on gaining skills in surgical teaching and leadership. In the United States, the American Surgical Association report on Surgical Education raised concerns that 'research training in surgery is regarded almost as an afterthought, and that the surgical profession has not placed a premium on its development and support…and that it lacks structure, organisation and oversight that are so well developed in clinical training'.[6]

The motivation for doing research training varies from individual to individual. For the majority, it is about fulfilling a training requirement, ticking a box, and moving on. For the minority, it is the quest to acquire the range of skills that will allow them to be strong contributors through a combination of research, training and leadership. When it comes to research training, it is helpful to make a distinction between what is required for all future surgeons and what is required for the minority who embark on a career in academic surgery.[7] It is no different from anatomy, where all surgeons need a foundational knowledge of anatomy, but not all surgeons need to become academic anatomists. The foundational research competencies for all surgeons continue to be refined and are usually acquired through courses and research activities undertaken during training. A different approach is needed for those who are training to be academic surgeons. It is usual to take leave from their training program, for a period of full-time research training, often over a 3-year period, with the goal of attaining a PhD.

The timing of this full-time research training is the subject of some debate.[8] The advantages of doing a higher research degree during surgical training (rather than before it) are that you have secured your position in surgical training (which is, after all, the primary career objective), the specialty has been decided (making it possible to better match the research to your clinical interests), and the funding of the research is easier (because the RACS Foundation can help).

Embarking on full-time research training is a brave decision, and you will want to reduce any risks. Having some prior experience of research is important for you (so you know you want to do it) and for the University (so they know you can do it). The most important decision to be made is not in which University or Department you should do your research, but who you are going to be supervised by. Supervision is critical. Less important is the subject area of the research, because it is just as much about your development as a researcher as your contribution to the body of scientific knowledge. When thinking about the sort of research you might want to do, it is helpful to appreciate the breadth of surgical knowledge (and opportunity) and how it is acquired (Figure 2).

The focus of this article has been on those who might want to develop a career in academic surgery. Without people prepared to commit to such a career progress in surgery would be slow. Such a career requires careful planning and no little commitment. However, the training investment brings enormous opportunities for contribution and immense satisfaction throughout a professional career, where the balance of the elements might vary through different phases. When I was trying to decide whether an academic career was for me, my mentor asked if I wanted to keep doing things the same way, or to help find ways to do it better. For me there was no choice. And for me 'academic surgery has been the perfect blend of the cerebral and practical'.[9]

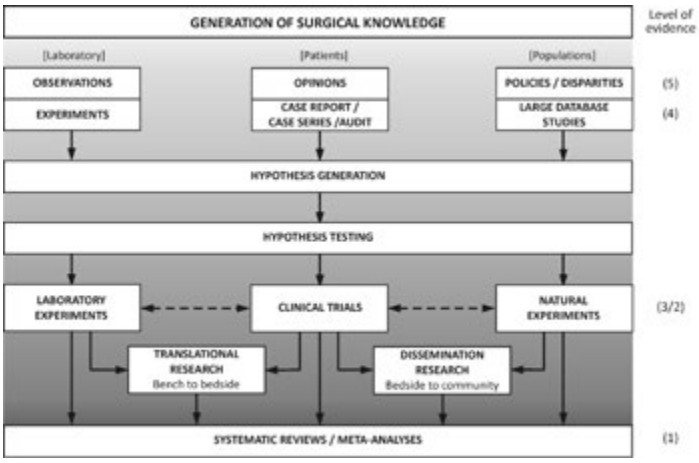

Figure 2. The generation of surgical knowledge, settings for research, types of studies and their relationship to levels of evidence.

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INVITED ARTICLE

Should all Doctors be Academic Clinicians?

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Should all doctors be academic clinicians? Perhaps unsurprisingly, this is not a straightforward question. Indeed, it really comprises two different, related, questions. Should all clinicians engage in academic pursuits? Should all clinicians be career academics?

We already require clinicians to be continually engaged in teaching, learning and research activities as part of continuing professional development. These activities are enshrined in specialist college continuing education programmes, which are required for various accreditation processes. In addition to the need for lifelong learning by medical practitioners, there is also an inherent and widely-accepted tradition of contributing to the training of the next generation, be it undergraduate students or postgraduate health professionals.

The role of research in clinical practice is less clear. Research is often regarded as an optional pursuit with limited practical value undertaken by career academics only. Unfortunately, this view undervalues the important role research activities can play in process improvement for health delivery, and ignores the fact that many ongoing audit and quality improvement activities are actually types of research. In addition, this view overlooks the wonderful potential research environment that is the New Zealand health system. The recent New Zealand Health Research Strategy outlines the requirement for research to be an integral part of District Health Board activities.[1] This document is important for clearly stating that research is a legitimate part of business as usual for New Zealand's publically-funded health system. The challenge now is to turn this into practice across the country. A university appointment is not a prerequisite to engage in such research activities. There is already a large body of high quality research coming out of District Health Boards, especially those that have formal partnerships with academic institutions. The aim should be to create true teaching institutions where research and education are normalised as part of everyday activities.

Partnerships between health service delivery (including primary care) and academic institutions are crucial in order to maximise these education and research opportunities. The rebuild of Christchurch after the Canterbury earthquakes has provided the opportunity to create a Health Precinct that brings together clinicians, researchers, educators and students from all key institutions who work in the health space.[2] This is a good example of an effort to take advantage of natural synergies, but requires good leadership and a collective vision. There is also plenty of opportunity to provide more academic rigor within medical specialist training programmes. All postgraduate training programmes require project work to be completed by trainees, and this needs adequate supervision and training in research methodology and publication.

Clearly, not all clinicians can nor wish to be career academics. However, there are plenty of opportunities for those interested in this pathway. Joint clinical academic positions have several permutations, typically involving a combination of senior medical officer clinical duties (usually with a District Health Board or in primary care) and university academic duties (teaching, research and service). A major challenge with joint clinical academic positions is to get a realistic balance between clinical and academic duties, and to ring fence time in order to be successful with each activity. The natural law tends to be that patient demands have highest priority, followed by teaching responsibilities, then research activities. It is important to acknowledge this trend when managing a weekly routine. Some academics manage this by physically and/or temporally separating different activities. Another challenge for the clinician academic is to have sufficient clinical time in order to maintain skills and street credibility. The reality is that joint clinical academics tend to overdo their clinical duties in order to be seen to be doing their bit, thereby potentially compromising their academic duties.

The pathway to a career academic position usually involves studying for a higher degree and spending some specialist training time in an academic centre of excellence outside New Zealand. Indeed, do not miss the opportunity to do some postgraduate training in an overseas centre of excellence, regardless of whether you plan to be a career academic or not. This is a unique opportunity that is unlikely to reappear at another time in a clinician's career. Some aspiring academics are quick at understanding research methodology and logistics, but almost everyone requires specific training and mentoring. A higher degree, such as a PhD, is one formal way to train as a researcher. Regardless, it is critical to have at least some time embedded within the culture of a successful research group and to select some good mentors. These people are likely to have a lasting, if not lifelong, impact on an academic's career. Establishing good research habits is best done early, and it really helps to develop a love of writing.

Most medical students and young doctors see themselves as lifelong clinicians. The reality is that most doctors approaching mid-career start looking at part-time non-clinical roles to partially offset the relentless pressures of full-time patient care. Some take on managerial and leadership positions within their organisations. Some take on service roles, such as with professional colleges. Some take on other careers. In my view, career academics have an advantage in already having a variety of activities embedded within their job descriptions, and usually have greater freedom to change various components over time. This might mean a change in emphasis from education to research, or vice versa, or taking on leadership roles in service, teaching or research.

I always wanted to be an academic, although my career pathway was far from straightforward and involved many distractions. I travelled in Asia and Europe for nearly two years soon after graduation from medical school, maintaining the travel through locum work in the United Kingdom. I worked at a high altitude aid post in the Himalaya for three months during that period, and took a two-year break half-way through specialist training to be a volunteer rural general practitioner in a remote village in Nepal (the best job I have ever had). Don't believe anyone who tells you that you are ruining your career prospects by taking a break in specialist training. Life experiences will only make you a better clinician and academic.

I started my specialist training in infectious diseases and then realised the benefits of training in clinical microbiology as well. So, I ended up as both a physician and pathologist. Unexpectedly, it turns out that my microbiology "ticket" has created more research opportunities for me on the international stage due to a relative shortage of academic clinical microbiologists. My first major research project was as a summer student after my fourth year at medical school. This was a wonderful introduction to the joys of research and scientific writing. Thereafter, I took every

opportunity to be involved in research during specialist training, and even during my time in rural Nepal, some of which ended up in a doctorate. I finished my training with a fellowship in the USA within a stimulating academic environment that can bring out the best in everyone.

I returned to New Zealand as a full-time District Health Board consultant, and it was two years later when the first opportunity appeared to transition to an academic position with the University of Otago. The personal study did not stop there. As a mid-career academic, I fulfilled a latent desire and belatedly obtained a masters degree in epidemiology by distance learning. We can all benefit from a greater grounding in epidemiological principles.

Undoubtedly, my career has been made much more interesting and stimulating through the privilege of being a career academic clinician. It has provided me with an extensive network of colleagues and friends from around the world, and has ensured I regularly interact with bright young minds. It has enabled me to meet some truly extraordinary people in diverse circumstances, and provided incredible variety in my work. It has allowed me to interact on both the national and international stage and, importantly, to contribute to real health impacts in several countries.

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INVITED ARTICLE

The Academic General Practitioner

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Academic general practice has a short history compared to other medical disciplines.[1] The British College of General Practitioners was founded in 1952, establishing general practice as a recognised vocational qualification. It took another decade for the first Chair in General Practice to be founded in Edinburgh, Scotland in 1963, followed by the first English Chair in Manchester in 1972.[2] During the 1970s there was a steady growth in general practice as an academic discipline, and by the 2000s there were 27 departments of general practice in medical schools in the United Kingdom. New Zealand (NZ) was further behind. When the medical school at the University of Auckland first opened in 1967, there was a department of community health, but not one for general practice. The first Chair of General Practice in Auckland was appointed in 1988.

Since then there has been rapid expansion of the discipline. The University of Auckland Department is now General Practice and Primary Health Care, and incorporates a number of other fields including community-based nursing, pharmacy, psychology, medical sociology, palliative care and sports medicine. As well as responsibility for general practice teaching for the undergraduate medical programme, the department offers postgraduate courses, certificates and diplomas, supervision for masters and doctoral students, and produces a large volume of high quality research. The department houses the Goodfellow Unit which provides continuing education services to general practitioners (GPs), nurses and other professionals in primary health care through a variety of media including face-to-face events, eLearning, podcasts and webinars. The national Immunisation Advisory Centre and the linked immunisation research unit also have strong relationships with the department.

The department currently employs ten GP academics, ranging from very part-time (0.1 fulltime equivalent, FTE) to full-time appointments (which include 0.2 FTE for clinical practice). However there is no clear pathway to become an academic GP in NZ. In some countries, for example Malaysia[3] and South Africa,[4] family medicine registrars are required to enrol in a Masters level degree programme and complete a research dissertation or thesis while also undergoing their vocational training. In Australia there are academic posts available for registrars 'to develop skills in research, teaching, project work and critical evaluation of research relevant to the discipline of general practice.'[5] This includes undertaking a supervised research project at an Australian university, which may pave the way to becoming a GP educator, or to further postgraduate study such as a masters or doctoral degree in academic general practice. In NZ the Royal New Zealand College of General Practitioners (RNZCGP) is responsible for general practice vocational training, and no university qualification is included, nor are academic posts currently available.

The GPs in our department have come to academia via different routes. Some aspired to academic roles early in their careers, undertook masters and PhDs and gained appointments in the department. These days part-time teaching positions may come available, especially as student numbers grow and regional cohorts are extended. GPs can be appointed as professional teaching fellows, but if they are sufficiently research active then they can be senior lecturers, with their time split (40/40/20) between teaching, research and service. Research often requires writing grant proposals, considerable work with no guarantee of funding – there is strong competition throughout NZ for health research dollars. An established GP academic will start supervising students – for summer studentships, honours, masters or PhDs, a good way to extend a research portfolio. Research often involves working in teams, with collaborators from other disciplines, other universities, even other countries. Primary care research is eclectic in nature. It can be inter-disciplinary, use a variety of innovative approaches and methodologies, and have mixed quantitative and qualitative datasets. Academic general practitioners may have a large service component to their job, both within and external to the university. These roles are diverse, such as sitting on or chairing committees, peer reviewing journal papers and grant applications, examining theses, working on editorial boards, and providing policy advice at national or even international levels.

My own pathway was very ad hoc. I never anticipated a career in academic medicine. After many years in full-time practice I enrolled in a single postgraduate course on the philosophy of general practice. Before I knew it, I found myself doing a masters and discovered the joy of research, which combined so well with my love of writing. For a number of years I combined clinical work with a series of part-time, short-term research contracts in a wide range of topics. In 2010 I was awarded a chair in general practice and primary care, and in a topsy-turvy fashion, I subsequently enrolled in and completed my doctorate. In 2009 I was able to start a brand new medical journal for the RNZCGP (the Journal of Primary Health Care), to design it, arrange peer reviewing for submitted papers, commission non-research material, do all the editing and sub-editing, and take the journal forward to be indexed in Medline and other databases.[6] This was an incredible opportunity, which few people have been afforded.

The path may not be straightforward, but there are many intrinsic benefits. True academic GPs will still be involved in clinical practice, providing comprehensive care to patients and their families in the community. They will be conducting research, which in primary care is often pragmatic in nature, with the overarching aim of improving community-based care and patient outcomes. They will be involved in the teaching of knowledge, skills and professional attributes to medical students, and/or other health professionals at undergraduate and postgraduate levels. Their clinical experience and their research informs their teaching. Clinical practice involves providing care and helping effect positive change in people's health often one person at a time. Teaching others to provide this care may reach many more people. Research findings have the potential to improve health outcomes for many. Combining clinical practice, teaching and research can be very rewarding.

It is not necessary to have a university appointment to engage in academic pursuits. New questions arise every day for GPs working in the community. When a local primary care doctor is curious and committed he/she can ask a question, and go in search for the answer. Conducting such grassroot research can be facilitated by academic and community partnerships. For example, recently a GP in Newfoundland, Canada raised a question about the cause of sickness in his community, and investigated with the support of university colleagues. He sought community engagement to test the arsenic levels in water from their wells, and found this to exceed safe levels. Subsequent action by citizens, local authorities and the media resulted in residents adopting safe alternative water practices. This community engagement project was jointly published by the academic and community partners in a medical journal.[7]

Academic GPs have many roles: clinician, educator, researcher, supervisor, mentor, writer, reviewer, editor, policy advisor. Many GPs seek an interest outside of full-time clinical practice for challenge and intellectual stimulation, and academic pursuits can help provide a work balance.

Clearly not all GPs can nor wish to include an academic component in their career. However I support the growing international trend for family doctors/GPs to complete a masters project during their training. Even if they never engage in further studies, they must remain lifelong consumers of research. This training will assist them in critical appraisal of papers in the literature, assessing the quality of the methodology and the relevance of the findings in the context of their own practices - either practice changing or practice confirming. Beyond a masters, we need a clear pathway for GPs to enter academia, with provision of doctoral and post-doctoral support, to provide an academic pipeline and succession for older academics moving into retirement.

For those privileged few who are able to adopt such a career, a combination of clinical and academic work is varied and rewarding. It provides the opportunity to engage with many people from a diversity of cultures and backgrounds - patients, students, colleagues and others. Conferences and collaborations open many doors to travel, both in NZ and nationally. I recommend academic general practice as an excellent and fulfilling career choice for those who are keen to take up the challenge.

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Medicine Needs Medical Student-Scientists: Update on an Old Theory

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Cam is a final year medical student at Waikato Hospital. During an Honours year Cam developed an electrochemical assay that can potentially be used in multi-modal neuromonitoring. Outside of medicine Cam is probably devouring a good book or dumplings.

The cynical medical student sees research as a frustrating task to be endured for career advancement. The idealistic student sees medical research as their way to contribute to humanity's greatest achievement. The professor sees research as a way to teach skills to students that will make them better clinicians. Each of these hypothetical characters are right, but only the cynic should be ignored.

Science needs medical student-scientists

Your biggest contribution to medicine as a medical student may not happen in a hospital. In the clinical setting, your job is to learn, cut sutures, and write the odd discharge summary. In the laboratory, you are free to create knowledge that could lead to better diagnostic techniques or treatments. Medical students have long known that knowledge can simultaneously be studied and created. Naïve medical students are uniquely qualified to challenge clinical dogmas because they have never experienced the "we have always done it this way" mentality. Young students are also unlikely to be restricted by the obligations of middle age (e.g. mortgage, children, golf). Most research produces small incremental advancements in knowledge, but there are a few medical students whose research had greater positive impact than the whole of that student's clinical career (Table 1).[1]

Table 1. Major discoveries and inventions by medical students

Medical student	Discovery or invention
Thomas Fogarty (1960)	Catheter based balloon angioplasty
Charles Best (1921)	Insulin
Jay McLean (1916)	Heparin
Ernest Duchesne (1897)	Penicillin*
Augusta Klumpke (1885)	Brachial plexus anatomy
Paul Langerhans (1867)	Microscopic anatomy of pancreas
William Clark (1842)	Ether anaesthesia

*Examples are discussed by Stringer and Ahmadi 2009.1 *Duchesne succumbed to tuberculosis soon after his discovery and never lived to see penicillin rediscovered.*

Times have changed since Paul Langerhans could use the same light microscope to discover pancreatic islet cells and make a diagnosis. Science and medicine are increasingly becoming dependent on complex techniques that require specialist training, take for example robotic prostatectomies and viral vector gene transfer methods. The increasing challenge of mastering both science and medicine may explain why the numbers of physician-scientists are in decline.[2] Losing the unique insights that can only come from clinical training and patient contact will slow the progress of medical science. Fogarty catheters may not exist if the inventor had not witnessed patient's suffering after invasive open embolectomy surgery.[1] Reversing this workforce trend will require introducing more medical students to research and providing stronger support to those students that choose to pursue both clinical and research training.

Clinical medicine needs student-scientists

Doctors constantly update their clinical practice based on their interpretation of scientific data. Proper data analysis demands an understanding of the strengths and flaws of specific statistical methods, experimental designs and outcome measures. Analytical thinking is hard to teach and even harder to learn. Many medical students, including this author, wouldn't think twice about skipping an hour-long lecture on multivariate regression analysis. Designing and carrying out your experiment to test a question that you care about is the best way to learn these essential thinking skills. Understanding the scientific method will make you better at spotting bad data that shouldn't influence your practice.

> *"The first principle is that you must not fool yourself and you are the easiest person to fool"*
> — Richard Feynman.

Listening to Richard Feynman, the quintessential scientist, could make us all better clinicians. Doctors are vulnerable to cognitive biases that worsen clinical decision making and cause medical error.[3] Scientific training teaches you to identify and overcome bias in yourself and others. Good scientists seek out criticism as a way of protecting themselves from confirmation bias. A critical review of your research proposal or manuscript by a supervisor or peer reviewer may be crushing at first, but ultimately is the best way to improve your writing and thinking skills. In contrast, there are several well-known disasters caused by senior doctors' reluctance to accept criticism from junior staff.[4] Scientists interpret data from experiments with a slow, explicit, and reflective reasoning style (i.e. Kahneman's "system 2" thinking). Doctors interpret data from patients using both system 1 (i.e. instinctual, rapid and non-analytical) and system 2 thinking styles. Diagnostic instinct, a celebrated hallmark of the respected clinician, is easily foiled by recent diagnosis bias, anchoring, and availability bias.[5] Encouraging clinicians to adopt science's system 2 style has been shown to improve diagnostic accuracy.[6]

Advice for the frustrated medical student-scientist

I have experienced some of research's classic frustrating moments: when you realise the data doesn't care about your hypothesis, when your funding gets revoked because your study failed to get ethics approval, and that bitter taste in your mouth when you open an email saying "manuscript rejected". Overcoming those challenges taught me that theories must be made to fit evidence and not vice versa and how to convince intelligent people that my ideas have value. The frustration heightened my joy on seeing p-values < 0.05, presenting my findings at an international conference, and soon I will see those two magnificent words "manuscript

accepted". Medical students should find their own research problem that will challenge them to develop their analytical and communication skills so that they can advance patient care.

Conflict of interest: None

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Student publications in the New Zealand Medical Student Journal: the first fourteen years

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Abstract

Introduction: Medical student journals (MSJs) play an important role in supporting students to improve their academic writing skills, gain familiarity with the peer-review process and ultimately publish their work. International literature examining the role of MSJs is scarce, with no published analyses of their outputs or impact on the scholarly activities of medical students. The aim of the current study was to examine the author characteristics and publishing trends in the New Zealand Medical Student Journal (NZMSJ).

Methods: A retrospective analysis of all articles published in the NZMSJ from 2004 to 2017 was performed. Article related data were collected for student-authored publications, in addition to author, editor and reviewer gender. Univariate analysis was conducted using the chi-squared goodness-of-fit test.

Results: Twenty-four issues of the NZMSJ have been published to date, containing a total of 204 student-authored articles. Published articles were more likely to be authored by clinical students than pre-clinical students ($P<0.001$). No gender gap was identified in the authorship of articles or overall editorial board positions. However, NZMSJ issues were significantly more likely to have a male Editor in Chief (71% $P=0.04$).

Conclusion: The NZMSJ provides students with opportunities to publish their work and develop their academic skills. Medical students should be encouraged to submit their academic work for publication in the NZMSJ. Future research should investigate the impact of publication in MSJs on students' subsequent scholarly activities.

Background

Medical students have made many notable contributions to science throughout history, being responsible for the discovery of heparin, insulin, the sinoatrial node, and ether anaesthesia, among others.[1,2] A broad range of research opportunities currently exist for medical students in New Zealand, including summer studentships, intercalated degrees, and other extracurricular research activities.[3] Multiple studies have shown that New Zealand medical students are capable of successfully publishing research in peer-reviewed academic literature.[4-7] Despite these successes, many students still face considerable challenges when attempting to publish their work in mainstream medical and scientific journals.[8,9] Academic publishing can be daunting, arduous, and time-consuming, and may result in demotivating rejections, impacting on students' confidence and discouraging them from being involved with research in the future.[9]

A number of medical student journals (MSJs) have been established in response to these challenges, and aim to promote academic research and publishing amongst the medical student community. These include the New Zealand Medical Student Journal (NZMSJ),[10] Australian Medical Student Journal (AMSJ),[11] and Student BMJ.[12] MSJs provide a student-friendly environment for students to publish their work, improve their academic writing skills and gain familiarity with the peer-review process.[3] More than 18 MSJs are published in English across the world, with several more in other languages.[8]

The NZMSJ is a student-led journal which is indexed in Google Scholar and primarily publishes academic articles written by medical students.[10] The journal was founded in 2003, with the first issue published in 2004, making it one of the longest-running MSJs in existence, and publishes two issues each year.[8] The primary objective of the NZMSJ is to help "medical students make the transition from writing for medical school to publishing quality work in professional journals".[10] The journal publishes several different types of articles, including academic research (original and review articles), case reports, feature articles (usually opinion or perspective items), and reviews of books, podcasts, documentaries, and other media.

Despite the recognised importance of MSJs in providing a platform for medical students to develop skills and experience in academic publishing, no analysis of articles published in the NZMSJ has formally been conducted to date.[9] Furthermore, the international literature examining the role of MSJs is scarce, with no published analyses of their impact on scholarly activities of medical students.

The aim of this retrospective analysis was to describe and examine the characteristics and trends in publication of student-authored articles in the NZMSJ.

Methods

Search strategy

All published issues of the NZMSJ were retrospectively identified via the journal website.[13] Issue 1 of the NZMSJ was published in March 2004, while the most recent edition of the NZMSJ analysed was Issue 24 (June 2017), representing a 14-year period available for analysis.

An article was deemed to be authored by a student if the author biography clearly identified at least one student author. Articles published by medical graduates that were clearly stated as written prior to graduation were included in this definition. Editorials and guest editorials were excluded.

Data collection

Data were collected from previously published issues of the NZMSJ. No attempt was made to contact authors due to the lack of accurate contact details. For each issue, the total number of articles, as well as the number

of student-authored articles was recorded. For each student-authored article, the following data were collected: number of authors (student and non-student), gender of student authors, student authorship order (first vs. co-author vs. both), level of university study (preclinical vs. clinical vs. intercalated research year vs. other undergraduate degree), institutional/medical school affiliation (University of Auckland vs. University of Otago vs. international), and the type of publication (original research vs. case report vs. academic review vs. feature article vs. book/media review).

Author gender was recorded as per the author biography, which is written by the author as part of their submission. If unclear, an Internet search was performed using the author's name to attempt to determine the gender of the author. For each issue of the NZMSJ analysed, the names and gender of the student editors and reviewers were also recorded.

Statistical analysis

Collected information was entered into a pre-designed Excel spreadsheet. Descriptive statistics were utilised for the majority of the data. Continuous data were expressed as mean ± standard deviation (SD). The X^2 goodness-of-fit test was used to determine variance from an equally-proportioned distribution for author gender, author year level, and editor/reviewer gender. A P-value of < 0.05 was considered statistically significant. All analyses were performed using SPSS for Macintosh (Version 22; IBM Corp., Armonk, NY, USA).

Results

Study sample

To date, 24 issues of the NZMSJ have been published, with two being published as a combined release in 2014 (Issue 18/19). A total of 309 articles have been published, of which 204 articles (66%) were authored by at least one student.

The proportion of student-authored articles varied from 33% to 85% per issue, although there was no discernible trend over the 14-year period (Figure 1). Likewise, there was no clear trend in the overall number of articles published per year.

Student-authored publications

Overall, there were 273 authors (230 students, 43 non-students) contributing to the 204 student-authored publications. Accounting for students who published more than one article in the NZMSJ, there were 185 unique student authors identified. Of these, 88 were female (48%), and 97 were male (52%) (P=0.51), showing no statistically significant gender gap for authorship in the NZMSJ.

The majority of student-authored articles (92.2%) were written by a single student author, while only one article was identified that did not have a student named as first author (Table 1). Most articles (73.5%) were authored by clinical medical students, with a clear increase in authorship rates from 2nd to 6th year (P<0.001) (Figure 2). Academic review articles and feature articles made up most of the student authored publications in the NZMSJ (26% each), while original research and case reports contributed only 15% and 4% respectively. Over 90% of student authors were affiliated to either the University of Auckland or University of Otago, with only 15 articles attributed to overseas student authors (P<0.001).

Table 1. Characteristics of student authored articles in the NZMSJ, 2004-2017

	n = 204 (%)	*P*-value*
Student authorship order		<0.001
First author only	188 (92.2%)	
Co-author only	1 (0.5%)	
Both (multiple student authors)	15 (7.4%)	
Stage of study **		<0.001
Preclinical	40 (19.6%)	
Clinical	150 (73.5%)	
Intercalated	7 (3.4%)	
Other undergraduate	2 (1.0%)	
Not stated	8 (3.9%)	
Institutional affiliation		<0.001
University of Auckland	80 (39.2%)	
University of Otago	104 (51.0%)	
Overseas	15 (7.4%)	
Not stated	5 (2.5%)	
Type of article		<0.001
Original research	31 (15.2%)	
Academic review	52 (25.5%)	
Case report	9 (4.4%)	
Feature article	53 (26.0%)	
Book/media review	38 (18.6%)	

** Chi-squared goodness of fit test with null hypothesis being an equally-proportioned distribution.*
*** Percentages do not add to 100% due to three articles authored by both preclinical and clinical medical students.*

Editorial staff and reviewers

Over the 24 issues, there were a total of 433 acknowledgements to students contributing to the NZMSJ as editors or reviewers (mean 18.8 per issue, SD 5.2). This corresponded to 130 individuals (63 males, 65 females, 2 unclear) (P=0.86). Each individual contributed to a mean 3.3 (SD 2.1) issues of the NZMSJ.

Of the Chief Editors of the NZMSJ to date, 5 of 12 have been female

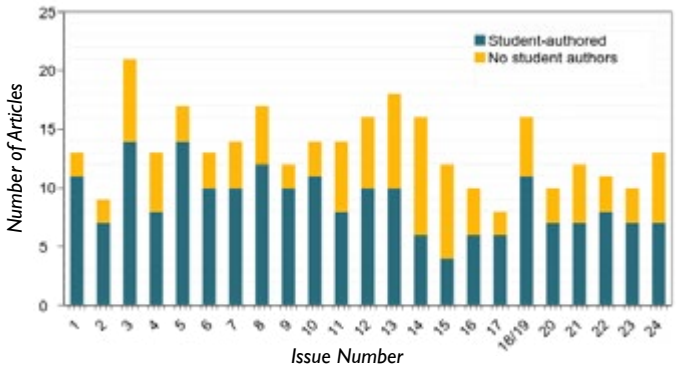

Figure 1. Trend of total articles per issue vs. student authored articles (2004-2017).

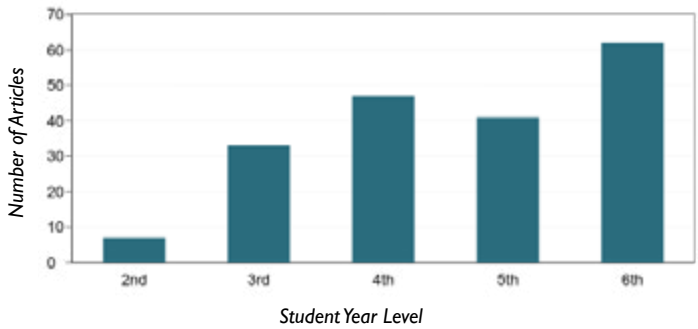

Figure 2. Number of articles in the NZMSJ published by medical student year level. P< 0.001 for variance from an equally proportioned distribution.

(42%, P=0.56), who have been responsible for 7 of 24 issues (29%, P=0.04) published thus far. The Deputy Editor position was formally established from Issue 13 onwards, and three of the five individuals who have held this role have been female. Of the Academic and Features Editors acknowledged in the journal, 45% (19 of 42) have been female (P=0.55). Student reviewer names have been provided in the NZMSJ since Issue 13, with 52 females (58%) and 37 males (42%) listed (P=0.11).

Table 2. Gender data for student authors, editors, and reviewers

	n (%)	*P*-value*
Student authors	n = 185	0.51
Female	88 (47.6%)	
Male	97 (52.4%)	
Overall editors/reviewers	n = 128	0.86
Female	65 (50.8%)	
Male	63 (48.5%)	
Chief Editors	n = 12	0.56
Female	5 (41.7%)	
Male	7 (58.3%)	
Deputy Editors	n = 5	0.66
Female	3 (60%)	
Male	2 (40%)	
Academic/Features Editors	n = 42	0.55
Female	19 (45.2%)	
Male	23 (54.8%)	
Reviewers	n = 89	0.11
Female	52 (58.4%)	
Male	37 (41.6%)	

** Chi-squared goodness of fit test with null hypothesis being an equally-proportioned distribution.*

Discussion

The NZMSJ provides a medium for New Zealand medical students to publish their academic work in a peer-reviewed journal, with over 200 student-authored articles identified in the current retrospective analysis. No trend in the number of student-authored articles was evident over the 14-year history of the NZMSJ, suggesting the journal has consistently provided opportunities for medical students to publish and develop their academic skills.

To the authors' knowledge, no other analyses of articles published in MSJs have been conducted, despite there being over 20 MSJs in print as of 2017.[8,14] NZMSJ articles were significantly more likely to be authored by clinical medical students, similar to the trend found by Al-Busaidi et al. in an analysis of articles published in the New Zealand Medical Journal.[5] Wells et al. also found that senior students completing summer studentships at Auckland University were significantly more likely to have subsequently published in the mainstream literature as a first author.[7] This trend is likely influenced by multiple factors; senior students are more experienced and have had more opportunities to conduct research. Additionally, the time taken to review and process articles may also delay the time from submission to publication.

Few authors completing intercalated degrees were authors of NZMSJ articles, despite a previous analysis of BMedSc(Hons) students at Otago showing a publication rate of 33%.[6] Given the differences between the present study and the analysis of Al Busaidi et al.,[6] it appears high-quality research undertaken by intercalating students and their supervisors is more likely to be published in mainstream journals. However, approximately two-thirds of students still remain unpublished following an intercalated BMedSc(Hons) year or summer studentship.[6,7] The NZMSJ may have an important role in supporting students who have completed summer studentships and/or intercalated degrees publish the results of their work, if they are unable or unwilling to publish in the mainstream medical literature.

A gender gap has previously been identified in academic medicine, with females being less likely to hold senior academic positions,[15,16] publish in mainstream medical journals,[17] and to be appointed as editorial staff of journals.[18,19] The current study examined whether the gender gap in academic medicine begins at a medical student level, and found no evidence of a gender gap in authorship in the NZMSJ. However, despite there being no significant overall difference in the gender of chief editors, significantly more issues of the NZMSJ had male chief editors, indicating males were more likely to hold the role for a longer period of time. As part of a larger effort to combat gender inequity in academia, peer-mentoring programmes or other positive interventions for women should be considered.[20] To the authors' knowledge, these do not formally exist in New Zealand medical schools, and may provide female medical students with opportunities to develop academic skills to reduce the gender gap observed in more senior academic roles.

The null hypothesis for this analysis was that there would be an equal distribution in authorship and editorial/reviewer positions between males and females (ie. 50% male and 50% female). However, this may be an incorrect assumption, given that females now outnumber males at most medical schools around the world and in New Zealand,[21,22] meaning an "equal" distribution may still under-represent women. The lack of available data on the number and gender of New Zealand medical students over the past 14 years prevented adjustment for this trend, and therefore the true gender gap is possibly wider than calculated in the present study.

There are several other limitations of the present analysis. The citation rate and academic impact of articles published in the NZMSJ was unable to be assessed due to inconsistent Google Scholar indexing over the 14-year period. It was also not possible to obtain a matched "control group" of students who have published in mainstream journals other than the NZMSJ, or have not published at all. The impact of publication in the NZMSJ on subsequent academic output by students should be investigated in further studies as a measure of student development. Due to the retrospective nature of the analysis, it was not possible to obtain and assess important variables that were not readily available; ethnicity, age, and/or undergraduate/postgraduate entry to the medical programme, and these remain areas for future research. Finally, while authors were able to "self-report" gender in the author biography, it was not possible to assess fully assess non-binary genders, and this remains a weakness of the present study.

Despite these limitations, findings from this study have implications for medical students, MSJs, including the NZMSJ, and future research. First, non-clinical medical students appear to be underrepresented in medical student and mainstream journals.[5,7] MSJs should target junior medical students and encourage them to submit their research to provide them with early experiences in peer-review and academic publishing. Second, inconsistent indexing of MSJs may result in reduced visibility of published research and therefore low accessibility among the wider international medical student audience. Achieving better recognition and international visibility through consistent indexing in biomedical databases should be an objective for all MSJs.

Future research should examine the effect of publication in the NZMSJ on subsequent academic activities, such as publication in mainstream medical journals, and completion of higher academic degrees. The identification

of barriers to publication faced by medical students may facilitate the development of targeted strategies to improve publication rates,[3,23] and thus further the role of the NZMSJ in publishing the work of medical students from New Zealand and abroad.

Conclusion

The NZMSJ provides medical students with opportunities to publish their work and develop their academic skills. Given that up to two-thirds of medical student research remains unpublished, students should be encouraged to submit their work to the NZMSJ. No gender gap in authorship or overall editorial board representation was identified, though NZMSJ issues were significantly more likely to have a male Chief Editor. Future work should investigate the impact of publication in the NZMSJ and other MSJs on students' subsequent scholarly activities.

Conflict of Interest: Cameron Wells is the NZMSJ Academic Editor. This article has gone through a double blinded peer-review process applied to all articles submitted to the NZMSJ and has achieved a standard required for publishing. The authors have no other conflicts of interests to declare.

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Stimulating the clinical academics of tomorrow: A survey of research opportunities for medical students in New Zealand

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Abstract

Developing the clinical academic workforce of the future is a priority of international relevance. Despite a number of measures implemented to address this challenge, a small proportion of medical students engage in research. Lack of knowledge of available research opportunities, and difficulty finding projects and suitable mentors are key barriers to undergraduate medical research. To date, there is no consolidated source of information on undergraduate research training opportunities and their outcomes available to medical students in New Zealand. Based on a comprehensive review of the published and grey literature and the authors' personal experiences of research training activities as medical students, this article presents an overview of the research training opportunities available to medical students in New Zealand. Challenges facing medical student research involvement are discussed and current knowledge gaps in the literature are highlighted. The article concludes with suggested strategies to help promote research training opportunities and support students through their research experience.

Background

Clinical academics are medical doctors who also undertake research and other academic activities alongside their clinical responsibilities.[1] They typically make substantial contributions to patient care, but also to medical research, undergraduate and postgraduate teaching, and university administration. Furthermore, clinical academics play a pivotal role in bridging the gap between bench and bedside, with their work spanning from basic science to translational, clinical, and population health research.[1] Given their unique combined experiences in research and patient care, clinical academics are well positioned to identify unanswered questions, conduct basic and clinical research, and translate their findings into practical bedside applications.[2]

Unfortunately, the contribution of this unique group may be dwindling. Recent international trends from the United States,[1,3] the United Kingdom,[4] Europe[5] and Australasia[6] indicate the proportion of clinical academics is declining relative to the rest of the medical workforce. To reverse this trend, systematic and concerted efforts have been put forth at the undergraduate and postgraduate levels.[3,7] Studies have shown that early exposure to research increases undergraduate medical students' subsequent interest in academic medicine as a career.[8,9] For this reason, a number of measures have been implemented to engage medical students in research across the globe.[7-14]

In addition to the development of interpersonal and research-specific skills,[15] early student participation in scholarly activities is associated with improved short- and long-term academic productivity.[8] Numerous studies have demonstrated that medical student research activities can regularly result in publications in peer-reviewed medical and scientific journals.[8,10,11,13-19] Furthermore, early exposure to research enhances medical students' confidence in conducting research and improves their critical thinking and literature appraisal skills,[13] qualities essential for the practice of evidence-based medicine.

Despite the importance and benefits of undergraduate research, relatively few students participate in scholarly and research activities.[8,10,15] In New Zealand, only one-quarter of students are involved in research during their time at medical school.[17] International studies exploring perceived barriers to undergraduate research involvement have identified a number of potentially ameliorable factors. As well as time and financial constraints, lack of awareness of available research opportunities and how to get involved in research projects were some of the main barriers cited by medical students. [8,15,20]

To date, there is no consolidated source of information on undergraduate research training opportunities and their outcomes available to medical students in New Zealand apart from individual university medical school websites.

Aim

The aim of this review was to present an overview of the research training opportunities, formal and informal, offered at New Zealand medical schools. Based on a comprehensive review of the literature, and the authors' personal experiences of research as medical students, challenges facing medical student research involvement are discussed and recommendations are presented in order to promote research opportunities and support students through their research experiences.

Methods

A comprehensive search of the published literature was performed using the MEDLINE database to identify articles relevant to medical student research opportunities in New Zealand. MEDLINE searches were carried out via PubMed in March 2017. The following terms were used alone or in combination: medical student, undergraduate, physician-scientist, academic medicine, intercalated degree, research, publication, New Zealand. The reference lists of identified articles were scanned for additional relevant publications. The websites of the Universities of Auckland and Otago were also searched to identify grey literature sources. Both Universities were contacted to attempt to obtain quantitative data about the uptake of student research opportunities where this was not available from previously published literature.

Available research opportunities

A broad array of research and scholarly activities are available to medical students.[7,11] These include curricular (i.e. mandatory research modules) and extracurricular (i.e. intercalated research degrees and summer studentships) research training opportunities. A summary is provided in Table 1.

Intercalated research degrees

Undertaking an intercalated degree is the most focused formal research training opportunity offered by medical schools in New Zealand, Australia, the United Kingdom and North America.[21-24] Depending on the combined degree, students are often required to take time away from the medical programme to complete a full-time research-based degree. The aim of research-based intercalated degrees is to "provide an opportunity for medical students to obtain research experience in preparation for an academic or research career".[23]

A variety of intercalated degrees are offered worldwide; these include Honours, Master's and Doctorate degrees. In New Zealand, Honours and Doctorate degrees are the two degrees awarded to intercalating medical undergraduates.[11]

Currently, two intercalated research programmes are available to interested medical students in New Zealand; the Bachelor of Medical Sciences with Honours (BMedSc(Hons)) and the Doctor of Philosophy (PhD) degrees. Financial support for students undertaking such programmes may be provided by medical schools, local trusts, and other funding bodies in the form of scholarships and awards.

While only offered to students following completion of their third or fifth year at the University of Otago,[25] the BMedSc(Hons) degree is available to medical students at any stage after satisfactorily completing the third year of the MBChB programme at the University of Auckland.[26]
A PhD degree is widely regarded as an essential component in the training of physician-scientists.[27] Exceptional undergraduates who have a clear vocational direction and are committed to a career in academic medicine may consider pursuing a dual MBChB/PhD degree.[27] The University of Otago offers medical students with an exceptional academic record and research experience a unique opportunity to simultaneously intercalate their medical programme with a PhD degree (MBChB/PhD programme). After completing 3 years of preclinical medicine, students spend 2 years undertaking full-time research then complete 3 years of clinical training while completing their theses to graduate with a joint MBChB/PhD degree.[28]

There is a paucity of literature investigating New Zealand medical students' attitudes towards, interest and involvement in, and outcomes related to intercalated research degrees. Available research suggests that the uptake of intercalated degrees in New Zealand is low when compared to the United Kingdom and Australia.[10] Reasons for the low interest in intercalated research degrees in New Zealand have not been extensively scrutinized. However, a recent survey of intercalating medical graduates from the University of Auckland reported 80% of students encountered ameliorable difficulties while intercalating, which include heavy workload, poor academic mentorship, financial constraints and prolonged time to graduation.[24] Not surprisingly, these challenges are similar to those identified by intercalating students in Australia and the United Kingdom.[10,23]

Research output is the most commonly reported outcome measure to evaluate the success of undergraduate research programmes.[8,15] A review of the literature revealed only one study which investigated the outcomes of intercalated research degrees in New Zealand. Al-Busaidi et al. found the number of students enrolled in the intercalated MBChB/BMedSc(Hons) programme at the University of Otago steadily increased from 1995 to 2014.[11] Furthermore, research output from BMedSc(Hons) theses was found to be relatively high when compared to international studies, with nearly one-third of theses resulting in at least one peer-reviewed publication.[11] However, the outcomes of the intercalated MBChB/PhD programme at the University of Otago have yet to be reported.

Required research experience

One of the methods used by medical schools to engage prospective medical doctors in research is the integration of compulsory research training activities into the medical curriculum. The format and requirements of these research training programmes vary greatly between medical schools. In New Zealand medical schools, students receive teaching on research methods and design in the preclinical years which is reinforced by participation in mandatory research projects during the clinical years of the MBChB programme, often as part of the Public Health module at the University of Otago,[29] or required clinical audits during the Paediatrics and Obstetrics & Gynaecology attachments at the University of Auckland (discussed below).

The Trainee Intern Health Care Evaluation module offered at the Dunedin School of Medicine, University of Otago is an example of a curricular research training opportunity.[29] Under the supervision of Faculty staff members and over a period of 6 weeks, final year medical students (trainee interns) work in groups to conduct a study, from design to data

Table 1. Summary of currently available research opportunities for medical students in New Zealand

Research Opportunities	*Duration*	*Auckland*	*Otago*	*Uptake[a]*	*Research Outputs*
Intercalated Degrees					
- BMedSc(Hons)	1 year	✓	✓	O: 12.6/year[b]	O: Publication rate 33% [11]
- PhD	2-3 years	X	✓	O: 1.2/year[b]	NA
Required/compulsory research experience					
- Public Health Module	6 weeks	X	✓	All Trainee Interns	O: Publication rate 8.4%
- Clinical Audit	4-6 weeks	✓	X	All Trainee Interns	NA
Formal Extracurricular Opportunities					
- Summer Research Studentships	10 weeks	✓	✓	O: 120/year[b] A: 87/year[19]	A: Publication rate 32% [19]
- Research Electives	2-3 months	✓	✓	O: 4/year[b]	NA
- Clinical Audits	Variable	✓	✓	NA	NA
Informal Extracurricular Projects	Variable	✓	✓	NA	NA

A: Auckland; O: Otago, NA: Not available.[a] Average number of students from last 5 years of available data. [b] Data obtained from personal correspondence with university.

interpretation. Student groups are required to present their findings in a forum and submit a written report of the study. Although students are not required to publish their project findings, mandatory medical school research training experiences can result in publications in peer-reviewed journals,[13] and presentation at local and international conferences (Al-Busaidi & Tarr, unpublished). The tangible research outputs from these curricular training modules attests to their value for students and medical schools in New Zealand, though their effect on long-term engagement in research remains unknown.

Extracurricular research opportunities

Despite perceived lack of time being one of the most commonly reported barriers to undergraduate medical research, students continue to participate in extracurricular scholarly activities. These include taking part in formal (i.e. summer studentships) or informal (i.e. research during spare time) research opportunities.

Formal Opportunities

Summer Research Studentships

Summer studentships are supervised research projects, supported financially by grants/scholarships, available to medical students over a 10-week period during the summer vacation. It is commonly accepted that well-structured and mentored summer projects provide students with the basic research knowledge and skills and spark their interest in a future career in academic medicine while mitigating the barriers associated with intercalating and other long-term research endeavours.[30]

Summer studentship programmes are the most common form of medical student research involvement in New Zealand.[17] Furthermore, recently published data indicate summer studentships appear to be increasing in popularity among New Zealand medical students as a short-term research activity. Wells et al. identified the number of students undertaking summer studentship projects at the University of Auckland has at least tripled since the early 2000's.[19] Financial incentives, an interest in research, and CV development are reported to be the main motivating factors for medical students to undertake a summer studentship, while most students hope to develop skills in critical thinking, research methods, interpretation of results, and academic writing (Wells, Wallace, Alexander, McLaughlin & Shelling, unpublished). Notably, three-quarters of students stated they were more likely to be involved with research again in the future because of their summer studentship experience.

Long-term follow up of summer research students at the University of Auckland from 2001 to 2013 has shown 32% have published at least one article with their studentship supervisor,[19] a comparable publication rate to students undertaking intercalated BMedSc(Hons) degrees.[11]

Research Electives

Electives are a potentially valuable opportunity for students to obtain an in-depth experience in medical research.[31] Similar to summer studentships, research electives provide medical students with a protected period of time to build upon existing research skills, free from curricular assignments and other clinical commitments. Students may acquire new research skills, build valuable connections and improve their research productivity during a period even as short as 4-9 weeks (depending on the student's ability, commitment, and available resources).[32] In addition to boosting institutional research performance, electives might represent an opportunity for medical schools where research-oriented students could be identified and directed towards an academic career pathway. A mandatory Canadian undergraduate research elective significantly increased medical students' interest in pursuing a career in medical research.[31]

As part of the final year of the University of Otago and University of Auckland 6-year undergraduate medical curriculum, students are required to complete an elective attachment (usually for 8-12 weeks), in clinical or non-clinical medical-related disciplines (e.g. medical education, journalism or research) in New Zealand or at an institution abroad. Furthermore, the University of Otago, Christchurch School of Medicine, offers its final year medical students a supervised 4-week selective period where students elect to join a specialty of their choice to pursue further clinical and/or research training, sometimes culminating in peer-reviewed publications.[33] A review of the literature revealed no published data on the uptake and outcomes of research electives by New Zealand medical students, though correspondence with the University of Otago found only 1-2% of students undertake this option during their elective placement.

Clinical Audits

Medical students on clinical attachments may be presented with opportunities to participate in clinical audits or other quality improvement projects, either voluntarily or as part of the required assessment for the attachment. These projects are usually small and based on retrospective chart reviews from a single clinical department. The results of these audits may be published, contribute to larger research projects, or inform quality improvement strategies within the clinical department. While these projects are often limited in scope, they may present a valuable opportunity for medical students to gain initial experiences and skills in research. However, no published data was identified evaluating the outcomes from clinical audits undertaken by medical students in New Zealand.

Informal Opportunities

Extracurricular/independent research

Medical students may also contribute to research projects during their personal time during the academic year, often under the supervision of clinical staff or university faculty members.[17,18,34] These projects make up a minority of the research experience of New Zealand medical students,[17] but may be more common amongst motivated clinical students who have fewer opportunities to undertake summer studentships due to their shorter vacation periods.[16]

Reinders et al. showed that medical students who participate in extracurricular research opportunities have significantly greater research outputs both prior to and following graduation.[18] To date, very little attention has been paid to the study of the prevalence and impact of independent/extracurricular medical student research in New Zealand.[17]

Student-led initiatives

1. Medical student journals

Students involved in medical research are often confronted with challenges when attempting to publish their findings in mainstream journals.[35] Such challenges at an early stage in undergraduate research involvement can erode students' confidence and discourage them from pursuing future participation in academic medicine.

Medical student journals (MSJs) may play a critical role in promoting medical student research involvement. MSJs provide a friendly medium where students share their research findings, develop research-related skills, and navigate through the peer-review and publication processes. However, no published data was found evaluating the effectiveness of MSJs in stimulating interest in research or promoting academic careers. The New Zealand Medical Student Journal was established in 2004, and has since published over 250 articles. It aims to support medical students as they transition from writing medical school assignments to publishing research in peer-reviewed journals.

However, mainstream medical journals are also common outlets for the dissemination of medical student research. In a recent analysis by Wells et al., the New Zealand Medical Journal (NZMJ) was found to be the most common journal for published studentship research projects.[19] Furthermore, in a recent large review of the NZMJ (1999-2013), medical students were found to have authored or co-authored around 9% of the total articles published and their contributions to the NZMJ have more

than quadrupled since 2000.[36]

2. Student research conferences

The HealtheX Conference at the University of Auckland provides an opportunity for undergraduates and postgraduates from across the Faculty of Medical and Health Sciences to present their research, whereas students at the University of Otago may present their work at the meetings of the Otago Medical School Research Society. Medical students frequently present their work from summer studentships or other research projects at these meetings. However, no data exist assessing the impact of presentations at these meetings on subsequent publication, engagement with research, or development of clinical academics.

3. Academic medicine societies

Student-run academic medicine societies have been established at several overseas universities in response to the declining interest in research careers.[37,38] These groups have successfully run events such as lectures, student research symposiums, and nationwide student research conferences, and have shown positive impacts on student interest in academic careers.[37] To the authors' knowledge, similar student-led academic medicine societies do not currently exist in New Zealand.

4. Student-led collaborations

Student-led collaborative initiatives such as STARSurg have been notably successful in the United Kingdom, publishing multi-centre observational studies with close to 8,000 patients from more than 160 centres.[39,40] These initiatives are based on a successful surgical trainee collaborative model, and have been adapted for medical students to gain experience in data collection, processing, and research methods.[41] Notably, all students who participate are PubMed-indexed authors on the final manuscript, which is published under the authorship of the collaborative group. No similar collaborative initiatives currently exist in New Zealand.

Challenges and solutions

Perceived barriers to performing research during medical school are well-described in the literature. Lack of knowledge of available research opportunities, difficulty finding projects and suitable mentors, and time and financial constraints may serve as early deterrents for medical students interested in research careers.[7,13,17]

Various strategies to promote research opportunities and support students through their research experience have been implemented with great success. Recently established programmes to advertise research opportunities and help students identify academic mentors, such as university-administered student research offices have succeeded in increasing interest and involvement in research.[14] Furthermore, a web-based "Medical Student Research Portal" has recently been introduced at the University of Queensland, linking medical students interested in research with clinical and academic supervisors.[42]

Most studies identified in two recent meta-analyses examining medical student research activities (including experience, perceived barriers and outcomes) emanated from North America and Europe.[8,15] Comparatively few published studies have examined the state of medical student research in New Zealand.[11,17,19,21,24,36] Findings from these studies should be used to optimise medical students' research experience and design programmes that provide productive, rewarding research experiences that ultimately inspire and encourage students to pursue medical research following graduation. More research is required to formally assess undergraduate medical research training opportunities currently offered in New Zealand.[11,19] Furthermore, the state of the clinical academic workforce in New Zealand should be evaluated by future research. Trends in the number of academic positions, research funding, remuneration, and postgraduate research opportunities should be assessed, given these factors are likely to affect long-term engagement in academia.

Review of the pertinent literature identified a number of recommendations to improve New Zealand medical student engagement in research. Providing students with early positive experiences in research is essential to attract high-achieving students to careers as clinical academics. Creating more compulsory research projects for medical students is unlikely to be successful, given students may not be interested, and the projects are usually brief or limited in scope.[8] Ideally, research projects should be meaningful and interesting; poor-quality projects are unlikely to motivate students to continue their involvement in research. Supervisors of undergraduate medical students should aim to involve and support students in all aspects of the research process from study design to publication.

Mentorship of young researchers by established scientists is crucial, and has been shown to predict future scholarly productivity.[43] Academic staff and clinical teachers should be encouraged to supervise projects by undergraduate medical students, and be equipped with information about the availability of medical student research training activities. The establishment of formal academic mentoring programmes for motivated students may facilitate the development of relationships between medical students and clinical academics, and may lead to an increased uptake of available research opportunities.

Medical schools should develop a process by which currently offered undergraduate research training opportunities are regularly evaluated and deficiencies are identified and rectified if possible. Furthermore, universities should work with academic staff to create more opportunities for medical students to engage with research, and promote these to interested students. We recommend establishing a university-based student research office to support student engagement in research, reduce barriers for those interested in pursuing research projects, help students find suitable academic mentors and encourage students to disseminate their findings through peer-reviewed publication or presentation at scientific and medical conferences.[10] Furthermore, students with a particular interest in research and academic medicine should be encouraged to pursue further training in postgraduate research (e.g. enrolling in higher academic degrees including Masters and PhD programmes).

Finally, the establishment of collaborative research networks for trainees and medical students in Australasia may enhance the generation of high quality research, provide medical students with meaningful opportunities to contribute to research, and promote the development of clinical academics in New Zealand.[44]

Conclusion

This report is the first consolidated source of information on undergraduate research training opportunities available to medical students in New Zealand. Medical educators should use this review to familiarise their students with the available research opportunities. At the medical school level, additional measures to facilitate students' involvement in undergraduate research activities should be implemented. The literature evaluating New Zealand medical student research involvement and opportunities, although slowly growing, is generally lacking. Future research should focus primarily on examining the prevalence of, and barriers to medical student research involvement, and evaluating the outcomes of currently offered undergraduate research training activities.

This review was first published in the New Zealand Medical Journal. 130 (1462), 80-8. Permission to reproduce this article was granted by the New Zealand Medical Association.

Acknowledgements

The authors would like to thank Associate Professor Greg O'Grady (Department of Surgery, The University of Auckland) for reviewing prior drafts of this manuscript.

Conflicts of Interest: None

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Reviewing the literature on anxiety and depression in Pacific youth: a fresh perspective

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Abstract

Introduction: The primary aim of this review was to investigate the current prevalence of anxiety and depression in Pacific youth who live both in Westernised countries and the Pacific region. A secondary aim was to identify key themes that underpinned anxiety and depression in Pacific youth.

Methods: Literature on the Pacific peoples of New Zealand, the United States, and the Pacific Islands within the last 15 years was examined. 91 pieces of evidence were collected. The databases Scopus, Medline, PubMed and Google Scholar were used to gather literature.

Result: The evidence suggests that Pacific youth have a higher prevalence of mental illnesses such as anxiety and depression compared to other ethnic groups. Common risk factors and protective factors from the literature that contribute to Pacific youth mental illness include spirituality, religion, culture, and family. In the Pacific Islands, urbanisation and modernisation are major risk factors for Pacific youth mental illness. For Pacific youth living in countries such as New Zealand and the United States, migration and acculturation are important risk factors.

Conclusion: This review has amalgamated various perspectives from studies on the topic of mental health in Pacific youth. The findings may provide evidence for mental health services that cater to Pacific youth. More research is needed, and the gaps of knowledge identified serve as a basis for future research possibilities.

Introduction

Before the early 2000s, little was known about the prevalence of mental illness among Pacific peoples. In New Zealand, Pacific peoples rarely presented to community mental health clinics with common mental illness diagnoses such as anxiety and depression compared to other ethnic groups.[1] It was therefore assumed that they had lower rates of mental illness than the general population. The ground-breaking Te Rau Hinengaro study in 2006 showed that New Zealand's Pacific peoples had higher rates of anxiety and mood disorders compared to the general population.[1] The Youth2000 survey series found Pacific youth were more likely to attempt suicide than the general population.[2] A 2017 review of suicide data has also concluded Pacific youth are more at risk of attempting suicide.[3]

There has been a paucity of recent research on Pacific mental wellbeing. Some research on rates of suicide in Pacific peoples has been conducted in New Zealand, but there has been little quantitative research on Pacific youth mental health in the Pacific region. This article aims to review existing evidence that discusses anxiety and depression among Pacific youth, and to identify gaps in the literature to direct further research in this area. It is hoped this will contribute to a growing evidence base to help inform policy and improve Pacific youth mental health initiatives.

Methods

The databases Scopus, Medline, PubMed, and Google Scholar were used to gather literature. The search terms focused on the three most important aspects of the review's aims. Key words for mental health were "mental health", "wellbeing", "anxiety" and "depression". Key words for Pacific peoples were "Pacific" and "Polynesia". Key words for youth were "youth" and "adolescent". Only literature written in English was accepted for review. Reports from a variety of organisations such as the World Health Organisation and the United Nations were included. In addition, the supervisor's personal collection of Pacific literature was included. In total, 91 pieces of literature were reviewed and 51 included in this article. Initially, the literature review was confined to the period between 2010-2016. However, due to a lack of evidence within this timeframe, it was extended to 2005. Due to the limited evidence pertaining to anxiety and depression for Pacific youth, evidence for Pacific peoples of all ages has been included. It is difficult to undertake a review on anxiety and depression without encountering evidence that includes mental illness, psychiatric distress and suicidal behaviours. Additionally, there is very little literature around anxiety and depression alone in the Pacific youth population. The search criteria were thus redefined to include studies that explored mental illness, psychological distress, and suicidal behaviour. The method used comes with limitations. Literature written in languages other than English were not included, despite the strong French presence in the Pacific. Literature may not be held on mainstream online databases, and therefore were not included in this review.

Results

Prevalence of anxiety and depression among Pacific youth

In the Pacific region, Pacific youth are more likely to experience a mental illness such as anxiety and depression compared to other ethnic groups. In the early 2010s, the United Nations conducted a Global School-Based Student Health Survey (GSBSHS) which included 12 Pacific Island nations. The questionnaire was sent out to students aged 13-17 years, and included questions around their mental health. Mental health statistics on loneliness, suicidal ideation in the past twelve months, and suicide attempts in the past twelve months, were collected from the survey.[3-14] The results, summarised in Figure 1, illustrate that youth from the Pacific Islands have higher levels of suicidality compared to the New Zealand youth population. According to the GSBSHS and the Youth'12 survey, a Samoan high school student was twenty times more likely to attempt suicide than a New Zealand high school student.[12, 15]

In New Zealand, Pacific youth are more likely to experience mental illnesses such as anxiety and depression compared to the general

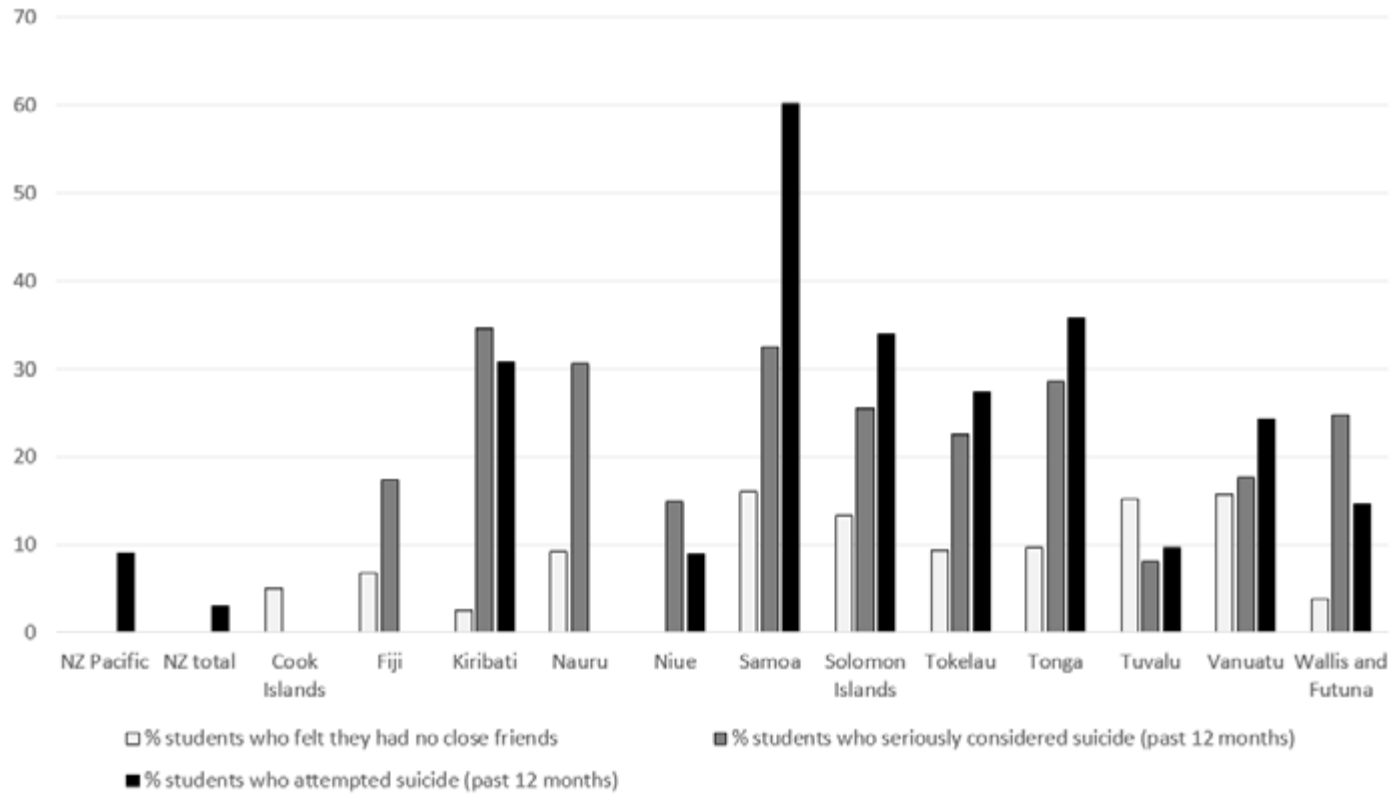

Figure 1. Summary of responses to the Global School-Based Student Health Survey and the Youth'12 survey on mental health and suicidality[1-3]

population. A 2011 report from the Mental Health Commission stated that 21.8% of Pacific children and youth had experienced some sort of psychological disorder, compared to 19.5% of children in total.[17] A report released from Statistics New Zealand and the Ministry for Pacific Peoples (formally, the Ministry of Pacific Island Affairs) in the same year reported that Pacific youth were twice as likely to have depression, be anxious, or attempt suicide compared to non-Pacific youth.[18] Pacific youth were also found to have lower contact with mental health services, with only 7.9% attending mental health clinics compared to 13% of non-Pacific, non-Maori youth.[1]

In the United States, there is evidence to suggest that Pacific peoples have higher rates of mental illness than non-Pacific peoples. It is difficult to determine the exact rates of anxiety and depression in American Pacific youth, as 'Pacific Islanders' are often grouped with Asian Americans in data sets. However, a 2013 study confirmed that 4.8% of the American Pacific population suffered from moderate to severe depression, compared to 1.5% of American Asians and 3% of the total population.[19] Pacific peoples in the United States also had less engagement with counselling services proportional to their representation in the population.[20]

Risk factors and protective factors impacting on anxiety and depression among Pacific youth

The evidence highlights that for most Pacific youth, the themes of spirituality, religion, culture, and family underpin mental wellbeing. These themes can be seen as both risk factors and protective factors. For Pacific youth living in the Pacific Islands, urbanisation and modernisation are risk factors for mental illness. For migrant Pacific youth, acculturation, deprivation and discrimination are risk factors mental illness. These factors are summarised in Figure 2.

In the Pacific Islands themselves, studies have explored the harmful and protective links between spirituality and mental illness.[21-24] Literature stated that Pacific peoples were likely to attribute mental illness to spiritual

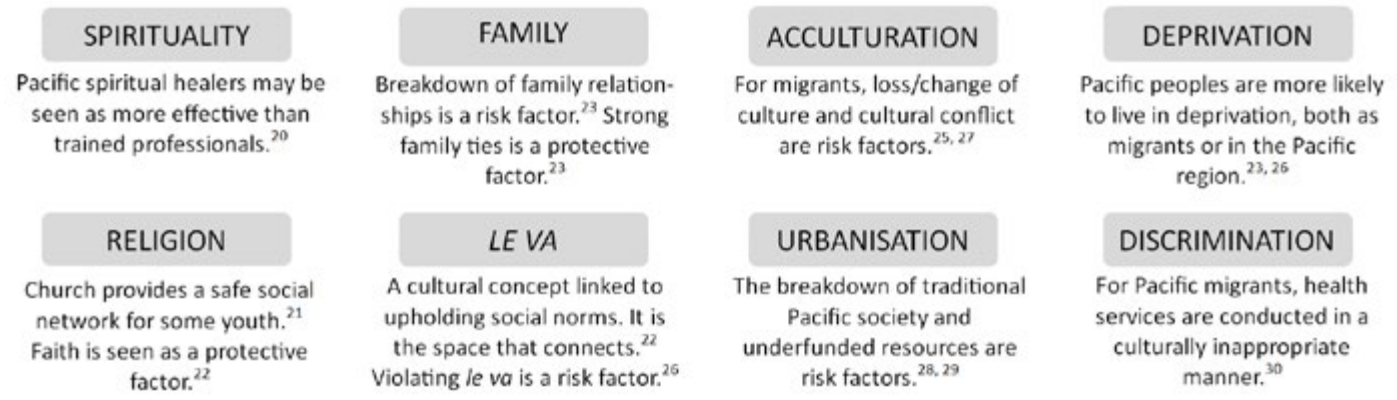

Figure 2. Summary of factors identified in the literature that influence the prevalence of anxiety and depression in Pacific youth.

possession. These spirits could be benevolent or malicious, depending on the island's culture. Studies also found that traditional healers were often considered more trustworthy and effective than Western mental health professionals, and in some cases, Western treatments seemed to exacerbate mental illness among Pacific patients.[21, 24, 25] New Zealand studies focusing on Pacific peoples have identified ghosts, intergenerational curses, and offending spirits as causes of mental illness.[26-28]

Religiosity is a strong theme that underpins Pacific mental wellbeing. With 80% of New Zealand Pacific peoples affiliated to a church, it is believed that close community networks provide a safe sociocultural support to those with a mental illness.[26] In addition, prayers from a church minister help to relieve mental illness.[28, 30] Strong spiritual and religious faith is often seen as a protective factor for mental illness, and can help hasten recovery time.[28, 29]

The cultural concept of *'le va'* was identified in the literature as being a both a risk factor and a protective factor, primarily in Samoan youth anxiety and depression. *Le va* can best be translated as an interconnecting space that connects people together, nurturing positive relationships between them.[24, 26, 28, 30-33] The literature indicates that mental illness in Pacific peoples is borne out of an imbalance of these relationships. Harming the space, or *le va,* is a consequence of overstepping boundaries, whether they be on a societal, community, familial, and individual level.[22, 24, 30, 33] To violate *le va* is to disrespect Samoan social norms, beliefs and standards, and subsequently offend one's family and community.[34] Consequences of offending *le va* can include public humiliation and loss of status. This in turn may lead to the onset or development of mental illness.[35]

Family is another important theme to consider when examining Pacific youth anxiety and depression, as it is both a risk factor and a protective factor.[35] The breakdown of traditional family structures in the Pacific region has led to an increase in negative mental health outcomes for Pacific youth.[36] Bereavement of a close family member may also be a contributing factor towards mental illness.[35] Strong familial and societal pressures to conform to Pacific social norms are another risk factor for Pacific youth mental illness and suicidality.[16, 37, 38] However, research shows that when the family of a Pacific mental health patient is included as a positive and encouraging support structure during recovery, the patient experiences improved mental health outcomes at a faster rate.[28, 39]

For youth living in the Pacific Islands, urbanisation and modernisation are risk factors for anxiety and depression. Studies claim that unemployment, poverty, and a breakdown of the traditional supportive village structure have all played a role in increasing mental illness among Pacific young peoples.[21, 36] This is coupled with under-resourced and over-stretched mental health services and an ingrained stigma associated with mental illness.[40, 41]

The consequences of historical migration are risk factors for mental illness in New Zealand Pacific youth. Acculturation is an important risk factor. Acculturation describes the loss of, or change of, a person's traditional culture when confronted with their adoptive culture.[42] An example for New Zealand Pacific youth is the difference between defining the concept of 'self' in New Zealand European and Pacific settings. For many Pacific communities, the concept of self is relational and dependent upon the relationships one has with their family and community. In a Westernised setting such as New Zealand, the concept of self is normally deemed individualistic and independent.[31, 33] Pacific youth experience conflict between these opposing world views, which can lend itself to psychological distress and mental illness.[39] The literature argued that Pacific youth who are New Zealand born, or of mixed-ethnic Pacific and New Zealand European ethnicity, are more likely to experience the negative effects of acculturation on their mental health.[39, 43, 44]

The literature identified poverty, unemployment, social and economic constraints, economic and cultural pressures, and social deprivation as major risk factors for Pacific mental illness.[28, 39, 43, 45-47] The Samoan practice of *fa'alavelave,* in which individuals remit some of their financial earnings to their family and wider community, has been identified in the literature as an economic risk factor for depression.[39, 43, 48] Pacific peoples are more likely to live in areas of higher social deprivation, which can be correlated to higher rates of suicide. In addition, they have higher rates of suicide than those of European descent in the same deprivation bracket.[3] Pacific patients are less likely to engage with mental health services and experience barriers to accessing these services in relation to transportation costs, extra childcare costs, and taking time off work.[28]

Pacific youth living in developed countries are more likely to be discriminated against, which is a risk factor for mental illness. Studies from New Zealand and the United States have found that perceived discrimination leads to heightened stress, anxiety and depression.[19, 49] A New Zealand study showed that increased bullying of nine-year-old Pacific boys led to an increase in their depressive symptoms.[50] In addition, there is an undercurrent of discrimination in the provision of mental health services for Pacific peoples, as most services are conducted in English. This lack of Pacific health literacy was described by Pacific patients as being culturally inappropriate.[31, 51]

Discussion and future research recommendations

The literature indicates that there is a significant gap in evidence-based knowledge on Pacific youth anxiety and depression. The Global School-Based Student Health Survey has limitations, as there were no specific questions around anxiety and depression. Questions instead pertained to loneliness, suicidal ideation, and suicide attempts. In addition, the disproportionate number of students admitting to suicide attempts but not suicide ideation in countries such as Samoa calls into question the efficacy of the survey. Many of the conclusions drawn from the survey results were therefore exploratory. The New Zealand data collected was either old and detailed, or current and generalising. Many conclusions in this literature review were therefore drawn on mental illness rates in New Zealand Pacific adults from older literature.

It was challenging to interpret literature from the United States, as the category 'Pacific Islanders' was often paired with Asian Americans, in a group termed AAPI. Studies have shown that Asian Americans have a lower prevalence of mental illness than 'Pacific Islanders', and so any study that did not separate the two ethnic groups falsely cited Pacific Islanders as having a low risk of mental illness.[20] The evidence collected from American studies focused mainly on risky sexual behaviour, violence, or substance abuse, instead of anxiety, depression, or psychological distress. It was difficult to interpret this data for the literature review. Research from the United States may have focused on high rates of Pacific violence and substance abuse because it presents more immediate damage to American society than high rates of anxiety and depression.

Many studies chose to investigate the near-epidemic rates of suicide in the Pacific. However, these studies noted that in ethnic minorities suicide is not strongly linked to mental illness and that suicide may not be an appropriate indicator for anxiety and depression. An alternative view on this is that stigma against mental illness, alongside underfunded mental health services, could be the cause of high suicide rates but low mental illness diagnoses not proportionate to the population.

Older studies highlighted the importance of spirits, witchcraft, magic or religious beliefs in the pathology of mental illness in Pacific populations. In contemporary Pacific youth, themes such as *le va,* acculturalisation, modernisation, and poverty may more important risk factors of mental illness.

More research is needed on the rates of anxiety and depression among youth in the Pacific region. A culturally relevant Pacific study focusing solely on mental illness such as anxiety and depression is needed to address this gap in the literature. More research is needed on Pacific mental illness in the United States, as ethnic grouping of Pacific Islanders and Asian Americans is misrepresenting Pacific peoples in mental health data. More New Zealand-based Pacific mental health research is needed,

focusing on the rates of anxiety and depression in New Zealand-born and Pacific mixed-ethnic youth.

Conclusion

This literature review concludes that Pacific youth are experiencing higher levels of depression and anxiety compared to other ethnic groups worldwide. Themes such as spirituality, family, religion and ***le va*** are risk and protective factors for Pacific youth across the globe. Acculturation and deprivation are risk factors for migrant Pacific youth. Urbanisation and modernisation are risk factors for Pacific youth in the Pacific region. Pacific youth mental health and wellbeing is an under-researched area of study. There are a number of opportunities to develop this field with new and innovative information.

Conflicts of Interest: None

Funding: University of Auckland Summer Research Scholarship

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Glycaemic control in Otago children with type 1 diabetes

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Final year medical students at the University of Otago undertake a research project, as part of their medical education, in the Department of Preventive and Social Medicine, to extend their knowledge of research methods and develop strategies for avoiding or ameliorating problems in the delivery of health care.

Abstract

Introduction: Type 1 Diabetes mellitus (T1DM) is one of the most common chronic childhood diseases. Regular glycaemic control audits are important for the Otago region to evaluate its management of this population. This audit aimed to describe the change in glycaemic control using HbA1c, by year from 2009 to 2011, and May 2016 to April 2017, in Otago children (aged <18years) with T1DM; and to compare these children to national HbA1c targets.

Methods: Recorded HbA1c data were retrospectively collected from the Southern District Health Board (SDHB) diabetes database on 131 patients, 0 - 18 years inclusive, with T1DM, for periods 2009, 2010, 2011 and 2016/ 2017. This data was analysed using Microsoft excel version 2016 and R v3.4.0 software.

Results: Mean all-age HbA1c values were lower in 2016/2017 when compared to 2009-2011 (71 mmol/mol and 77 mmol/mol, respectively). Average HbA1c value in the 0-12 age group remained constant while the 13-18 age group decreased (84 in 2009 to 73 in 2016/2017). The percentage of children achieving guideline HbA1c targets were 11% in 2011 and 30% in 2016.

Conclusion: Mean HbA1c values of children with T1DM in Otago in the 2016/2017 group were lower than National Diabetes Audit Mean HbA1c values. The average HbA1c (73 mmol/mol) is still above the recommended target value of 58 mmol/mol. There were more children meeting the target value in 2016/2017 compared with 2009-2011.

Ethics consultation:

Ethics approval was not required for this project, however the University of Otago Human Ethics Committee (Health) were consulted for use of health-related audit data. The Ngāi Tahu Research Committee were consulted during this process to ensure effective audit data research in accordance with benefiting Māori development.

Background

Type 1 diabetes is one of most common chronic diseases of childhood. Internationally the incidence of type 1 diabetes has been increasing.[1] Local research suggests that similar trends have been occurring in New Zealand. In a 2012 Auckland review of type 1 diabetes in children aged 0-14 years, the incidence increased from 10.9 per 100,000 in 1990, to 22.5 per 100,000 in 2009. The greatest increase in incidence occurred among children aged 10–14 years.[2] A similar review was done in Canterbury of type 1 diabetes in young people aged 15–24 years. The researchers found an increased prevalence of about 45 per 100,000 (12%) between 2003 and 2010.[3] A cross-sectional survey of 4,721 New Zealanders aged 15 years and above found a diabetes prevalence of 7.0%. They were unable to distinguish between type 1 or type 2 diabetes in their study. It was more frequent in men (8.3%) than women (5.8%). Pacific Islanders (15.4%) and Māori (9.8%) had a higher prevalence than NZ European and Other groups (6.1%).[4]

Diabetes is an illness of special interest for the Ministry of Health and the Southern DHB. The national priority of the National Diabetes Work Programme is on delivering and enhancing care and quality of life for people with diabetes.[5] This includes prevention, identification and management of the increasing burden of this disease. Maintaining glycaemic control is important as healthy control is associated with a lower risk of long term complications of diabetes as demonstrated by long-term follow-up studies.[6, 7]

Glycaemic control can be estimated by measuring the glycated haemoglobin A1c (HbA1c) level indicating the level of glucose in the blood over the previous 12-week period.[7] The International Society of Paediatric and Adolescent Diabetes (ISPAD) recommends a HbA1c target of <58 mmol/mol (7.5%) for those children who have T1DM, which is reflected in the *New Zealand Starship* guidelines.[8, 9] As adolescents progress into adulthood, this level is reduced slightly to the adults' target HbA1c of 53 mmol/mol (7.0%).[10] It has been reported that children and adolescents often fail to meet glycaemic targets. Analysis of international paediatric diabetes registers show that 54-58% of paediatric patients fail to achieve the international target haemoglobin for young people (58 mmol/mol).[9] This is particularly noticeable as children enter the pubescent period with a number of studies showing poorer glycaemic control in the adolescent population.[11] A 2006 New Zealand national audit of diabetes in young people aged 0 - 26 years suggested inadequate glycaemic control with a group mean HbA1c of 76 mmol/mol (9.1 +/- 0.3%).[12]

Over the past 10 years considerable changes have occurred in New Zealand and Otago regarding access to diabetes technologies (insulin infusion pumps), insulin therapies, and target orientated goal setting. Insulin pump therapy has gained popularity since its advent. In New Zealand, insulin pumps became eligible for public funding in September 2012. Between 2012 and 2014, funded pump use among patients with type 1 diabetes (n = 13,727) increased from 1.8 to 9.3 % overall.[13] This change follows a similar pattern worldwide as insulin pumps may offer a number of advantages. Continuous infusions have been shown to achieve HbA1c targets, lower insulin requirements and decrease treatment induced hypoglycaemic crises and/or ketoacidosis hospital admissions, ultimately improving patient quality of life.[14]

It is unclear how well these apparent clinical benefits seen in randomised clinical trials translate into clinical practice in New Zealand. Quality of control of T1DM may be affected by many variables such as patient selection and motivation, and the insulin pump experience of the medical

team. Bock et al.'s retrospective analysis compared glycaemic control of paediatric T1DM patients in Auckland using insulin pump therapy or non-pump therapy, it was affirmed that there were significant improvements in HbA1c and episodes of hypoglycaemia for insulin pump users in accordance with international data.[15]

The objectives of project were to describe the change in HbA1c, by year, for periods 2009, 2010, 2011, and May 2016 to April 2017, in Otago children (aged <18years) with T1DM; and to compare these children to the national and international T1DM HbA1c targets.

Methods

Recorded HbA1c levels were extracted by the SDHB from three databases based on the following criteria: patients seen in paediatric diabetes clinic from 2009-2016 and aged <18 years of age at time seen in clinic. The three databases that were interrogated included the SDHB database of paediatric patients, and two laboratory databases of HbA1C results, covering 1998-2011 and May 2016-April 2017 respectively. The databases were linked, matching paediatric patients to their HbA1c values, giving matched cross-over data for 2009, 2010 and 2011. HbA1c data were not available for 2016 in its entirety, so data in the 12-month period from 1 May 2016 to 30 April 2017 were used instead. Linking the databases resulted in 2291 HbA1c records.

Mean HbA1c per year per patient was calculated, resulting in 331 measurements. 51 measurements were excluded based on the following criteria: non-type-1 diabetes or a date of diagnosis less than three months prior to the latest available HbA1c measurement. After exclusion, 280 measurements per patient per year remained. There was 85-90% overlap in patients between the 2009, 2010, 2011, and 2016/17 year groups enabling HbA1c trend evaluation. Data was stratified by age into two groups (0-12, 13-18), to reflect changes in glycaemic control between children and adolescents. Mean and median HbA1c were calculated for each year group. The proportion of all patients meeting international HbA1c targets was calculated.

Results

As seen in Table 1 Mean all-age HbA1C values were 77, 77, 77 and 71 mmol/mol in 2009, 2010, 2011 and 2016/2017 respectively. In the 0 to 12 age group, mean HbA1c values were 71, 70, 70 and 69 mmol/mol in 2009, 2010, 2011 and 2016/2017 respectively. In the 13 to 18 age group, mean HbA1C values were 84, 85, 84 and 73 mmol/mol in 2009, 2010, 2011 and 2016/2017 respectively.

As seen in Table 2, the proportion of children meeting the HbA1c target of 58 mmol/mol was 7%, 6%, 11% and 30% in 2009, 2010, 2011 and 2016/2017 respectively.

Summary

Otago HbA1c values for paediatric patients with Type 1 Diabetes are lower when compared with the 2006 Diabetes Audit.[12] However, the average HbA1c for each year was above the 58 mmol/mol recommended target for diabetic control in young people. There is a lower mean HbA1c value in the 2016/2017 year compared with the HbA1c values in the 2009-2011 year groups. This change came primarily from the 13-18 year group while the 0-12 age group remained consistent. It is not clear what proportion of the 0-12 year group 2009-11 moved on to the 13-18 aged by 2016/17 in the sample. The percentage of children who met the target HbA1c value increased in the 2016/2017 year compared with the 2009-2011 years. This result is consistent among both age groups measured.

Discussion

Based on these findings it would appear that overall glycaemic control has improved slightly in the 2016/17 year compared to 2009-2011, with more individual means trending closer to the national and international HbA1c target of 58 mmol/mol. This trend is primarily seen in the 13-18 year group, while the 0-12 age group remained fairly consistent over the 2009-2011 periods. It is unclear if continuous insulin infusion pumps are a possibly, explanation in an age group where one would expect poorer glycaemic control, as children in the pubescent period start assuming autonomy over their glycaemic control, typically showing elevated HbA1c measurements with the multiple insulin injection regime. However, there are many limitations to our dataset which make this difficult to confidently assert. If we accept that our results accurately represent an improvement in glycaemic control, this could possibly be due to the funding and subsequent uptake of insulin pumps for type 1 diabetics which occurred in 2012.

Despite the National 2006 audit not containing any data for the Southern DHB, it is reassuring that our results for Otago children with type 1 diabetes are roughly concordant with those found for other regions.[12] This lower mean HbA1c in 2016/17 may indicate diabetic control improving over the last 10 years for children and adolescents in the Otago region. However due to the significant limitations of our data as described above, it is difficult to make any meaningful conclusions about diabetes control in this population.

For this study, we had initially intended to investigate the trend in HbA1c over the past 8 years. However, we encountered many challenges in acquiring the appropriate data in the limited time available for this project. Due to time restraints, our final data set was lacking HbA1c data for the years of 2012-2015, which limited us to describing the average HbA1c levels by year and age group. We had initially planned to perform a more in-depth analysis of diabetes control, investigating the effect of insulin delivery method, ethnicity and BMI on HbA1c levels as a marker of diabetes control. However, the datasets lacked the information required to perform these analyses.

In our analysis, we used both mean HbA1c for each unique patient per year, as well as using only their last HbA1c measurement each calendar

Table 1. Mean cohort HbA1c (mmol/mol) measurements per year. Key: x (mean); M (median); n (number).

	2009			2010			2011			2016-2017		
Age	x	M	n	x	M	n	x	M	n	x	M	n
0 to 12	71	73	34	70	69	41	70	72	37	69	64	23
13 to 18	84	78	35	85	83	38	84	83	39	73	71	33
All ages	77	75	69	77	75	79	77	75	76	71	68	56

Table 2. Proportion of children meeting international HbA1c target by year

	2009			2010			2011			2016-2017		
	%	No. meeting target	Total No.	%	No. meeting target	Total No.	%	No. meeting target	Total No.	%	No. meeting target	Total No.
0 to 12	12	4	34	12	5	41	14	5	37	35	8	23
13 to 18	3	1	35	0	0	38	8	3	39	27	9	33
All ages	7	5	69	6	5	79	11	8	76	30	17	56

year. This was to assess whether using a mean value would bias the results towards higher values. Conversely, using only their latest measurement would theoretically provide an overall lower HbA1c level as ideally, the longer a patient is under the care of a diabetes team, the better their diabetes control becomes, as represented by a lower HbA1c. However, in our analysis we found that overall, using the mean HbA1c value resulted in either no difference, or at most a 1 mmol/mol higher mean HbA1c in each year compared to using only the latest measurement.

Using a single value for HbA1c per patient, rather than including multiple measurements from each patient, avoided overrepresentation in the data of patients who had poorly controlled diabetes and therefore who may have had more frequent monitoring. We excluded those patients diagnosed in less than 3 months prior to their latest HbA1c measurement, as we acknowledge that HbA1c values from these would reflect blood glucose levels from prior to starting treatment. The dataset was combined for 2016/2017 to obtain an adequate sample size for comparison with 2009, 2010 and 2011 datasets. We noted the lower patient numbers (n=56 in 2016/2017) are possibly due to patients lost to follow-up whether having moved out the region for work or study, or having transitioned to the adult diabetes services. This group also displayed greater variance compared to previous years. Although this is unlikely to affect the mean (Table 2), this may have resulted in more patients falling below the HbA1c target value by chance. This limitation to the data must be considered prior to asserting conclusions regarding glycaemic control.

Further research could be undertaken in this area for the purpose of improving glycaemic control in the Otago paediatric diabetes population. With a more comprehensive data set, it would be possible to compare insulin regimen and patient characteristics with trends in HbA1c, which could help inform clinician management choices. An audit of progress in glycaemic control, as measured by HbA1c, in terms of age and insulin regimen would be of great interest and help with future goal setting and monitoring of paediatric teams' progress over the region, especially given that public funding of insulin pumps began in 2012 in New Zealand. This information may assist in negotiations for accessing additional resources in the Otago region.

Acknowledgments

1. Southern District Health Board Diabetes Database for providing audit data for analysis.
2. Associate Professor John Dockerty and Dr Ari Samaranayaka, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, for supervising this project.
3. Dr Ben Wheeler, Department of Women's and Children's Health, Dunedin School of Medicine, University of Otago, for assisting with the data and development of this research project.

Conflicts of Interest: None

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Supplementary figures

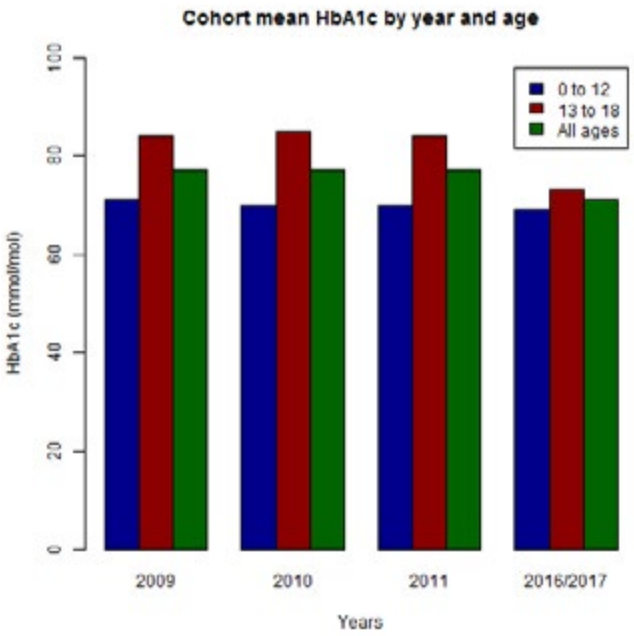

Figure 1. Graphic representation of mean cohort HbA1c measurements by year and age.

A lower mean HbA1c value in 2016/2017 compared to the 2009-2011 year groups. This is noticeable in the 13-18 year while the 0-12 age group showed similar trends over the study periods.

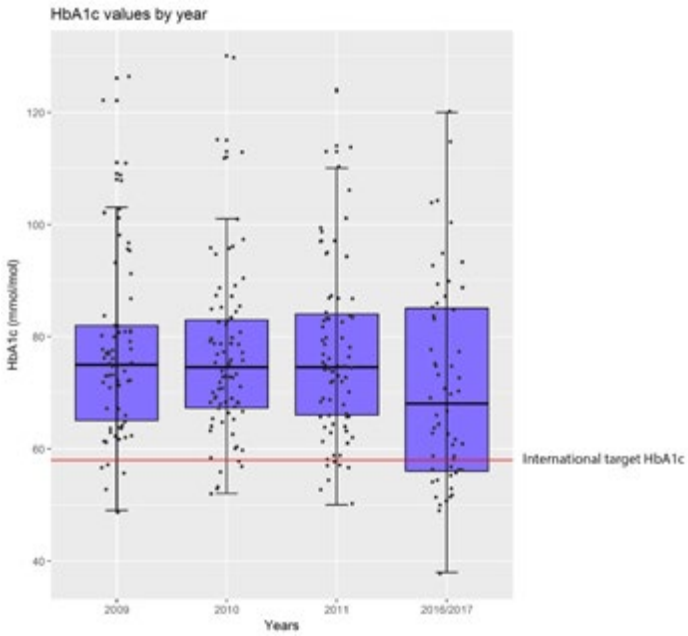

Figure 2. Bar-and whisker mean HbA1c measurements in all ages by year compared to guideline targets.

The average HbA1c values for each year in Otago T1DM paediatric patients were above the recommended target (58 mmol/mol). The percentage of children who met the target increased to 30% for all ages in the 2016/2017 year compared with the range of 6-11% for the 2009-2011 years.

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Treatment of lupus nephritis

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Sarah is a first year house officer at Middlemore Hospital. She graduated from the University of Auckland in 2016. Sarah wrote this case study during her General Medicine attachment in her final year at university. As she progresses through her training as a doctor, she hopes to become more involved in the field of medical education. Outside of medicine, she is a classically trained singer.

Abstract

This case demonstrates a classical presentation of newly diagnosed systemic lupus erythematosus (SLE) in a previously fit and healthy 23 year old woman. A significant feature of Ms EX's presentation is the renal involvement of her SLE, classified as Class III A Lupus Nephritis. There are two main treatment options considered for Ms EX's active lupus nephritis: a combination of 1) cyclophosphamide or 2) mycophenolate mofetil with methylprednisone (given in pulses), followed by prednisone (tapering course). The discussion below summarises the current literature on short- and long-term treatment of lupus nephritis.

Case Report

Ms EX, a 23 year old Samoan woman, presented with a one month history of headaches, fevers and night sweats.

The headaches were bi-frontal in location with no radiation. They occurred intermittently almost every day, with each episode lasting three to four hours. They were described as a dull, heavy ache. There were no associated speech or visual changes, weakness, or numbness.

During this time Ms EX was suffering from fevers and night sweats. She also reported generalised myalgia, fatigue and anorexia. There was no history of weight loss. A non-itchy, red rash had also developed on both her arms over the past month. Three days prior to admission, a new red rash had appeared on Ms EX's face in the butterfly distribution. She denied any photosensitivity. Review of systems revealed no further symptoms.

Ms EX had no relevant past medical history and was not using any regular medications. She reported no recent overseas travel and family history was unremarkable.

Ms EX was living at home with her parents. She was enrolled in a hospitality course but had missed a month of this due to her current illness. She was a non-smoker and did not drink alcohol.

On examination, Ms EX was febrile at 38.3°C. Her arms revealed a widespread blanching vasculitic rash bilaterally. There was a malar rash present on her face and her lips and oral mucosa were ulcerated. There were no other positive findings.

Several investigations were carried out on Ms EX. Below are the relevant results (the extractable nuclear antigen antibodies [ENA] screen results are presented in Table 1):

- Erythrocyte sedimentation rate 136 mm/hr (1 – 19 mm/hr);
- C-reactive protein 74 mg/L (0 – 5 mg/L);
- Creatinine 102 μmol/L (45 – 90 μmol/L) ;
- Mid-stream urine: protein-creatinine ratio 128 mg/mmol (< 23 mg/mmol), 3 hyaline casts;
- Antinuclear antibodies: Positive;
- Complement C3 0.2 g/L (0.8 – 1.8 g/L), C4 <0.1 g/L (0.2 – 0.6 g/L);
- Kidney biopsy: Class III A (proliferative) lupus nephritis.

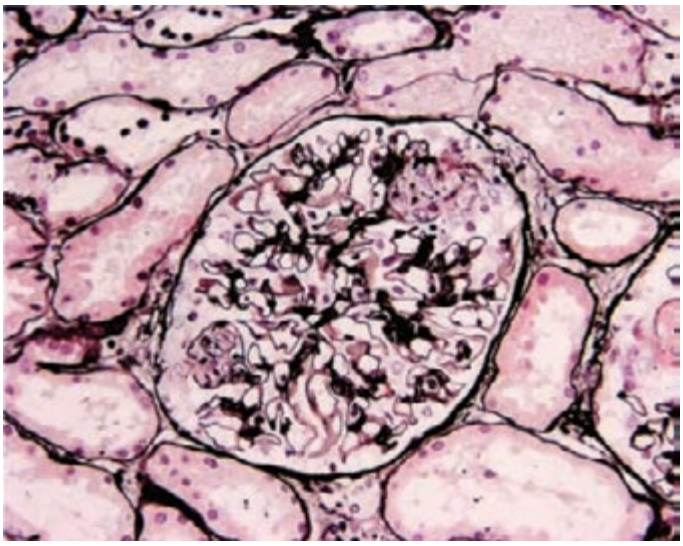

Figure 1. Light micrography demonstrating a glomerulus with segmental capillary necrosis however sparing of the remainder of the capillary tuft, a vasculitis-like lesions (methanamine silver)[1]

Table 1. ENA screen results for Ms EX in ELISA Units (EU); positive results ≥ 20

ENA Screen for Ms EX in ELISA Units (EU)	
Anti-SS-A	133 EU
Anti-SS-B	17 EU
Anti-Sm	>200 EU
Anti-Sm/RNP	171
Anti-Scl-70	51
Anti-Jo-1	22
Anti-DsDNA	>200
Anti-Centromere	7

Table 2. 1997 Update of the 1982 American College of Rheumatology Revised Criteria for Classification of SLE.[1] A patient must meet four or more of the above 11 criteria for them to be classified as having SLE.

The Diagnostic Criteria for SLE according to the American College of Rheumatology	
Malar Rash	Fixed erythematous rash either flat or raised over the malar eminences
Discoid Rash	Raised erythematous patch with keratotic scaling, follicular plugging or atrophic scaring
Photosensitivity	Skin rash caused by an unusual reaction to sunlight
Oral ulcers	Ulcers in the mouth or nasopharynx, usually painful
Arthritis	Non-erosive joint inflammation involving ≥ 2 peripheral joints
Serositis	Pleurisy or pericarditis
Renal disorder	Persistent proteinuria or presence of cellular casts
Neurological disorder	Seizures or psychosis not explained by other causes
Haematological disorder	Haemolytic anaemia with reticulocytes, leukopenia, lymphopenia or thrombocytopenia
Immunological disorder	Presence of Anti-double stranded DNA, Anti-Smith or positive findings of antiphospholipid antibodies (anticardiolipin antibody, lupus anticoagulant, or false positive venereal reference laboratory test)
Anti-nuclear antibody	Abnormal ANA titre at any point in time in the absence of drugs known to be associated with drug-induced lupus syndrome

Together, Ms EX's clinical presentation and investigation results indicated a new diagnosis of systemic lupus erythematosus, with Class III A lupus nephritis and possible CNS lupus.

Discussion

Background

Systemic Lupus Erythematosus (SLE) is a chronic, multi-systemic autoimmune disease. In European populations it is more common in women than men, with a female to male ratio of 9:1.[3] Although SLE can affect any age group, it typically manifests during the reproductive age in women.[3] In New Zealand the prevalence of SLE is significantly higher in Pacific Islanders and Māori.[4]

Approximately 50% of all SLE cases will develop renal involvement, termed lupus nephritis.[5] This is one of the more serious and common manifestations of SLE. Lupus nephritis occurs through a complex inflammatory process following the deposition of immune complexes in the glomerulus, ultimately leading to glomerulonephritis and in severe cases necrotising crescentic GH (Class IV). Long term, lupus nephritis may progress to ESKD.

A retrospective New Zealand study conducted in 2007 demonstrated that Pacific Island and Māori people were at a three times and eight times higher risk respectively of developing lupus nephritis compared to European populations.[4] In Ms EX's case, a high index of suspicion for lupus nephritis was maintained due to the elevated serum creatinine, increased protein-creatinine ratio, and presence of hyaline casts in the urine. These laboratory-based indicators of a decline in kidney function warranted a kidney biopsy. A kidney biopsy is the gold standard for the diagnosis of lupus nephritis.[6] It enables lupus nephritis to be classified on the basis of histopathology. This classification further guides therapeutic options and indicates likely prognosis.[7] According to the ISN/RPS lupus nephritis 2003 classification, Ms EX's lupus nephritis was classified as Stage III A.[7]

Treatment of Lupus Nephritis

Proliferative lupus nephritis, such as Class III lupus nephritis, is treated using immunosuppressive agents. Treatment can be divided into two forms: induction and maintenance therapy.

Induction

Induction therapy aims to delay disease progression and achieve remission. The first agents used for the treatment of lupus nephritis were corticosteroids, such as methylprednisone. However, in the 1970s, several clinical trials, including those carried out at the National Institutes of Health, showed that the combination of cyclophosphamide (CYC), a cytotoxic agent, and corticosteroids was more superior in producing remission than corticosteroids alone.[5] Since then, this combination became the first-line regimen for induction therapy of lupus nephritis.[5,8] Nevertheless, despite its high efficacy, CYC has numerous adverse effects, including bone marrow suppression, increased risk of infection, haemorrhagic cystitis, bladder cancer, and gonadal failure.[5]

Over the past decade, mycophenolate mofetil (MMF), a drug used for preventing transplant rejection, has emerged as another agent to pair with corticosteroids for induction therapy. A Cochrane review comparing various regimens of MMF and CYC in 10 randomised controlled trials (RCT) demonstrated that MMF was as effective at achieving remission in lupus nephritis as CYC, but was associated with fewer adverse effects of premature ovarian failure, alopecia, and leukopenia.[8] However, one disadvantage of MMF was that it caused more gastrointestinal side effects such as diarrhoea than CYC. It should also be noted that a major contraindication to both MMF and CYC is pregnancy, as both these drugs are teratogenic.[5]

There are fewer studies conducted on the use of azathioprine (AZA), a purine antimetabolite, as an agent in induction therapy. However, two randomised control trials have both showed that long-term AZA used in induction therapy was associated with higher relapse rates than CYC.[9, 10]

More recently, calcineurin inhibitors, such as cyclosporine and tacrolimus, have been investigated as induction agents. A small RCT comparing cyclosporine and CYC in 40 patients found no difference between the two treatments after 40 months of treatment.[11] Another small pilot study with a study population of 60 patients, compared tacrolimus to MMF and concluded that there was potentially faster resolution of proteinuria and hypoalbuminemia with tacrolimus than the other two agents.[12]

Biological agents such as rituximab have also been considered for use of induction therapy in lupus nephritis. The LUNAR study, a RCT with 114 participants, found that rituximab therapy resulted in a greater reduction in serum anti-dsDNA and C3/4 than CYC. However, after a one year treatment period, this did not lead to any improvement in clinical outcomes.[13]

Meaningful conclusions into the efficacy of tacrolimus, cyclosporine and rituximab as induction agents cannot be drawn due to the limited number of RCTs and the small sample sizes in the studies completed.

Since Ms EX is a young woman of childbearing age, the most appropriate induction therapy for her lupus nephritis would be MMF with methylprednisone, as it has a more favourable side effect profile compared to CYC and achieves similar efficacy.

Maintenance

After remission is achieved, maintenance therapy is given to prevent relapse and reduce the risk of developing end-stage renal disease. This is usually achieved with either MMF or AZA.

In the past decade, the National Institutes of Health trials have demonstrated that maintenance therapy with MMF or AZA is more efficacious and is associated with fewer adverse effects than long-term treatment with CYC.[5] Furthermore, a systematic review carried out by the Cochrane collaboration group on two RCTs also concluded that MMF was superior to AZA in preventing renal flares, but was equal to AZA in doubling creatinine, mortality, risk of infection, gastrointestinal effects and leukopenia.[8] However, another meta-analysis that compared MMF and AZA in four RCTs found that MFF was safer and a better tolerated form of maintenance therapy.[14]

Limited studies have been conducted investigating the use of rituximab as a form of maintenance therapy for lupus nephritis, but it appears to be a promising area of development.[8]

MMF would be a suitable treatment for maintenance therapy in Ms EX's case. However, if Ms EX wished to become pregnant, then AZA could be used as the next best form of maintenance therapy.

Follow up and complications

The degree of renal disease in lupus nephritis is typically monitoring with both clinical examination such as blood pressure recording, as well as biochemical markers: urinalysis, protein/creatinine ratio, serum creatinine, C3/C4 levels and anti-DNA.[15] The frequency of testing is determined by whether the patient has active nephritis at commencement of treatment, previous active nephritis, current nephritis and their current pregnancy status.[15]

In the long run, morbidity in lupus nephritis is linked with the progression of renal disease as well as the adverse effects of therapy. Worsening renal function can lead to hypertension, anaemia, uraemia, electrolyte and acid-base disturbances. Early onset lupus nephritis is also associated with an increased risk of ischaemic heart disease.[16] In cases with nephrotic syndrome there is an added risk of developing coronary artery disease and thrombosis.[17] The major complications from therapy include immunosuppression, and those directly associated with long-term steroid uses: hypercholesterolemia, hypertension, diabetes mellitus, bone thinning, osteoporosis and fractures.[17]

Conclusion

Lupus nephritis is a common manifestation of SLE that is associated with serious mortality and morbidity. For this reason, clinicians must have a low threshold for suspecting lupus nephritis in asymptomatic patients like Ms EX and urinalysis must be undertaken in all patients presenting with evidence suggestive of SLE. In Ms EX's case, laboratory findings pointed towards renal involvement of SLE. This was promptly followed up with a kidney biopsy and the ISN/RPS classification was used to classify Ms EX's lupus nephritis as Class III A. The current literature suggests that the best treatment for Ms EX's lupus nephritis would be with methylprednisone and MFF in the induction phase, followed by MFF and prednisone in the maintenance phase. Suitable alternatives (if MFF was contraindicated) would be CYC and methylprednisone in the induction phase, and AZA in the maintenance phase. More research into newer therapies such as calcineurin inhibitors and biological agents is needed to determine their role in the treatment of lupus nephritis.

Conflict of interest: None

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Typhoid fever in a traveller returned from Samoa

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Maria is a surgical house officer who has been working in the Auckland region since graduating from the University of Auckland in 2015. This case report was written during her time in General Medicine, as a sixth year medical student. Maria intends to pursue a career in surgery (specialty TBC) and particularly enjoys working in the busy and diverse environment at Middlemore Hospital.

Case

A 39 year old male patient presented to Middlemore Hospital directly from Auckland Airport on his return from Samoa, with a 13 day history of febrile illness. His symptoms began with high fevers, chills and polyarthralgia, and diarrhoea developed around day five of his illness. Other associated symptoms included sweating, nausea, intermittent headaches, myalgia and weight loss (10 kg over 2 weeks).

Five days after becoming unwell, the patient was admitted to Apia Hospital overnight. He was diagnosed with presumed Chikungunya fever based on his clinical presentation. Definitive blood tests for viral illnesses such as this are not routinely performed in Samoa. He received intravenous fluids and analgesia and was discharged the following day. When his condition failed to improve the following week, he decided to return to New Zealand.

The patient had been volunteering as a builder in Samoa, including work with septic tanks. He was mostly working outside and had suffered many insect bites. He had also eaten at two local restaurants in the days before becoming unwell. He is normally fit and well, with no significant past medical history and no regular medications. He normally works as a builder, is a non-smoker and drinks minimal alcohol (2-4 standard drinks per week).

On physical examination the patient appeared unwell, with rigors and sweating. His vital observations were normal, other than a low-grade fever (37.6°C). He was clinically dehydrated with dry mucous membranes and his JVP was not visible. There was no rash, joint swelling or tenderness. His liver edge was palpable 1cm below the costal margin, but non-tender. Examination of his abdomen was otherwise normal. Cardiovascular and respiratory examinations were unremarkable.

Investigations

Bloods

- LFTs deranged
- GGT 875 [<60 IU/L]
- ALP 268 [40-110 U/L]
- AST 216 [<45 U/L]
- ALT 455 [<45 U/L])
- CRP 110 mg/L (n = <5mg/L)
- Normal full blood count, electrolytes, creatinine, albumin, bilirubin, mosquito-borne viral panel, hepatitis/ EBV/CMV serology
- Microbiology: normal faecal pathogen screen and midstream urine test, peripheral blood cultures: growth of gram negative bacilli, Salmonella typhi isolated

Imaging

- normal chest x-ray and upper abdominal ultrasound scan

Problem list

- Typhoid fever
- Dehydration, secondary to diarrhoea and reduced oral intake

A 39 year old male patient presented after returning from Samoa with a 13 day history high fevers and diarrhoea, resulting in significant dehydration and weight loss. He appeared visibly unwell with rigors, a low grade fever, and was clinically dehydrated. Laboratory investigations showed deranged liver enzymes, and peripheral blood cultures grew Salmonella typhi.

Although a positive blood culture offers a reasonably confident diagnosis in this case, prior to this result the differential diagnosis was broader. Chikungunya virus, which had been the diagnosis given by the doctors at Apia Hospital the week before, was still a possibility, especially given the current outbreak in Samoa. Chikungunya virus commonly presents with fever and polyarthralgia as the main symptoms and can cause diarrhoea and deranged LFTs (mainly affecting transaminases)[1] which fits relatively well with the clinical picture that this patient first presented with. However, Chikungunya virus is usually self-limiting and symptoms typically resolve within 7-10 days.[1] Other differentials included typhoid fever, acute hepatitis (including hepatitis A, EBV and CMV), or Dengue fever.

Discussion

There are a number of vital pieces of information required when presented with a case of fever in a returned traveller. These include where the patient was travelling, their purpose of travel and the specific activities they undertook, timing of the illness, including symptom onset, duration of travel, how long since they have returned and what measures had been taken against contracting diseases, eg. vaccinations, prophylactic medications.[2] Knowing this information is important when developing a differential diagnosis, combined with knowledge of endemic diseases in the travel destination, current outbreaks and incubation periods.

Febrile diseases that are currently prevalent in Samoa include mosquito-borne viruses, such as Dengue fever, Chikungunya virus and Zika virus and diseases which are spread via faecal-oral transmission, often through contaminated food or water, such as hepatitis A and typhoid fever.[3]

Little information is available regarding ill travellers returning to New Zealand. A study from sites in Auckland and Hamilton published in 2003 found that 14% of travellers who were unwell upon returning to New

Zealand had a febrile illness, of which the majority were of unknown origin. Tropical diseases such as Dengue fever and typhoid fever, although important and potentially fatal, were uncommon.[4]

Salmonella are gram negative bacilli of which there are seven subspecies and >2500 serotypes.[5] Infection with Salmonella enterica serotypes typhi and paratyphi (often shortened to S. typhi and S. paratyphi) causes typhoid fever, also known as enteric fever.[5,6] S. typhi is more common in typhoid fever from the Pacific region,[6] and generally causes a more severe infection than that of S. paratyphi.[5,7] Infection is initiated by ingestion of organisms, usually through contaminated food or water. The organisms leave the gut by being phagocytosed by M-cells in the Peyer's patches of the small intestine, thus crossing the epithelial layer. They are then phagocytosed again by macrophages, which proceed to carry the organisms throughout the body within the lymphatic system, leading to colonisation within tissues including liver, spleen, lymphatics and bone marrow.[5]

The average incubation period of S. typhi is 10-14 days, with typhoid fever often presenting non-specifically with symptoms of prolonged fever and abdominal pain. Other symptoms may include headache, chills, cough, sweating, anorexia, nausea, vomiting, myalgia, arthralgia and diarrhoea or constipation. A 'rose spot' maculopapular rash may be present on the trunk or chest of about 30% patients during the first week of illness. If untreated for 3-4 weeks, there is a risk of developing life-threatening complications of gastrointestinal bleeding and perforation.[5]

Initial investigations should include a full blood count, urea and electrolytes, and peripheral blood cultures.[2,5] Typhoid fever can only definitively be diagnosed by isolates in blood, stool or bone marrow. Peripheral blood cultures may only be 40-80% sensitive; thus if typhoid fever is suspected and no other cause is found, or if the patient has already been given antibiotics, a bone marrow culture (55-95% sensitive) may be helpful.[2,5]

Once S. typhi has been isolated, targeted treatment should replace any empiric therapy which has already been started. Susceptibility to antibiotics differs in different regions and likely susceptibility profiles based on local strains are available to guide initial empiric antibiotic therapy.[5-7] Fluoroquinolones are most effective in fully susceptible strains and ciprofloxacin is used most commonly.[2,5-7] Nalidixic acid resistance is a growing concern in some areas, particularly South-East Asia.[5,7] However, most of the S. typhi in the Pacific region does not appear to have developed this feature.[6]

If untreated, up to 5% of infected patients may become chronic carriers and unknowingly spread the infection, especially if they are involved in activities such as food preparation. Thus, typhoid fever is a notifiable disease in New Zealand and Ministry of Health can investigate and manage cases and contacts in order to prevent further spread.[8]

Typhoid fever is considered to be partially vaccine preventable with limited efficacy against S. typhi and none against S. paratyphi.[5,7] There are currently two commercially available vaccines, which include Ty21a (oral) and Vi-polysaccharide (parenteral).[5,7,9] This patient had received no vaccination. A recent Cochrane review evaluating these, along with another emerging modified Vi vaccine, found Ty21a to be between 33-50% effective in the first two years, with no benefit after the third year.[9] Vi-polysaccharide vaccine showed efficacy of around 69% in the first year dropping to around 55% in the third year following vaccination. The new vaccines showed promise with similar efficacy but potentially offering longer-term immunity.[9]

A recent New Zealand study found 25% of cases of typhoid fever in Auckland were from patients returning from the Pacific; mostly from Samoa.[6] Although there is a medium incidence (10-100/100000) of typhoid fever in the Pacific region, incidence in Samoa is significantly greater (134-406/100,000) and has been increasing since 2002.[7] Furthermore, 25% of cases of typhoid fever in Auckland between 2005-2010 were found to have been locally acquired; 55% of these within the Samoan population.[6] This demonstrates this disease is an important consideration in the South Auckland population, even in the absence of a history of recent travel.

Conclusion

Fever in a returned traveller presents a diagnostic challenge and it is important to take an accurate history, gathering key information about travel details and the time-course of illness. Knowledge of endemic diseases in particular areas and incubation periods of common tropical diseases is helpful to develop a relevant differential diagnosis. It is particularly important to always consider potentially life-threatening causes of fever in returned travellers, such as typhoid fever and Dengue fever, despite these being relatively uncommon in New Zealand.

Conflict of Interest: None

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Bachelor of Medical Science (Honours) Abstracts

Outcome Measures for General Surgery

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Introduction: Robust outcome measures are needed to evaluate surgical performance. The choice of measures for low-risk procedures, such as Laparoscopic Cholecystectomy (LC), is contentious. This study aimed to review the current measures used to evaluate the outcomes of LC, and to apply a novel outcome measure, Days Alive and Out of Hospital (DAOH), to a retrospective cohort of surgical patients.

Materials and Methods: Two systematic reviews were conducted, examining the reporting of complications and patient-reported outcomes (PROs) after LC. Prospective studies published between 2013-2016 were studied. A retrospective analysis of adult patients undergoing LC or colonic resection (CR) at Auckland City Hospital between 2010-2015 was conducted. DAOH values for these patients were calculated. DAOH curves were constructed for surgeons and the surgical unit. The relationship between DAOH and complications was studied.

Results: A wide variety of complications were reported after LC (n = 976). Definitions for complications were infrequently provided and variable. PRO measurement for LC is focused on short-term outcomes, such as pain and nausea. In the retrospective study, 1228 patients undergoing LC and 635 patients undergoing CR were studied. Patients who experienced complications after LC (n=65) had fewer DAOH than patients that did not (median 82 versus 88, P<0.0001). Patients who experienced complications after CR (n=308) had fewer DAOH than patients that did not (median 69 versus 81, P<0.0001).

Conclusion: A variety of measures are used to evaluate LC. DAOH can be calculated from existing data sources and is sensitive to the occurrence of post-operative complications.

Exploring patterns of weight change and the differences between individual and population trajectories

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Introduction: Overweight and obesity affect around 1.9 billion adults worldwide and are a major risk factor for many chronic conditions. Few practical and affordable strategies have been found to combat obesity at either individual or population levels. This study explores possible paths to a healthy weight future and the implications for individual body weights over the life course.

Materials and Methods: Excel was used to plot and model several hypothetical patterns of weight change over the life span and how this may affect a population. STATA was then used to analyse NHANES data and R was used to plot mean weight and BMI for different age groups over time.

Results: Three population scenarios were developed - a weight gain society, a slimming society, and a static society, one that remained low-weight, and one affected by obesity. Individual and population trajectories are not always in the same direction. It is possible for an average individual to gain weight as the population as a whole gets slimmer. From the NHANES data, it appears the United States tracks the weight-gain society model, with some slowing of the epidemic recently to resemble the model of a static society with high obesity rates.

Conclusion: It is not necessary to eliminate age-related weight gain in order to reduce the prevalence of overweight and obesity in the population. This apparently counter-intuitive finding has important implications for health policy.

A mouse model to investigate the effect of acute Staphylococcal infection on the tight junctions in nasal mucosa

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Introduction: *Staphylococcus aureus* has been previously noted intramucosally in patients with chronic rhinosinusitis (CRS). It may be that a disruption of the integrity of epithelial tight junctions in these patients provides a mechanism for bacterial entry. We aimed to investigate the ability of *S. aureus* to disrupt epithelial tight junctions by introducing it to the sinuses of healthy mice.

Materials and Methods: A total of 21 BALB/c, species-free mice were used. Three mice were sacrificed at baseline to provide a control group for comparison. The remainder were infected intranasally, with either JSNZ (n=9) or 26-T1 (n=9), strains of *S. aureus*. Three mice from each group were sacrificed at 2, 5 and 14 days post infection. Sinonasal mucosa was then examined histologically for the presence of intramucosal *S. aureus* and the expression of the tight junction protein zonula occludens-1 (ZO-1) was quantified with immunohistochemical staining techniques.

Results: No intramucosal *S. aureus* was observed in any of the infected mice. There was also no significant difference in the expression of ZO-1 between the infected groups of mice and the control group.

Conclusion: Introducing *S. aureus* to the sinonasal cavities of healthy mice does not result in the disruption of epithelial tight junctions and therefore no intramucosal *S. aureus* was noted. Future work could investigate introducing *S. aureus* to the sinonasal cavities of an animal model of CRS.

Sub-cellular structural and molecular changes in experimental heart failure

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Introduction: Despite a burden of disease affecting over 23 million worldwide, cellular mechanisms for heart failure (HF) remain poorly understood. This investigation quantified changes during right-heart failure, focusing on structural disruption in the t-tubular system of cardiac myocytes and changes to regularity and extent of expression for the Ryanodine Receptor 2 (RyR2) protein.

Materials and Methods: Male Wistar rats (300-350g) were injected with monocrotaline (MCT; 60mg/kg) to induce pulmonary capillary damage and acute decompensated HF within 4-6 weeks. 11 MCT-treated animals and their time-matched controls were dissected at onset of acute HF, with tissue samples from left and right-ventricular free walls, trabeculae carneae, and papillary muscles collected for immunohistochemistry. Slides were labelled with RyR2 primary antibodies and wheat germ agglutinin (WGA) for t-tubular membranes, imaged using confocal microscopy, and analysed for structural periodicity and area quantification.

Results: T-tubular structure showed significant disruption in HF animals, with greatest change against control in structural periodicity (measured by t-power) taking place in the right-ventricular free wall (mean ratio 0.58, P<0.0001). RyR2 receptor expression also decreased in HF, especially in the right ventricle (RV) wall (mean ratio 0.64, P<0.001), with greatest change in RV trabeculae (mean ratio 0.44, P<0.0001).

Conclusion: Decline in heart function is correlated with t-tubular ultrastructural disruption and reduced RyR2 receptor expression. More significant reduction of RyR2 expression within RV trabeculae also suggests that conditions for trabecular cardiomyocytes are different to those within free walls, perhaps contributing to receptor down-regulation.

The effect of position on maternal collateral venous circulation in late pregnancy

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Introduction: Maternal supine sleep position is associated with an increased risk of late stillbirth. In this position the gravid uterus compresses the inferior vena cava (IVC). It is speculated that the azygos venous system provides collateral circulation in order to compensate for this phenomenon.

Materials and Methods: Twelve pregnant women between 34–38 weeks gestation underwent scanning in the supine and left lateral decubitus positions using a 3T Skyra (Siemens) MRI system. Phase contrast images were evaluated to measure blood flow through the AA, IVC and azygos vein.

Results: The supine position was associated with a reduction in cardiac output when compared to the left lateral position (4.64 ± 1.41 vs 5.49 ± 1.10 L/min; P 0.004). Blood flow through the IVC at its origin decreased in the supine position (0.17 ± 0.18 vs 1.26 ± 0.38 L/min; P<0.001) while blood flow through the azygos vein increased (0.81 ± 0.26 vs 0.31 ± 0.21 L/min; P<0.001). Blood flow through the aorta at the level of its bifurcation also decreased in the supine position (1.09 ± 0.24 vs 1.69 ± 0.54 L/min; P<0.001).

Conclusion: Women in the third trimester of pregnancy experience an increase in collateral venous blood flow in the supine position, likely to compensate for compression of the IVC. However, a significant reduction in arterial blood flow was found which may cause a significant reduction in uteroplacental blood flow and may explain the association between maternal supine sleep position and increased risk of late stillbirth.

Foot deformities in paediatric neuromuscular disorders – factors affecting plantar pressure distribution

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Introduction: Dynamic pedobarography is used to assess plantar pressure distribution across the sole of the foot during gait. This study explored the relationships between radiographic measures of foot deformity, pedobarographic measures of plantar pressure and the effect of lower limb transverse rotation in gait.

Materials and Methods: Prospectively collected clinical, plain film radiography, pedobarography and 3D gait analysis kinematic data of 80 feet from children with cerebral palsy (CP) and other neuromuscular disorders (NMD) was retrospectively analysed. Seven X-ray parameters, coronal (CI) and sagittal indices (SI) of plantar pressure and dynamic rotational profile measures at the pelvis, hip and ankle level were derived.

Results: Two X-ray measures, talocalcaneal (P=0.02) and AP talo-1st metatarsal angles (P<0.01) combined with dynamic pelvic rotation (P=0.02) best correlated with change in modified CI (R=0.687, R^2=0.473).

Forefoot SI best correlated with AP talo-1st metatarsal angle (P=0.033), shank-foot angle (P=0.051) and tibiotalar angle (P=0.002); (R=0.396, R^2=0.157). Midfoot SI best correlated with calcaneal pitch angle (P<0.01) and tibiotalar angle (P<0.01); (R=0.506, R^2=0.256). Hindfoot SI was predicted by calcaneal pitch angle only (P<0.01); (R=0.356, R^2=0.127). Dynamic rotational profile measures were not correlated with sagittal indices.

Conclusions: Weight bearing X-rays are predictive of dynamic plantar pressures in both coronal and sagittal planes. When planning corrective surgery of foot deformities secondary to CP and other NMD, in particular coronal deformities, rotational profile should be incorporated as part of quantitative assessment. These findings adds further evidence supporting single event multi-level surgery over isolated deformity correction.

Clues to the regenerative potential of notochordal cells: development of a model to study the secretome of intervertebral disc cells

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Introduction: Intervertebral disc (IVD) degeneration accounts for 40% of back pain. The central nucleus pulposus consists of notochordal (NC) and mature nucleus pulposus (MNP) cells. NC cells secrete anabolic factors that maintain a healthy disc, whereas a reduction in NC cells with aging strongly correlates with disc degeneration. However, the precise anabolic factors are not fully characterised. This study aimed to examine protein localisation in the NC cell microenvironment and develop a model to examine the secretome (secreted soluble factors) of NC cells in response to static and dynamic loads.

Materials and Methods: NC and MNP cells were isolated from bovine IVDs, fixed or cultured in 3D-alginate beads in 21% or 5% oxygen for 72h, and assessed for cell viability. Protein concentration from conditioned media was measured using the EZQ protein assay. Collagens I, II, IV, aggrecan and TGF-β1 expression was examined in NC cell clusters using immunohistochemistry. Intact discs were mechanically loaded (0-1000N, 4h), cultured for 24h and assessed for viability.

Results: NC and MNP cells maintained >85% viability in 5% and 21% oxygen over 72h. Sufficient protein was detected in conditioned media for proteomic analysis, although gel electrophoresis showed contamination from culture media-derived serum. The NC cell microenvironment expressed collagen types I, II, VI, aggrecan and TGF-β1. Loaded IVDs showed viability >90%.

Conclusion: We have established a 3D-culture model that maintains viability over 72h in phenotypic levels of 5% oxygen. Due to high levels of serum albumin, further study is required before embarking on mass spectrometry proteomic analysis.

Business Impact Assessment – Obesity and Population-level Nutrition: An investigation into the nutrition-related commitments of the New Zealand food industry

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Introduction: The BIA-Obesity has been developed as a national-level tool to monitor and benchmark the commitments of the food industry towards improving population nutrition. It consists of a range of indicators within seven domains: corporate population nutrition strategy (STRAT), relationships with external organisations (RELAT), product formulation (FORM), nutrition labelling and health claims (LABEL), promotion to children (PROMO), product pricing (PRICE) and product distribution and availability (AVAIL).

Materials and Methods: 25 companies were selected to cover at least 50% of the market share in the packaged food (n=15), beverage (n=2), supermarket (n=2) and chain restaurant (n=6) sectors in New Zealand. Publicly available information was collected through an online search. A relevant representative from each company was asked to review and/or supplement the publicly available information. The collected commitments were scored according to the BIA-Obesity and presented to the companies as absolute and relative scores.

Results: Overall BIA-Obesity scores ranged from 0-68.4% within the packaged food sector, 41.9-54.5% within the beverage sector, 32.6-55.7% within the supermarket sector, and 2.1-31.2% within the chain restaurant

sector. The best-performing domain was STRAT (median = 48.3%) and the worst-performing domains were PRICE and AVAIL (median = 0%). In general, several good practice examples were collected; however, many commitments were vague and non-specific.

Conclusion: In New Zealand, industry performance on nutrition-related commitments is varied and thus the BIA-Obesity is successful at differentiating between companies.

Epigenetics and changing understandings of heredity

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The idea that effects of our environment can be inherited was considered a *non sequitur* impossibility for most of the 20th century. Emerging research suggesting that environmentally-influenced epigenetic changes induced through DNA methylation, histone modification and non-coding RNA may be inherited is challenging the authority of this claim, and with it our assumption of the individual as autonomous and context-free. This thesis explores the evidence for epigenetic inheritance and how this might construct an alternative understanding of the biosocial body - one that cannot be separated from its historical, cultural and socioeconomic environments. The emerging picture may provide a more nuanced framework within which to understand and deal with the challenges in New Zealand of rising health disparities, child abuse and intergenerational poverty. This framework contrasts with the narrative that has influenced social policy over the last three decades which assumes the individual is rational, universal and individually responsible for their own health, a position that is increasingly untenable given the scientific evidence affirming our connection. I argue however that an alternative conceptual framework is not an inevitable consequence of this science. Unless we make deliberate changes to our social policy approach, we will continue down the same path we have been on over the past decade in which little improvements have been made to reduce inequity and poverty. The thesis concludes that Whakapapa - the Māori conception of heredity, which has always recognised the importance of this connection, may be a useful framework in informing an alternative application of epigenetic science.

Exploring the predisposition of Asian Eye to meibomian gland dysfunction

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Introduction: A higher prevalence and severity of dry eye in Asian populations compared to Caucasian populations is repeatedly reported in literature. A previous Auckland study of young adults showed significantly greater meibomian gland drop out in the Asian eyes compared to the Caucasian eyes. It is unknown whether differences exist from birth or arise at a young age.

Materials and Methods: 70 age matched paediatric participants (5-17 year olds) were recruited. Tear film quality, ocular surface characteristics, and dry eye symptomatology were evaluated in a single clinical session. Metrics were compared across different eyelid shapes – Asian single lid (ASL), Asian double lid (ADL), and Caucasian double lid (CDL).

Results: There were no significant intergroup differences in the tear film quality, dry eye symptomatology and meibomian gland drop out. A greater proportion of ASL and ADL participants exhibited incomplete blinking than CDL patients (all $P<0.05$). Asian eyelids exhibited significantly more shortening of meibomian glands than the Caucasian eyelids ($P=0.013$) whereas Caucasian eyelids exhibited significantly more tortuous changes ($P<0.0001$). Lid wiper epitheliopathy (LWE) in the lower lid was significantly greater in the ASL compared to the ADL group ($P=0.011$).

Conclusion: Ethnic differences in the meibomian glands do not exist from birth but appear to arise with age. Incomplete blinking may predispose the Asian eyes to MGD. Differences in eyelid tension may also contribute to gland morphology.

Corneal remodelling following cataract surgery

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Introduction: Phacoemulsification is the preferred technique of cataract removal, and the structural integrity of corneal wounds is important for wound healing and optimised vision in the postoperative period. The aim of the study was to characterise corneal wound healing and incision architecture with different incision sizes in the three months following cataract surgery.

Materials and Methods: A prospective randomised study of 100 patients undergoing cataract surgery assigned to incision sizes of 2.20mm or 2.85mm was completed. Incision length, angle, leakage and corneal thickness were recorded. Incision imaging using anterior segment optical coherence tomography and an evaluation of corneal biomechanics was completed at one day, one week, one month and three months, postoperatively. Statistical analysis was completed using R.

Results: Wound leakage was noted in one (1%) main incision (angle=35.0°), mean incision angles were 25.1±4.6° (main), 36.6±7.3° (side incision), $P<0.001$. Descemet's membrane detachments were observed in 62% (2.2mm) and 40% (2.85mm), $P=0.005$. Endothelial wound gaping improved within the first month ($P<0.001$) and wound retraction increased from one to three months post-operatively ($P=0.004$). Decreases was seen in mean corneal wound thickness between 1 day (949μm), 1 week (866μm) and 1 month (737μm), $P<0.001$.

Conclusions: Corneal wound integrity was related to the angle of incision rather than the nature of construction. Smaller surgical incisions are more vulnerable to corneal damage. Corneal wound healing is a dynamic process, with an early stage of repair up to 1 month, and a later stage of remodelling extending beyond 3 months after cataract surgery.

Declining tear film and anterior ocular surface health with age – a cross-sectional population study in New Zealand

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Introduction: Dry eye disease (DED) is a very common condition seen by eye care practitioners and is a growing population health problem. In the past decade, limited studies in populations below the age of forty and in regions south of the equator have been conducted. This study helps address these two major gaps in the literature by assessing aging effects in NZ.

Materials and Methods: Satisfying institutional ethical requirements, 277 participants, aged 36±23 years, completed standardized dry eye (DE) assessments evaluating DE symptoms and risk factors, as well as tear osmolarity, blink rate/quality, tear meniscus height (TMH), non-invasive break up time (NIBUT), lipid layer grade, bulbar redness, corneal/conjunctival staining and meibography, to determine the effect of age on the tear film and ocular surface.

Results: According to TFOS DEWS II diagnostic criteria, DED prevalence was 60.7% overall – with 51.1% under 40 and 73.1% over 40 years. Subgroup analysis demonstrated increasing prevalence with advancing age. Measures significantly correlated with age were: DEQ-5 scores (increased, $P=0.02$), TMH (increased, $P<0.001$), NIBUT (decreased, $P=0.005$), osmolarity (increased, $P=0.005$), bulbar redness (increased, $P<0.001$), superior and inferior meibomian gland dropout (increased, $P=0.005$) and superior and inferior lid wiper staining (increased, $P<0.001$ and $P=0.002$, respectively)

Conclusions: Almost all tear film and ocular surface measures except late signs, corneal/conjunctival staining, showed significant worsening with age. DE prevalence was 1.4 times higher in the older age group. The study results demonstrate the importance of evaluating DE for early therapeutic intervention to improve quality of life with aging.

Morphological evolution in melanoma in situ – a dermoscopic perspective

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Introduction: Melanoma in situ (MIS) have fewer structural features of malignancy visible under dermoscopy than invasive melanoma. As little is known about how these features change over time, we investigated structural changes in melanoma in situ that had undergone dermoscopic follow-up.

Materials and Method: Three dermoscopists retrospectively compared sequential digital dermoscopic images of histologically diagnosed MIS. By consensus, changes in lesion area, colours, presence of *chaos* (asymmetry of structure or colour) and *clues* to malignancy (9 specified local features) were determined.

Results: 124 MIS in 110 patients (41 male), all of European ethnicity, were compared. Mean age was 52.5 years and mean follow-up 41 months (range 3–144 months). Change in lesion area from baseline was significant at each follow-up time point except 12 months (P<0.001). All lesions had brown pigmentation. The mean time for newly observed pigmentation (black, grey, and white) was 39 months. The number of colours was significantly dependent on follow-up time and lesion area (P<0.001 and 0.01 respectively). Most lesions had chaos (75%) and the number of clues was significantly dependent on time and lesion area (both P<0.001). A clinically significant minority of lesions showed no change or loss of structural features.

Conclusion: MIS predominantly increase in morphological complexity over time. Longer follow-up periods allow identification of initially subtle focal morphological features associated with malignancy.

Zebrafish Gene Editing to functionally characterize a novel PDE6B founder mutation causing autosomal recessive rod-cone retinal dystrophy in Maori

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Introduction: *PDE6B* c.2197G>C; p.Ala733Pro is a novel founder mutation causing autosomal recessive rod-cone dystrophy (ARRCD), and is estimated to account for 15% of inherited retinal disease in Māori. Current therapies retard disease progression, and alleviate symptoms but do not cure disease. This project aimed to create, and characterize a transgenic zebrafish model of *PDE6B* c.2197G>C; p.Ala733Pro ARRCD to facilitate the screening of novel therapeutics, in particular those targeting cyclic GMP – a key role player in *PDE6B* retinal disease.

Materials and Methods: Transient morpholino knockdown of PDE6B was performed on zebrafish embryos, with validation by RT-PCR. CRISPR gRNA-Cas9 complexes were injected into zebrafish embryos to create a stable *PDE6B* mutant. Phenotypic characterisation of the morpholino zebrafish model was performed using light microscopy, OCT, cGMP expression by immunohistochemistry, and the optokinetic response.

Results: RT-PCR confirmed transient PDE6B knockdown. Decreased ocular pigmentation was observed in day 6 morpholino embryos. In day 4 and 6 morpholino embryos, no structural differences in histology, nor a reduction in the optokinetic response were seen. Permanent knock-out of PDE6B exon 1 has been performed and is awaiting confirmation.

Conclusion: The morpholino system temporarily knockdowns PDE6B function in a zebrafish model of retinal disease, with no significant impact on the phenotype, consistent with the theory that prolonged cGMP accumulation is toxic to photoreceptors. The creation and characterization of a CRISPR/Cas9 PDE6B zebrafish model will permit therapeutic drug screening, and assessment of changes in gross morphology, anatomy, visual function and cGMP levels which may occur during the retinal disease process.

Integrating health interventions into a youth health survey: exploring adolescent perspectives through the co-design of a prototype user interface

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Introduction: Heath surveys and health interventions frequently use digital technology. Large digital surveys, like the Youth2000 surveys exploring health and wellbeing of adolescents in New Zealand, generate important data. However, participants with health needs are not provided with support. Integrating evidence-based health interventions into surveys could address this with likely health benefits. This study aimed to explore adolescent perspectives on surveys integrated with interventions.

Materials and Methods: A systematic literature review was conducted to identify features of digital health interventions that affect usability. Adolescent perspectives were explored through the co-design of a prototype user interface. Four co-design sessions were conducted with eight secondary school students using semi-structured interviews and usability testing applying the "think aloud" method. Additionally, two focus groups (n=16) were conducted to evaluate the prototype. The findings were analysed using affinity diagramming (co-design sessions) and general inductive approach (focus groups).

Results: Survey-integrated interventions were perceived to be helpful for students needing support. A prototype was developed demonstrating the basic functionality of a user interface for survey-integrated interventions. Key features that were perceived to enhance usability included: assurance of confidentiality; adequate information about interventions and external support services; a tool for finding a local doctor; opportunity to message a youth health worker and; having freedom over the context of use. Suggestions were provided on how to optimise the presentation.

Conclusions: Adolescents see value in integrating interventions into a large-scale youth health survey. The findings provide an important basis for operationalising the idea of survey-integrated interventions with important implications for population health.

Consistency of Corneal Contours: The Influence of Accommodation and Biomechanics

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Introduction: Ciliary muscle contraction causes lens deformation during accommodation, and concurrent corneal deformation may occur, affecting vision. The current study aimed to quantify corneal refractive changes during accommodation and assess if corneal biomechanical factors predict these changes.

Materials and Methods: Corneal topography and tomography were assessed in sixty-three participants to a peripheral radius (r) of 5 millimetres(mm) with the GALILEI™ G2 Dual Scheimpflug Analyzer in the accommodated and unaccommodated states. Four dioptres of natural accommodation were induced using an electronic monitor transiently displaying near acuity calibrated words viewed through an externally mounted beam-splitter. Corneal biomechanical characteristics, including time, velocity, and amplitude of applanation, were assessed with the CorVis ST. Statistical analysis was completed in R software.

Results: The mean (± standard deviation) participant age was 24.2 ± 4.6 years and 35 participants (56%) were female. Anterior chamber depth reduced by 0.10 ± 0.07mm with accommodation (P<0.01). Mean anterior instantaneous corneal power increased by 0.1D centrally (95% confidence interval(CI) =0.02–0.2D) and in the superior nasal periphery (95% CI =0.05–0.2D), while a 0.1D reduction occurred in the inferior temporal periphery (95% CI = -0.05 – -0.15D). Mean

central corneal thickness decreased by 0.5μm and approached statistical significance. Corneal stiffness and the deformation amplitude ratio significantly predicted peripheral corneal changes with accommodation ($P<0.05$), but did not fully account for the observed changes (adjusted R^2 range = 3.5–16.8%).

Conclusion: Measurements using contemporary technology demonstrate no clinically significant corneal refractive changes during accommodation and corneal biomechanical factors are poor predictors of these changes.

Colonic Dysmotility in Acute Surgical Disease

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Introduction: Aberrations in colonic motility are common in surgical patients but are poorly understood. The objectives of this thesis were: i) review the literature investigating aberrant motility and pathophysiology of post-operative ileus and acute colonic pseudo-obstruction; ii) evaluate post-operative distal colonic motor activity; iii) pilot ambulatory high-resolution manometry recordings; and iv) investigate pre-operative changes in colonic motility.

Materials and Methods: Systematic reviews were conducted to critically appraise studies investigating post-operative colonic motility and the pathophysiology of acute colonic pseudo-obstruction. *In vivo* high-resolution manometry was used to investigate pre-, intra-, and post-operative trends in distal colonic motor activity in patients undergoing elective right hemicolectomy. A novel ambulatory fibre-optic acquisition system was evaluated.

Results: Systematic review showed that colonic transit is prolonged post-operatively and may be a rate-limiting factor in recovery. Electromechanical activity does not cease post-operatively but is abnormal. The pathophysiology of acute colonic pseudo-obstruction is multifactorial, though the underlying motility patterns remain unclear. High-resolution manometry studies showed colonic motility becomes abnormally hyperactive following surgery, characterised by cyclic motor patterns occurring at 3 cycles per minute, and an absence of high-amplitude propagating sequences. Recovery of bowel function is delayed until this pattern normalises. Ambulatory high-resolution manometry was feasible post-operatively. The percentage activity and amplitude of colonic cyclic activity increases with proximity to major surgery, possibly due to anxiety.

Conclusions: Hyperactive colonic motility may be central to ileus after colorectal surgery, and returns to normal prior to recovery of bowel function. Future studies should investigate whether similar derangements underlie prolonged ileus and colonic pseudo-obstruction.

Quantification and optimisation of intranasal fluticasone deposition

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Introduction: The corticosteroid fluticasone is used in the post-operative management of chronic rhinosinusitis. Disease recurrence is common, partly due to poor drug penetration into sinus cavities. The delivery device and associated particle characteristics seem to play a key role in deposition.

Materials and Methods: A standard nasal spray (Flixonase) and pressurised metered-dose inhaler (Flixotide) were studied. High-speed imaging was used to measure particle characteristics in the spray plume of each device. Two CRS patient CT scans were used to generate subject-specific three-dimensional computer models of nasal airways. High-speed imaging data was used to simulate particle deposition in models. Three-dimensional printing was used to manufacture plastic casts of nasal airways. High performance liquid chromatography (HPLC) was used to assess deposition in printed models. Computer modelling was used to optimize deposition factors for maximal sinus deposition.

Results: Measured particle size of Flixonase plume was significantly larger than Flixotide (median 75 vs. 3.5μm). All simulated Flixonase particles deposited in the anterior nose or nasal septum. Most Flixotide particles escaped into the nasopharynx but achieved greater paranasal sinus deposition, primarily in the maxillary sinus or middle meatus. Frontal sinus deposition was not observed. Sphenoid deposition was minimal. Preliminary HPLC findings support minimal sinus deposition observed in computer models. Smaller particles are favoured for optimal sinus deposition.

Conclusion: Smaller particles produce improved sinus deposition but increases pulmonary deposition. Deposition factors can be altered to optimise sinus deposition. This can open new avenues for research and development of devices for more effective drug delivery and post-operative management.

Demystifying Radiotherapy – clinical application and scientific principles

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Abstract

Radiotherapy is a treatment modality which utilises ionising radiation to treat or manage a condition, either benign or malignant, in order to cure a person of a condition, to palliate a person's symptom or as a prophylactic treatment. This article aims to introduce the field of radiotherapy, its role in medicine, the processes involved, the sciences that underpin it, the common side-effects encountered and simple measures to improve the therapeutic ratio of radiotherapy. It is our hope that this article gives a good introduction and understanding to this less-known sphere of medicine.

Introduction

Radiotherapy is a treatment modality which utilises ionising radiation to treat or manage a condition, either benign or malignant, in order to cure a person of a condition, to palliate a person's symptom or as a prophylactic treatment.[1]

Clinical role of radiotherapy

In general, radiotherapy is utilised for the following reasons:

1. Primary definitive treatment for a malignancy

For example, in prostate adenocarcinoma, radical radiotherapy is one of several treatment options and in terms of treatment outcomes, it is equivalent to radical prostatectomy.[2] This is a favourable treatment modality especially for medically inoperable patients.[2] Another example is stereotactic radiotherapy for early stage non-small cell lung cancer as shown in Figure 1(d). The local control rate is equivalent to surgical resection.[3]

2. To reduce the risk of local or regional recurrence after primary surgery

To illustrate this, adjuvant radiotherapy (see Figure 1(c)) is given post wide local excision of breast carcinoma and this treatment is now the standard of care for breast carcinoma.[4] A meta-analysis of randomised control trials has shown that adjuvant radiotherapy reduces local recurrence by 50% compared to wide local excision alone.[4]

3. To down-stage a tumour and increase the chance of complete resection

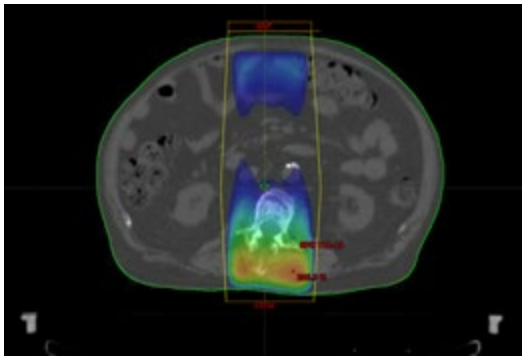
Neoadjuvant long-course concurrent radiotherapy with chemotherapy or neoadjuvant short-course radiotherapy (see Figure 1(b)) for rectal cancer is a good example for this. It is now considered standard treatment for rectal cancer as it has been shown to improve local control and the probability of a complete resection by down-staging the tumour.[5,6]

4. For symptom palliation

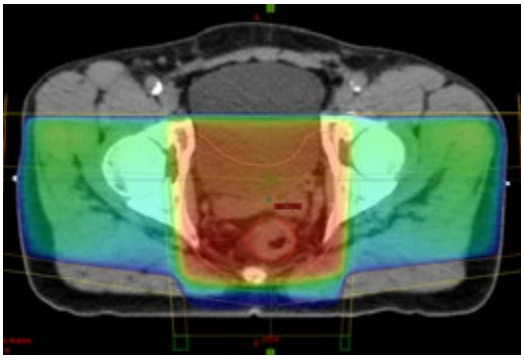
Bone pain secondary to metastases can be difficult to manage with analgesia alone and in these cases, palliative radiotherapy (see Figure 1(a) is shown to be effective in alleviating pain in up to 60% of patients.[7] Palliative radiotherapy is also used to shrink lung or mediastinal lesions to relieve airway obstruction, superior vena cava obstruction or spinal cord compression.[8,9,10]

5. For treatment of benign condition

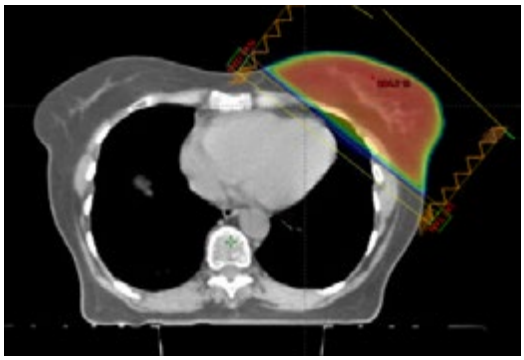
An example would be treatment of Dupuytren's contracture and it has been to shown in WHO Level 2 evidence studies to be effective in preventing or delaying disease progression, reducing the need for surgical intervention and relieving patient symptoms in early stage contracture.[11,12,13]



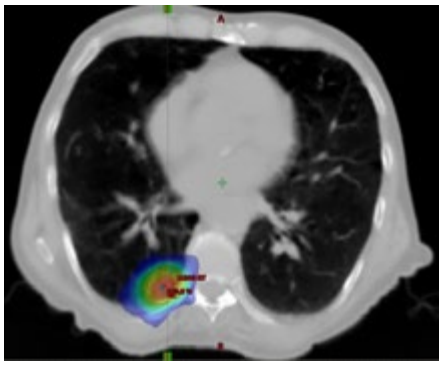
A. The blue region is 50% isodose region and the red region is 100% isodose with the colours in between reflecting isodoses between 50% and 100%. The 100% dose in this plan is 8Gy.



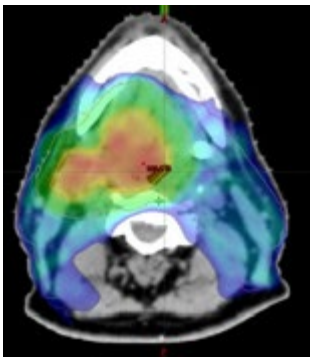
B. The blue region is 50% isodose region and the red region is 100% isodose with the colours in between reflecting isodoses between 50% and 100%. The 100% dose in this plan is 50.4Gy.



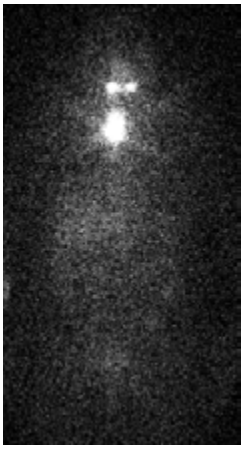
C. The blue region is 50% isodose region and the red region is 100% isodose with the colours in between reflecting isodoses between 50% and 100%. The 100% dose in this plan is 40Gy.



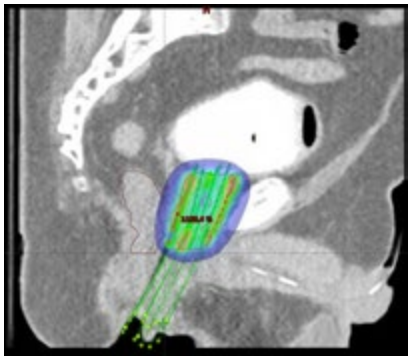
D. The blue region is 50% isodose region and the red region is 125% isodose with the colours in between reflecting isodoses between 50% and 125%. The 100% dose in this plan is 48Gy. Note the high dose within the gross tumour and rapid dose fall-off.



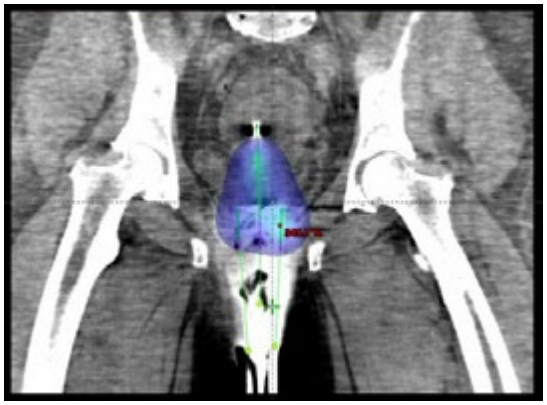
E. The blue region is 75% isodose region and the red region is 100% isodose with the colours in between reflecting isodoses between 50% and 100%. The 100% dose in this plan is 66Gy. Note the high dose region are concentrated at the gross tumour and the low dose region covers the intermediate risk area as well the elective draining lymphatics of level 2 and level 1b.



F. Increased uptake by the thyroid remnants and mediastinal nodes in a patient with mediastinal thyroid carcinoma metastases.



G. The blue region is 50% isodose region and the red region is about 1000% isodose with the colours in between reflecting isodoses between 50% and 1000%. The 100% dose in this plan is 13.5Gy. Note the rapid dose fall off beyond the prostate.



H. The blue region is 50% isodose region and the red region is 350% isodose with the colours in between reflecting isodoses between 50% and 350%. The 100% dose in this plan is 7Gy. Note the rapid dose fall off beyond the cervix and uterus.

Figure 1. a) Simple parallel-opposed pair field arrangement for spine bony metastasis, b) 3D conformal radiotherapy for neoadjuvant rectal cancer, c) Whole breast radiotherapy using tangential field, d) Stereotactic ablative radiotherapy for early stage lung cancer, e) Volumetric Modulation Arc Therapy for base of tongue SCC with large level 2 lymphadenopathy, f) Post Iodine-131 swallow scan, g) Prostate Brachytherapy, h) Cervical brachytherapy.

Patient's journey – sequence of events

When a patient is referred to radiation oncology, they are seen by a Radiation Oncologist. Radiation oncologists are medical doctors who specialise in using radiation to manage oncological conditions as well as other benign conditions. They form part of the core team of medical oncologists, subspecialty surgeons, pathologists, radiologists and subspecialty physicians, in oncology multidisciplinary meetings where patients newly diagnosed with cancer are discussed. Their role is:

- To assess and select which patients will benefit from radiotherapy
- To determine and delineate the treatment volume that needs radiotherapy in order to achieve the intent of the treatment
- To determine and delineate the critical structures to minimise dose to these
- To prescribing the radiotherapy course (dose, fractionation and treatment technique)
- To manage the side-effects that arises from the treatment course

There are a few procedures carried out prior to treatment delivery to the patient. This is illustrated below:

Consultation ⟶ Simulation ⟶ Contouring ⟶ Planning ⟶ Quality Assurance ⟷ Delivery

After consultation, a patient undergoes simulation, where the intended treatment is simulated to plan how it will be delivered and to ensure it is physically possible. During this procedure, the patient is positioned on the bed of a CT scanner and the set-up is documented in great detail. This is so that the patient can be set up in exactly the same way during treatment delivery.

The next step is contouring which involves delineating the 3D treatment volumes on the CT images acquired. The first step is to delineate the gross target volume (GTV) on the acquired CT images slice by slice. The GTV is the tumour that is visible on CT or clinically. To account for microscopic disease, a margin is added to the GTV while respecting natural boundaries. This new volume is called the clinical target volume (CTV). Depending on the treatment intent and the cancer biology of the condition at hand, the CTV may also include delineating the draining lymph nodes as well as neural pathways if there is perineural involvement. To account for set-up uncertainty and organ motion, another margin is added to the CTV. This volume is called the Planning Target Volume (PTV). Once contouring is completed, a radiation therapist will start the planning process and its aim is to generate a treatment plan that can deliver the intended dose as prescribed and conform to the PTV while protecting and minimising dose to surrounding organs at risk. In order to achieve this, the radiation therapist adjusts various variables such as positioning of treatment fields, weighting of the fields and beam modifiers. The treatment plan will then be reviewed by a radiation oncologist to ensure the treatment volume receives the prescribed dose and the doses to the organs at risk are within tolerance or acceptable limits. If these are met, the radiation oncologist then approves the treatment plan. This process may vary from a single day to two weeks depending on the complexity of the case.

Complex treatment plans will also undergo quality assurance by a medical physicist who ensures that the treatment plan is accurate in the delivery of the intended dose.

The patient will start his or her treatment course at an appointed time once a treatment plan has been approved and treatment slots are available. The treatment delivery session involve setting up the patient exactly the same way as they were positioned during planning CT followed by administration of radiation using the approved treatment plan. The same procedure is repeated for further fractions of radiotherapy.

During the treatment course, patients will be reviewed by a radiation oncologist to monitor and manage any side-effects. Once the treatment course is completed, the patient is usually followed up after a few weeks to ensure any acute side-effects that they experienced have resolved or are improving.

Deciphering radiation prescriptions

Radiation doses are normally prescribed in X Gray (Gy) delivered in Y fractions (#) over Z number of days. A fraction is an individual dose given usually once daily. A typical palliative prescription is 20 Gy in 5 fractions over 5 days. This translates to delivery of 4 Gy of radiation once a day for 5 days.

The Gray – Putting it into perspective

$$H_T = W_R D$$

W_R is the radiation weighting factor for radiation type R.

X-rays and electrons $W_R = 1$, Protons $W_R = 5$.

$$E = \sum W_T H_T$$

W_T is the tissue weighting factor.

Example: $W_T = 0.01$ for skin, $W_T = 0.12$ for bone marrow, $W_T = 0.04$ for oesophagus.

Figure 2. Equivalent (HT) and Effective dose (E)

One Gray of radiation (D) is a measure of 1 Joule of radiative energy being absorbed per kilogram of tissue. The concept of the equivalent dose (H_T) applies a weighting factor (W_R) to the absorbed dose to account for the different biological effect of each type of radiation, e.g. photons, electrons, protons. The equivalent dose for 1 Gray (Gy) of photons or electrons to an organ is 1 Sievert (Sv). The concept of effective dose (E) is used to further take into account the varying degree of sensitivity to radiation of human tissues. The total body effective dose is the sum of all equivalent doses to all organs multiplied by their individual radiosensitivity (W_T).[14] On average worldwide, all humans receive approximately 3 mSv in effective dose per annum from their environment.[15] This means that a whole body dose of 1Gy of radiation with a radiation weighting factor of $W_R = 1$ (e.g. x-rays, electrons) is effectively similar to exposing oneself to background radiation over 330 years.

Table 1. The average effective dose received from a selection of common medical procedures[16]

MEDICAL PROCEDURE	Average effective dose (mSv)
Chest radiograph (x-ray)	0.1
Abdominal radiograph (x-ray)	1.2
Abdominal Computed Tomography (CT) Scan	10
Cardiac angiogram	5-15

For a whole body dose of 1Gy of radiation where $W_R = 1$, this is equivalent to radiation exposure from 10000 chest x-rays, 833 abdominal x-rays, 100 abdominal CT scans or 66 cardiac angiograms. For this reason, radiotherapy should only be used when the benefit clearly outweighs any harm it may cause.

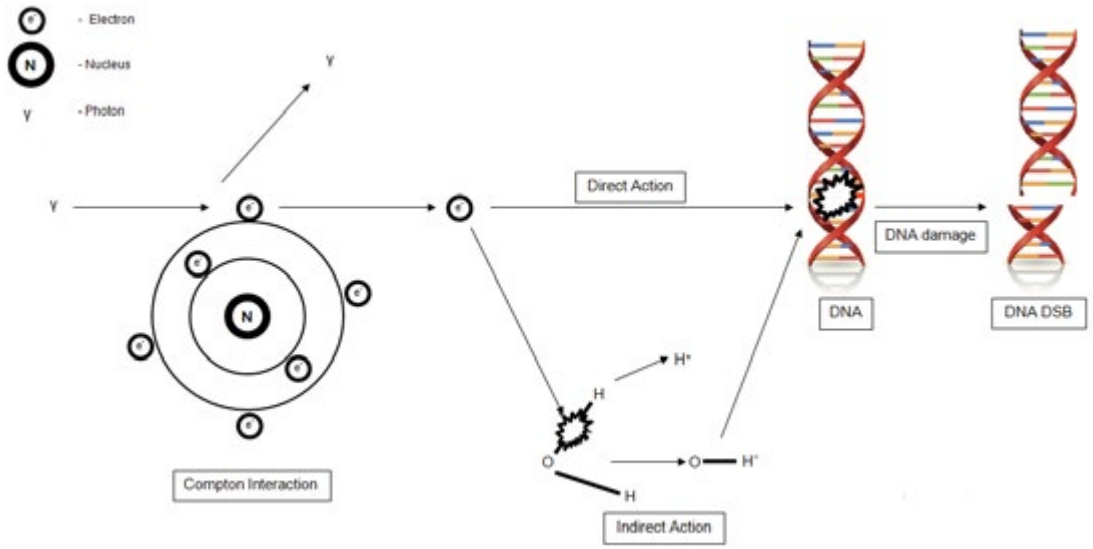


Figure 3. Atomic to molecular to biochemical reaction

Radiobiology - how does it work?

Radiation interacts with tissues in several ways, depending on the type of radiation. Photons interact with matter and cause the release of electrons via ionisation of atoms. These electrons will undergo many interactions in tissues, depositing an amount of radiation dose at each interaction location.[17] The Compton interaction is the main method of interaction of photons with material and is illustrated in Figure 3 below.[17] The electrons ejected are a result of ionisation, where an atom is given enough energy by the incoming photon to release an electron from its orbit around the nucleus. The mechanism of electrons interacting with tissue is either direct or indirect.[17,18] This may involve either direct damage of deoxyribonucleic acid (DNA) or indirect damage of DNA via free radicals when they interact with water.[17,18] The predominant route of DNA damage is via the indirect route.[18] Although they also interact with other structures such as organelles and proteins, the effect is negligible due to the multitude of these structures.[17,19] DNA, on the other hand, is limited in quantity and owing to the complexity of its protein structure, repairing any DNA damage is a complex process.[17,19]

The ionising radiation itself does not differentiate between normal and abnormal cells.[17] The selectivity occurs by the fact that abnormal cells have an impaired DNA repair mechanism, which has led them to transform in the first place, whereas the normal cells have an intact DNA repair mechanism.[17]

Depending on the extent of DNA damage, the cell with the damaged DNA may or may not repair itself.[17] If repair does not occur, the cells with the damaged DNA will undergo mitotic death when they attempt to divide.[17] Normal cells have better organized DNA repair processes so the likelihood of abnormal cells dying at the next mitosis is significantly higher.[17]

As the abnormal cells undergo mitotic catastrophe, the number of abnormal cells decreases as does the proliferation rate by virtue of reducing numbers of actively dividing abnormal cells.[17,18] These eventually result in a smaller tumour volume which translates to symptom alleviation.[17,18] If a high enough dose of radiation is delivered, it could potentially eliminate all the abnormal cells in the volume.[17,18] This is the goal for patients treated with curative intent. The result of the treatment may only be evident a few days, weeks or even months after treatment depending on how fast the cells divide.[17,18]

Why are the doses fractionated?

The therapeutic ratio is the balance achieved between the toxic and therapeutic effects of a treatment.[17,18] The best possible therapeutic ratio is achieved when we have minimised side effects whilst maximising the benefit of a treatment.[17,18] This is especially important when using radiation as a therapy, due to the harmful effect it may have on any tissue it interacts with.[17,18] The healthy tissues irradiated by the therapy beams would suffer severe side-effects if most prescriptions were delivered in one treatment session.[17,18]

The prescription doses are thus fractionated to allow for repair of normal tissue cells in-between fractions.[17,18] Cancer cells generally repair more poorly and at a slower rate than normal tissues, meaning the gaps in-between treatment are not undoing the radiation damage caused.[17,18] Fractionation also improves efficacy of therapeutic effects by:

- Allowing tumour cells to redistribute among cell-cycle phases, of which some are more sensitive to radiation damage[17,18]
- Enabling the reoxygenation of a tumour's hypoxic areas, where cells are more resistant to radiation damage[7,18]

Further details on the radiobiological mechanism behind these are beyond the scope of this paper.

Radiotherapy techniques – how is radiation delivered?

Radiotherapy can be delivered as internal or external radiotherapy. External radiotherapy, or external beam radiotherapy, is the commonest method of delivering radiation.[20] This is delivered from outside the body using a linear accelerator which produces a radiation beam which conforms to the target volume while aiming to spare any surrounding normal tissues.[20] A variety of techniques are available for the method of dose delivery, such as 3D conformal radiotherapy, intensity modulated radiation therapy (IMRT) and stereotactic radiotherapy.[20] Each has its own advantages and is utilised depending on the case at hand. An alternative to a linear accelerator is the traditional Cobalt-60 machine, which holds a Cobalt-60 source instead of producing therapy beams.[20] These machines are nowadays more common in developing countries due to their lower capital and installation cost, cheaper maintenance and servicing cost and lesser dependence on reliable electrical power.[20] However, the main disadvantage likes in the difficulty of disposing the radioactive source once it has passed its optimal clinical use and the need to replace it approximately every 5 years.[20]

Internal radiotherapy encompasses any radiation therapy where the source of the radiation is placed inside the patient. This includes sealed and unsealed source therapy, as well as the use of kV radiation sources placed inside body cavities. Brachytherapy is a radiotherapy modality where radiation is delivered using sealed radioactive sources which are surgically inserted into a cavity (see Figure 1 (g)) or interstitially (see Figure

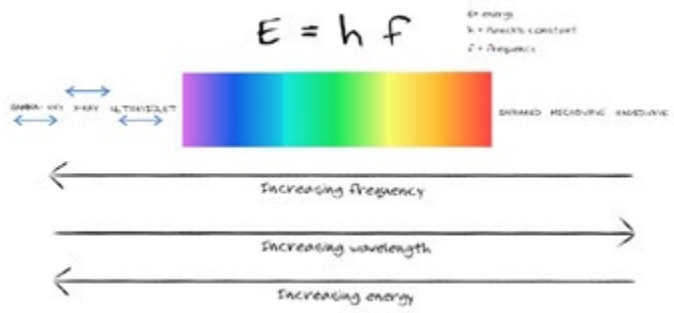


Figure 4. Electromagnetic spectrum

1(h)).[21] The radiation delivered is short-range and hence, localised to where the source is placed.[20] Another example of internal radiotherapy is treatments such as the Papillon contact radiotherapy where low energy x-rays can be produced from a very small x-ray tube placed inside a cavity inside the patient.[20] This is used for small rectal cancers, skin lesions or intraoperatively during breast cancer lumpectomy.[20]

Unsealed source therapy delivers a radioactive source to within the patients' body either intravenously or orally.[22] Depending on the nature of the source, it is taken up by a particular organ and the radiation is delivered locally to that organ.[22] One example is radioactive Iodine-131 (see Figure 1 (f)) which is preferentially absorbed from the blood stream into thyroid tissues and thyroid carcinoma metastases, hence is used to treat thyroid malignancy.[22]

What exactly is ionising radiation?

Ionising radiations consists of photons or atomic particles that have enough energy to ionise matter at an atomic level via various atomic interactions and an example, as mentioned earlier is, the Compton interaction.[23]

Many types of ionising radiation are used medically, mainly: electrons, protons, x-rays, gamma-rays and ultraviolet rays. Radiotherapy applications require radiation types of specific characteristics for them to be useful as a therapy. Modern radiotherapy utilises electrons, protons, x-rays and γ-rays. X-rays and γ-rays are both particles which carry electromagnetic (light) energy, commonly referred to as photons but drastically differing in the amounts of energy they carry.[24] As illustrated in the electromagnetic spectrum in Figure 4, gamma-ray photons are particles in a higher energy range than x-rays.[24] The energy of a photon determines how it will interact with tissue, mainly to what depth it will deposit its energy, or dose.[24] For example, photons of 80 kilovolts (kV) can be used to treat superficial lesions, whereas high energy 20 Megavolts (MV) photons can deliver dose to deep-seated tumours.

The electrons and protons on the other hand are not part of the electromagnetic spectrum.[25] These are atomic particles.[25] The main difference between these particles is their mass; protons are much heavier than electrons.[25] This determines how many interactions they will have with tissue molecules before they deposit the energy they carry.[25] The lighter the particle, the higher the number of interactions and the more spread-out the dose deposition.[25] The main advantage of protons is the fact that they are so heavy that they travel through tissue until near the end of their range and deposit most of their energy within a well-defined region of tissue.[25]

Selection of the type of radiation and energy used in a particular case is dependent on the location and size of the treatment target, the surrounding healthy organs at risk from radiation damage and the availability of the radiation.[26,27] To illustrate, electron therapy is mostly used for superficial lesions as it delivers a high surface dose and has a steep drop off in dose deposition at depths beyond the target tissue whereas megavoltage photons are mainly used for deep seated lesions as electrons cannot reach these depths without also delivering high doses of radiation to the healthy tissues shallower than the target.[26,27]

This dose change with depth can be illustrated by the concept of the percentage depth-dose curves shown in Figure 5. This is the percentage of the maximum dose deposited in tissue at depth in tissue.

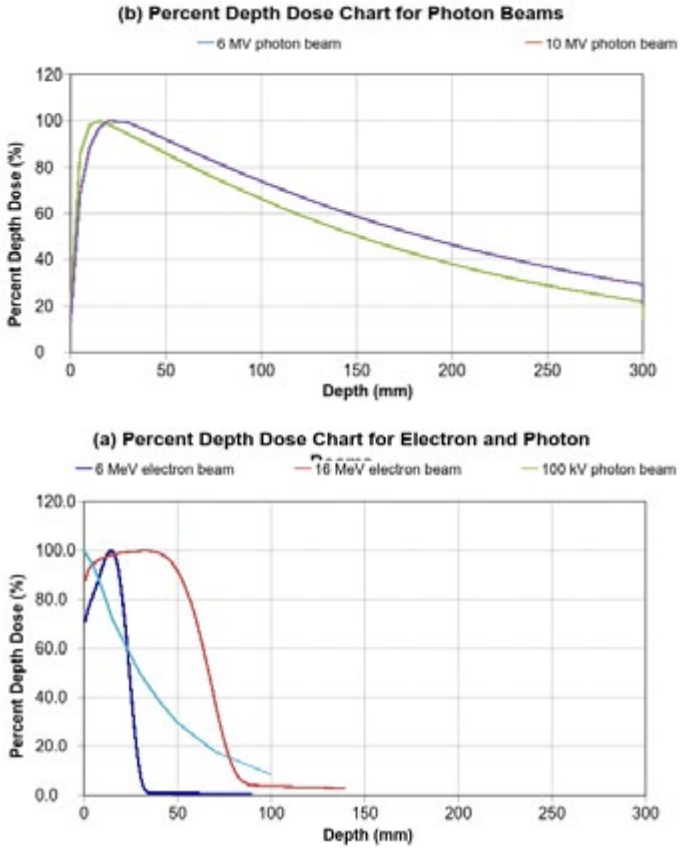


Figure 5. (a) Percentage depth dose of 6MeV electrons, 16MeV electrons, and 100kV photons (b) 6MV photons and 10MV photons.

Common side effects of radiotherapy

Generally, the side effects of radiation therapy can be categorised into systemic and local side effects. Systemic side-effects are mainly fatigue and nausea.

With local side-effects, only the cells within the treatment field are affected and they can be divided into early and late side effects. For example, the patient treated as shown in figure 1(e) will likely experience acute side effects such as radiation mucositis, radiation dermatitis, xerostomia, ageusia, nausea and odynophagia. His late side effects may include chronic radiation-induced skin changes, permanent xerostomia, low risk of radiation osteonecrosis and a very low risk of a secondary malignancy.

Whereas, the patient treated as shown in figure 1(b) will likely experience acute side effects which may include lower urinary tract symptoms such as dysuria, frequency and urgency, and gastrointestinal symptoms such as nausea and diarrhoea. With late side effects, this may include increased urinary frequency secondary to bladder shrinkage, change in bowel habits, rectal radiation-induced telangiectasia, impotence and a very small risk of secondary malignancy.

The risk of severe side-effects are kept as low as possible by ensuring the dose to the normal organs is kept as low as possible and below the safe limit. The acute side effects are usually controlled with medications so that few patients need hospitalization.

Simple measures to improve therapeutic ratio in the wards or clinics

- Treat anaemia (Haemoglobin < 100) especially with radical course

Increased haemoglobin translates to increased oxygen transportation and better oxygenation.[28,29] This in effect improves the efficacy of radiotherapy.[28,29]

- Cessation of smoking

Advise patient to stop smoking during treatment which may improve their blood oxygenation and improve the efficacy of radiotherapy.[30,31,32]

- Simple measures to prevent exacerbation of toxicity such as radiation dermatitis or radiation mucositis

Advise patient to minimise direct heat and trauma to irradiated area such as for radiation dermatitis, to avoid direct sun-light exposure, to keep skin cool and minimise skin friction by avoiding tight clothing and to apply moisturiser regularly to prevent dry skin.

Conclusion

This article aims to introduce the field of radiotherapy; its role in medicine, the processes involved, the sciences that underpin it, the common side-effects encountered and simple measures to improve the therapeutic ratio of radiotherapy. It is our hope that this article gives a good introduction and understanding to this less-known sphere of medicine.

The following websites are useful for further information on radiotherapy:
https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/ionising-radiation-and-health
https://www.fda.gov/radiation-emittingproductsradiationemittingproductsandprocedures/medicalimaging/medicalx-rays/ucm115329
https://www.targetingcancer.com.au

Conflict of Interest: None

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How to get the job you want

Dr Sam Hazledine
Managing Director of MedRecruit

I remember when I finished my medical training and applied for my first job. I was incredibly excited to be getting started after six years of training, and I was also nervous about whether I would get a job in the location I wanted.

Since I graduated, back in 2003, it has become more competitive to get exactly what you want, so it is important that you use every tool available to you to ensure you stand out and make a good impression.

The recommendations that follow have been put together through our experience over the last decade in recruitment, placing over 10,000 doctors, and through speaking with hiring managers to understand what makes candidates stand out.

Doctors often believe that getting a role is all about their abilities as a doctor, or about their track record as a medical student, but the reality is that you are being interviewed by people who are influenced by many factors other than just your abilities. People make decisions on emotion and justify on logic, so this guide serves to help you shape those other factors to ensure you are seen in the best light.

Diagnose

Conduct Research on the Employer, Hiring Manager, Job Opportunity

It is important to take time to understand your potential new employer, the requirements of the job, and the background of the person (or people) interviewing you. The more research you conduct, the more you will understand them, and you will demonstrate your commitment for this role, which lowers the risk of hiring you in their eyes. Information sources include the hospital's website and any other published materials or web based resources. Also, if possible, you should ask friends and other people in your network about the hospital to get any further insights.

Prepare

Review Common Interview Questions and Map Responses

As a doctor, you are likely to be assessed on several different elements by the hiring team, from your academic prowess to team fit, bedside manner through to being able to answer challenging situational based questions to test out how you might respond in high stress situations.

Your goal is to deliver detailed yet concise responses, focusing on specific examples and accomplishments. A good tool for remembering your responses is to put them into story form that you can tell in the interview rather than trying to memorise dozens of different responses.

The web is full of different tools and techniques you can refer to in this area, however the one that stands out for the majority of hiring managers is the STAR interview technique:

- Situation; what was the situation you were in related to the example you are giving?
- Task (at hand); what did you have to achieve / what were the challenges in front of you?
- Action; what did you do as either an individual or team? (Remembering to give examples of what your role was within that team)
- Results; what did you achieve as a result of the actions taken?

People love talking about themselves too, so take some time to prepare questions about the job you have applied for, such as;

- What is the culture like?
- What do you love about working here?
- What does a typical day or week look like?
- What are the main challenges that need to be addressed?
- What are you most proud of about working here?

Bedside Manner

Make Good First Impressions — to Everyone You Encounter

As a doctor, you are going to be pushed hard on how well the hiring manager thinks you will fit into their team (and how you will interact with their patients). The cardinal rule of interviewing is to be polite and offer warm greetings to everyone you meet — from the medical receptionist to the hiring manager. Employers are curious how job applicants treat staff members and your job offer could easily be derailed if there is an air of arrogance in the way you come across. Remember, having a positive attitude and expressing enthusiasm for the job and employer are vital in the initial stages of the interview; it is a well-known fact that hiring managers often make their decision about job applicants in the first 20 minutes of the interview.

Self-Awareness

Body Language and Bad Habits

You could give the best answers to every question thrown your way, but if there is something not quite right about how you are sitting or you have an annoying habit that you are unaware of, all of your hard work and preparation could amount to nothing.

There are so many resources out there on body language but to keep things simple focus on smiling, eye contact, alert posture, demonstrating active listening and nodding (in the right places).

If you have a good honest friend out there why not ask them if there is anything you do that could be perceived as a bad habit in an interview? If you do not want them to get too personal, maybe ask specifically if they have ever noticed you slouching, looking off in the distance, fidgeting, regularly using certain words more than others or whether you sometimes mumble. A true friend is an honest friend so if you do not like what you hear, remember you asked their opinion so it must be somewhat true!

Your CV

It will not get you hired, but it could get you not hired

Let us be honest, your CV is not going to get you a job. But if you make a real hash of it then it could get you put in the discard pile!

The key to a good CV is to deliver the information the employer requires in a concise way so they have a good experience reading it.

Here is a template we use, adjusted for you as a final year medical student, because it gets our doctors hired first. There is obviously draft information in there to demonstrate what we mean.

Personal / Registration Information

Nationality / Citizenship XXX
Languages XXX

Qualifications / Education

2011 – 2013 Bachelor of Biomedical Science (Exercise Physiology)

Note: These must be in reverse chronological order, with the most recent qualification first.

Work History

1 Dec 2016 – 1 Feb Oct 2017

- Job Title
- Employer
- Location

Any extra information about the role should be placed in bullet points.

01 Aug 2011 – 25 Oct 2016 Waitress

- ABC Restaurant
- Served patrons
- Managed the roster.

Note: While this will not be medical work, it is worth demonstrating that you have a work ethic. These must be in reverse chronological order, with the most recent role first.

Clinical / Procedural Skills

- Venepuncture
- Peripheral Venous Cannulation
- Emergency Airway Management

Publications / Citations

O'Connor P, Mu L, Keeffe J. Access and delivery issues in the use of a new model of low vision rehabilitation service provision. Clin Experiment Ophthalmol 2008; 36(6): 547-552

Note: If provided, this should be limited to 1-2 pages.

These can be bullet pointed. The order of text and dates in this section must be kept where the doctor has put them within the title of the publication. Formatting should be the same and consistent on each bullet point.

This section does not always need to be in chronological order. However, this is preferred for ease of reading.

Professional Development

- Advanced Life Support Course, (Nov 2016)
- BASIC Life Support Course, (Dec 2011)

Professional Memberships

- Member of XXX

Achievements

- Greatest person in the world award, 2016

Objectives / Goals / Personal Statement

- I am keen to pursue…

The Essentials

Finally, do not forget the critical things that need no explanation but must be adhered to if you are going to give yourself the best chance of success are:

- Dress professionally; if you are not sure where to start a plain ironed shirt or blouse, smart trousers or skirt and polished dark shoes are all good options to consider, whilst jeans, t-shirts, flowery summer dresses and open toe sandals can probably stay in the wardrobe.
- Arrive on time for the interview, maybe five minutes early, but not more. Give yourself time to compose yourself in your new surroundings so you can go into the meeting room with a clear and focussed mind.
- Be authentic, upbeat, focused, confident (after all you made it this far so you have got something they are interested in) and concise, and remember to thank the interviewer(s) for taking time to meet with you. You might also like to tell them at the end you are really excited about the opportunity and hope you will hear from them soon.

And remember, becoming a doctor is a major change. Do not underestimate just how hard it will be to suddenly have real responsibility. Do not forget about taking care of yourself.

There is an old paradigm in medical practice that we need to sacrifice ourselves to take care of our patients. My research has shown that in fact this is causing us to harm our patients.

You are part of the next generation of doctors. It is time to adopt a new paradigm; I take care of myself so I can provide care of the highest standard. Please visit www.MedWorld.org to access resources to help you achieve this.

It is a challenging adventure so enjoy this next step.

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Babies and Medical School

Dr Tara King
University of Otago, Christchurch

Tara King is a final year medical student studying through the University of Otago at the Christchurch campus. She has a Bachelor of Science in Biology and a Post Graduate Diploma in Science (Microbiology). She was born and raised on the Chatham Islands but has spent the majority of her adult life living in Christchurch. Tara lives with her four children, all girls and in her spare time enjoys painting.

Introduction

First Year Health Science commenced with a six-year-old, four-year-old and a barely three-month-old baby in tow, all girls. My family was upheaved from Christchurch where we had plenty of school friends, family and a great support network and setup in Dunedin for three years where we knew almost no one. Having completed a Postgraduate Diploma in Microbiology and working as a Senior Laboratory Technician for three years, I was ready for a challenge and I was not disappointed. Below are some of my experiences and hopefully helpful tips for those thinking about starting a family before or during medical school.

My experience of Medical school

First Year Health Science (FYHS)

FYHS was the most stressful year of my whole medical degree. When I started the first semester I was breastfeeding my beautiful baby. Within three weeks my milk dried up and I had lost eight kilograms. I had never done physics in my life and it seemed I lived, breathed and dreamed physics. My days were treated as a work day. Being at university from 8am- 4pm, following which I would go home, cook tea, hang out with my family and at 7pm on the dot I would go to my office and study until at least 10pm. During that time my husband would get the children to bed. Friday nights were my down time. I was almost unapproachable until I had sat down, had a couple glasses of wine and unwound from the week.

The second semester was less demanding; I did not take a fourth paper. The ultimate parenting challenge came in that final exam week. While walking my daughter into the day care centre before the Biochemistry exam, she began vomiting. Day care rules meant she could not stay and that she had to be vomit free for 48 hours before being allowed to return. As a result, my husband had to leave work to look after her while I sat my exam, even though he had no annual or sick leave left. If that was not bad enough, when I walked out of the Biochemistry exam, I needed to find a babysitter to be able to study and sit the Epidemiology exam in two days' time. With a sick child and a husband who had to go to work logistically, I did not know how I would sit the exam. Thankfully, my parents-in-law came to the rescue and later that evening they drove to Dunedin to babysit. The following day I was locked in my office preparing for the final exam of FYHS while they attended to the demands of a sick baby.

Despite the challenges of being physics naïve and having a sick child the grades I got that year were by far the best I had ever gotten in my life. I was so determined to do well, and together my husband and I found a routine that worked to get through it. It set me up well for the years to follow.

Early Learning in Medicine (ELM- years 2 & 3)

The day medical school started I was very excited. The hustle and bustle of all the baby medical students arriving for their first day, some even had their parents drop them off. I did not know many of the students, having not been in a hall the previous year, so it was interesting seeing my colleagues for the next five years. ELM was a breeze after FYHS. I could relax and simply absorb what we were being taught. I did not find it too challenging if I went to class, did my tutorial prep and kept up with assignments.

Throughout second year I was plagued by migraines. I put them down to having started on the Depo injection, while everyone else thought it was stress. However, second year was stress-free compared with FYHS. It was overwhelming studying a full year's worth of work for exams. I hate to admit but there were tears and tantrums. There were days when I was relying on the study time where I could not do anything because of a migraine and would instead hang out with my family. I got through it and passed. By this stage I had decided that a potential distinction was not a realistic goal for me and I just had to get through the next five years the best I could.

At the beginning of third year, my husband and I decided to conceive baby number four. We looked at the dates, did some calculations and decided we had a two-month window. If we conceived the first month, the baby would be due around exam time. If we conceived the second month, baby would be due when we were about to move back to Christchurch for Advanced Learning in Medicine (ALM). No time was ideal, as it turned out the baby was due around exam time.

I found being pregnant in Medical school variable. In ELM you are either in a tutorial, a lecture or at a laboratory session. In short, you are sitting down all day and the University staff were very supportive. In addition, that year I had decided to become the MECA (Medical student conference) Coordinator and the Coordinator for the OUMSA Charity Art Auction, thus I was very busy. Studying for exams was not always easy, I was often exhausted or unable to concentrate. The three evenings a week when my husband worked and I took care of the kids alone were at times a struggle. My eight-year-old would have to take over preparing dinner because the smell made me nauseous. It was difficult dealing with the children on my own after studying all day. I slept when I felt like I had to, I would rest with the kids and try not to be too hard on myself. The day of my final OSCE was also the day I gave birth, thus I sat it two days later instead with a sleeping baby downstairs being cooed at by adoring medical students.

Advanced Learning in Medicine (ALM- years 4, 5 & 6)

The summer holiday between third and fourth year was busy with a new baby, the big move back to Christchurch and trying to find a house. In this period, I managed to breast feed exclusively for four months and then supplement with formula for an additional month. Once in the hospital, I loved the clinical environment, but the hours were long and the days of work felt endless. Some weeks I felt like the worst mother in the world because I had barely seen the kids. Other weeks I would get home early each day and got to do all the "mummy things".

Preparing for fifth year exams required a lot of self-motivation and

discipline. I started an OSCE practice group in March and had weekly Sunday sessions with three of my classmates. 'I was well-prepared, and if any of my children got sick (and they did get sick, plenty), I knew I had been studying steadily since the start of the year. I had never been able to concentrate in the library, so before the finals, I hijacked a friend's house to study all day. I felt inadequate compared to the other students as they had as many hours in the day to study as they required. However, I developed a routine of studying at the hospital in between placement and then in the evenings studying at home until I could focus no longer once the children went to bed. I successfully passed the final exams and got to relax at home with the kids until Trainee Intern (TI) year started.

My TI year has gone well. I am very aware of my pending employment where I will not get away with starting 30 minutes late every now and then to drop the kids at school nor get away early so I can be home when they get home from school. I have gone through a marriage break-up this year and juggling children, housework and schoolwork can be challenging. As a result, the house is a mess and my assignments get done the day before they are due. Currently I have a temperamental 'tweenager', kids struggling at school, one child with chronically bad eczema with recurrent skin infections (now MRSA), all the while trying to ease them through the break-up of their family as they know it. It has been a learning curve. I have not always done the right thing but I always try to learn for next time and ensure my children know I love them and am there for them always.

Childcare

The biggy! It really depends on your family situation. Are you a solo parent or in a relationship? What is your support network like? Medical school can be 40-60 hours a week, sometimes more, with study time required on top of it, so you need something flexible. ELM was not too bad as there are no evenings or weekend shifts.

I have used a combination of childcare options:

- Day-care and Before and After School Care, it helps if you qualify for a childcare subsidy.
- Stay at home parent, the nicest choice by far but often not an option. Ladies remember men can be stay-at-home-parents too (you just need to be able to afford it). It is also the most flexible option to study around.
- Family and friends, relying on your greater support network is ideal when you need to do evenings and weekends or even early starts.

Alternatively, get a nanny, use home-based care, an au pair or poor University student- I cannot afford any of these options. Talking to people in a similar boat to you could also be beneficial, you could find a way to share childcare or both contribute towards a nanny or babysitter.

Tips for study

Being well organised is the best thing you can do to get you through medical school and out the other side in one piece. I must admit there have been plenty of times that my organisational skills have been lacking and I ended up making my situation more difficult for myself. Make a study plan and stick to it. This is most important when big exams are coming up or there are multiple assignments due around the same time. Remember, you are not a robot, so only be most regimented when it is most required and schedule in family time.

Treat university like a working week

Come to university between eight and nine every day, even when you have nothing on in order to do any assignments or study you need to. Try to fill all those annoying gaps during the day by doing any amount of work that will make life easier and give you more time to see the kids.

After 'work' is family time

In the evening I go home, tidy up, cook tea, sort out the kids and if I am lucky I have time to hang out with them a bit. After the kids are in bed, do what school work you need to early then schedule in some personal 'you' time.

Sleep

If you are tired, just go to bed, your productivity will go down if you are tired. Studies have shown that students that watch an episode of 'Friends' the night before an exam do better than those who stay up late studying.

Remember Murphy's Law

It will be exam week when your child wakes in the middle of the night with croup. A child gets sick on average 12 times a year, which is 48 sicknesses in my household a year. Then they make you sick. Stay on top of your work as best as you can. I have spent a lot of time up in the middle of the night with sick kids and it always happens when you need it the least.

Ask for help

Do what you need to do. Most people at university and the hospital are very understanding. Get extensions, ask to come in late. Most doctors who have supervised me during ALM said 'family first'.

Have mental health days

I did not come in to work one day because as a newly solo parent this year I was trying to figure out how I was going to find care for my kids in the mornings when I start at 7:30am for my first run as a house officer. My childcare arrangements with my ex's are complicated, they are reasonably flexible which is great and I am very grateful but I still have arrangements to make. So, on my mental health day I rang my sister, talked to her for an hour, felt sorry for myself, went to visit my aunty, cried on her shoulder, then came up with a plan. I think it is good to be miserable about things that upset you, but only for a little while. Let yourself cry and feel overwhelmed then pick yourself up and make things work. Have a break, read a book, go to a café without the kids, just breathe.

Remember the person who graduates last in their med school class is still a doctor

I am not saying do the minimal amount of work to get through, but rather do not put unrealistic expectations on yourself. You do not need to have an A+ average. As a student with children you already have more life experience than most and that helps you be an empathetic and knowledgeable doctor. It makes Obstetrics, Gynaecology and Paediatrics a lot easier.

Use the kids in your study

When my daughter was four, she laughed so much when I asked her if she was a smoker during a practice interview. The kids love feeling like they are helping out.

Watch Youtube videos

Youtube has everything nowadays. When you are tired or sick, or simply do not have the energy, put a video on. It will help you learn.

Medical school is a lot like a job. If I was not doing this, I would be working full time anyway, or studying something else. It is not a lot different to a usual working week. There are times when I am extremely busy and other times that are more relaxed. Go home early when you can. Cuddle your kids on the couch and watch Peppa Pig. Do not stress the small stuff and get the work done. Medical school is a lot of tick boxes, so tick them and keep going. In reality it is only the start of the medical journey!

Conflict of interest: None

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NZMSA: Unite, Empower, and Represent

Kieran Bunn
University of Otago, Wellington

Kieran Bunn is a final year medial student based in Palmerston North and the 2017 New Zealand Medical Students' Association President. He is a previous President of the Wellington Medical Students' Association, and has completed a BMedSc(Hons).

We are fast approaching the section of the year where nostalgia sets in. We are far enough along that the goals that we never got round to have faded (I was definitely going to get both more exercise and sleep, neither of which, in a surprising twist, happened) and instead, our achievements start to loom out of the mists of memory. 2017 really has been an excellent year for NZMSA. We are here to unite, empower, and represent the medical students of Aotearoa, and in the last 12 months we have definitely scored a hat-trick.

Our three unifying pillars have been our main events for the year: the conference in Tauranga, the Clinical Leadership Forum (CLF) and Sports Exchange in Christchurch. As always, these events proved popular, so much so that the conference and CLF both received far more applications than there were available positions. The anticipation paid off, as both were superb events to simultaneously reach inward and get to know your future colleagues, and outwards towards poetry, music, and research which you may have lost track of during medical school. The teams that organised these three events did an outstanding job.

On the theme of unity, NZMSA also gained a closer partnership with Te Oranga. This was formalised through a memorandum of understanding, based on the principles of Te Tiriti, which will provide a framework for our two organisations to collaborate. It has already proved valuable, with the attendance rate for Māori students at our events higher than in previous years, and with NZMSA and Te Oranga running a powerful and unified campaign on the issue of student loan access. This is the culmination of excellent work from both Te Oranga and NZMSA, and it is one of the many steps NZMSA has, and will take to meet our obligations under Te Tiriti and unlock the potential that this entails.

While we are here to represent you, there is no way that NZMSA could have the capacity to speak for all of you, which is why we assist you in speaking for yourself. This year in part we did so by supporting the Land of the Long White Coat podcast from Joshua Smith, which gives advice on how to navigate the clinical realm, and where there be dragons to avoid. We also worked with Victoria Catherwood who created a documentary on the use of medical cannabis, which aims to educate medical students on its potential uses. These are just two examples amongst the many other small ways we supported individual voices.

There were two broad activities NZMSA undertook to upskill students: the focus months, one on the election and one on careers. The latter was about getting the resources to you so that you can start thinking about what you want to be when your legs evolve and you climb forth from medical school ocean to the land of clinical medicine. The former was in keeping with the drive from the New Zealand University Students' Association, to promote youth voting, but with our spin focusing on the health policies. Taking a tangent from the focus months and swerving into a parallel project, we have also been an active contributor to the Choosing Wisely Campaign which aims to make you think about what tests and procedures are being done, and provide you with the tools to question or explain why these are happening.

Finally, I want to touch on representation in the field of wider health advocacy. We have spoken out about climate change, healthy housing, and vaccines. We have also had a focus on the lifetime limit on student loans, which we believe is an unjust, wasteful, and needless policy when it prevents you from finishing your medical degree. At the time of writing we are still waiting on the special votes to be counted, which may, due to our work in getting the Māori Party, NZ First, Labour, and the Greens to all adopt policies that would enable you to finish, resolve this problem. However, they may not, and I have no doubt that, if needed, next year's team will continue this campaign.

NZMSA only exists for you, and because of you, and I have had a delightful time being a part of this organisation. For those of you who have a break approaching I hope it is marvellous, for those who are heading into the world, I urge you to consider joining your professional body, the New Zealand Medical Association (NZMA), and your union the New Zealand Resident Doctors' Association (NZRDA). Like us, they will be there for you, and the most important realisation I have come to from my time in NZMSA is the incredible value of being united, empowered, and represented.

Conflict of interest: NZMSA President

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International Association for Medical Education Europe Conference: The Power to Surprise!

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Roshit is currently a Bachelor of Medical Science (Honours) research student based at University of Otago, Christchurch. His research aims to develop and evaluate Global Health Classroom, a learning model connecting medical students in Nepal, Samoa and New Zealand to share and learn about their health systems, challenges and culture. With interests in global health and medical education, he is looking forward to his role as Education Officer in NZMSA.

The International Association for Medical Education Europe (AMEE) Conference is a leading annual medical education conference which allows teachers, researchers, and students who are interested in education within the medical and healthcare professions to present advancements and challenges in medical education, network with others of similar interests, and to take part in numerous courses and workshops. The 2017 AMEE Conference was held in the charming city of Helsinki, Finland from 26-30 August. The 3,500 attendees brought with them varying perspectives and ideas from all over the world that generated boundless learning, sharing, and networking opportunities.

As part of my research project this year, I have had the opportunity to delve into the world of medical education, focusing specifically on global health, technology use, and transformative learning. I am extremely thankful to the Otago Medical School and AMEE for supporting my travel, and to my supervisors for encouraging this. As a first-time delegate to a major medical education conference, I was amazed by the scope and breadth of medical education. It is a field which is constantly evolving and transforming towards a socially accountable mission. My involvement at this conference was primarily as a member of the Student Task Force (STF) and participant in the Hackathon, and secondly, as a medical student attending as a delegate. Here, I will share my insights from both perspectives.

Every year the AMEE Committee selects health professional students to be part of the Student Task Force, to assist in the logistics and administration of the conference. I was honoured to be selected as part of the STF, among 38 other students representing 32 countries. The task force was assisted by local Finnish medical students, with whom we stayed at the same hostel.

Being a member of the STF was certainly one of the best experiences from the conference. Having the opportunity to hear and share stories from diverse cultures, backgrounds, and beliefs was eye-opening in many ways. Studying medicine has given us a common language, composed not only of the technical aspect of learning the science and art, but also of the personal struggles and sacrifices we have had in our journey. Despite our common language, the context and culture in which we learn and practice are often vastly different. Perhaps the most significant and sensitive discussion we had was around the high rates of mental illness among medical students and doctors. As a very relatable topic among the medical students, everyone could share insightful stories of their experiences. It was shocking and distressing to hear how stressful studying medicine is in some parts of the world. One of the STF members passionately made the point that we, as future healthcare professionals, have an obligation to take care of ourselves and seek help when required, and, in addition, pay attention to the wellbeing of our colleagues.

For our entertainment, the Finnish medical students had planned social events every evening. A particularly memorable one involved a Finnish-style dinner consisting of several rounds of speeches, drinking and eating delicious traditional food. Speeches consisted of expressions of people's gratitude and joy of being part of the STF and an invitation to their home country, followed by singing and dancing. After more than 15 rounds of speeches, singing and dancing, drinking and eating, it is safe to say that the Finnish know how to have an entertaining time and 'finnish' a night with a bang. The Finnish medical students were wonderful hosts, sharing with us much about their culture and great social services. We left having thoroughly embraced the sauna culture.

A recurring conversation in the STF was about the state of medical education in our respective schools and countries. Our conversations were especially insightful when medical students representing international medical education committees, such as International Federation of Medical Students' Associations (IFMSA) and AMEE, shared their experiences and reflections. I noted that there are stark contrasts between schools in their teaching content and style, student engagement, and opportunities for students beyond the curriculum. Based on these conversations, New Zealand appears to be doing well. In fact, a medical student from King's College, London shared what he knew about Otago's Rural Immersion Programme. I was surprised to hear that he knew about the programme on the other side of the world, let alone for him to be impressed by it. I have come away from the conference feeling proud and thankful towards our teachers and clinicians for the quality learning environment they have created. As students, it is important that we play our part, and continue to foster this learning environment when we are clinicians and teachers.

The AMEE Conference also hosts a Hackathon, and despite having never heard of it, I expressed my interest to partake any way. The Hackathon involved groups of medical students, developers, and designers banding together to produce innovative digital solutions that address challenges in medical education. The Elsevier publishing group sponsored the event and they had run an international competition to select medical students, developers, and programmers to participate. Medical students participating in the Hackathon came from every continent and brought with them challenges they wanted to address with digital solutions.

I was selected alongside Basil Badwan, a medical student from Jordan, to represent our STF in the Hackathon. For over 48 hours we brainstormed and conceptualised ideas, before producing a prototype with the help of our developers and designers. Our group worked on an application that aimed to improve clinical learning by providing tailored, personalised

information to students so they could anticipate and make the most of their clinical opportunities. Throughout the 48 hours we received mentoring from digital application and marketing experts so that we could design and produce an application that was both useful and marketable. Despite being very sleep-deprived and overloaded with caffeine, we were excited to be presenting our work to the judging panel, which consisted of Elsevier Directors and medical education experts. Eight prototypes were presented, from multi-media flashcards to chatbots that talked with the student user to improve their recall of study material, all of which were very impressive. We were filled with a sense of accomplishment for producing a prototype within 48 hours. The winning team designed Patient X, a chatbot using voice technology to improve clinical reasoning by using case scenarios.

Basil and I were asked to present our experience and learning from the Hackathon at the AMEE Symposium on Innovation, Creativity and Entrepreneurship. My learning was two-fold. Firstly, I learnt that focussed and dedicated problem-solving collaboration can yield promising results which otherwise may not occur in the normal routine of life. Secondly, I learnt that we must collaborate with different disciplines to find solutions to challenges we face in health-related areas. In the Hackathon, we worked with designers and developers to produce a learning application which none of us could have produced alone. It was a true team effort where each person's contribution was critical to the end outcome. Medicine is becoming increasingly inter-disciplinary, and healthcare professionals alone cannot solve the challenges we face. We must look beyond medicine to find our answers.

In summary, the AMEE Conference was an excellent opportunity to learn more in the field of medical education. This conference made me aware of the integral role that we as students have, to collaborate with our clinicians and educators to ensure quality is upheld through our ever-evolving education. Medical education is a speciality in its own right. As one of my co-supervisors, Professor Tim Wilkinson, said to me "Medical education is like a public health intervention because it has the potential to produce clinicians that will transform our health system, improve the care and outcomes of our patients, and who will become change agents of the future." Furthermore, medical students will undoubtedly find themselves in teaching and mentoring roles, if not now, then in the future. Consequently, it is essential that we learn to teach and mentor. We can be involved in medical education by being engaged with our teachers and student representatives in developing our curriculum and by initiating and continuing mentoring and educational initiatives. It is also important that we celebrate the great work that our teachers and students do. I look forward to contributing and engaging with my peers and teachers in the medical education space in 2018 as Education Officer of NZMSA.

Conflict of Interest: None
Funding: Otago Medical School (OMS) and International Association for Medical Education Europe (AMEE)

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New Zealand Medical Students' Association Conference 2017 - Ignite

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The authors were part of the organising team for the New Zealand Medical Students' Association Conference 2017 - Ignite which was held in Tauranga from the 3rd-5th June. Karen and Anita were co-conveners, and are currently 5th year medical students at the University of Auckland, whilst Apurva was the Academics Convener and is currently completing the BMedSc(Hons) programme after her 4th year of medical school.

Over Queen's birthday weekend, 230 medical students from across New Zealand arrived bright-eyed in Tauranga, ready to ignite their interests and spark their passion at the New Zealand Medical Students' Associations (NZMSA) Conference 2017. The theme of the conference was Ignite and the aim was to provide an opportunity to reflect on ways to rekindle the inner flames of the attending delegates. With the beauty of Mount Maunganui in the background, Tauranga was the perfect host city for this year's conference.

The conference began (as was only fitting for coastal Tauranga) on the beach. There, delegates were greeted by the famous Mount Maunganui and glittering surf as they waited for the aMASing Race to begin. Delegates were invited to meet the members of their teams, with whom they then embarked on the aMASing Race across Tauranga, which ranged from challenges set by the New Zealand Defence Force to rock climbing and other beach activities. As the sun set and the race drew to a close, delegates made their way back to their accommodation venues and began preparing for the first social event of the conference. The Cocktail Evening, held at the Mauao Performing Arts Centre on Totara Street, one of Tauranga's premiere music destinations, was perfect for relaxing after the race and for mingling with the other delegates.

The academic programme began on Sunday morning with an inspiring talk from one of our keynote speakers, Dr Swee Tan. Dr Tan is a plastic surgeon and world renowned researcher. He spoke about his work in the field of cancer research and his remarkable personal journey towards becoming a pioneer in his field. Dr Tan's talk was closely followed by the breakout session Rekindle Your Heart, which was focused on burnout and reigniting the inner flames of the delegates. Next was the much-anticipated Health and Well-being Panel, which was chaired by Dr Tony Fernando. Medical students shared their own experiences, and highlighted the burden of mental illness amongst our colleagues. The panel was immensely moving and emphasised the importance of caring for each other's health and well-being as well as our own.

The rest of the day was spent learning from Professor Shanthi Ameratunga, a paediatrician and public health physician, who spoke on global health issues and opportunities at medical school and beyond. The next breakout session, Build the Flame, revolved around building practical skills, with sessions on managing airways, robotic surgery, rural emergencies and clinical skills. The day ended with the Gala Dinner where the delegates celebrated in style at the stunning Eagle Ridge Estate. Connections were strengthened and conversations were continued over a delectable buffet meal.

The final day of the conference further developed on the health and well-being theme with two poignant presentations by Dr Glenn Colquhoun and Dr Robin Youngson, who spoke on the art of medicine and the importance of compassion in healthcare. Delegates were greatly moved by the poetry of their words and by the notion of preserving our humanity while working in medicine. In particular, the talks emphasised the impact of having compassion for our patients as well as each other. It reiterated the importance of bringing humanity back into medicine and realising that looking after ourselves helps us look after others better. Between these talks, students had a chance to explore a range of medical and surgical specialities at the Spark Your Passion breakout. Finally, delegates were given the opportunity to ask questions to political representatives from National, Labour, Green, NZ First and ACT in a wide-ranged and highly engaging discussion.

As the weekend drew to an end and students boarded their buses, we as an organising team had the opportunity to reflect on the weekend. Through the whirlwind of logistics, communication and administration, we observed new friendships forming, delegates gleaning new knowledge, and renewed commitments of our fellow delegates towards supporting one another in their journey through medicine. Although exhausted, we felt our efforts had been worth it and as though we had been part of something bigger than ourselves. We hope that everyone who attended Ignite 2017 enjoyed the experience as much as we enjoyed creating it.

We would like to thank the NZMSA Conference Team, the NZMSA Executive, all our sponsors, speakers, and delegates for making this conference possible.

Conflict of Interest: Members of the 2017 NZMSA Conference organising team.

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BOOK REVIEW

Time to Care by Robin Youngson

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Robin is a third year medical student at the University of Auckland with a keen interest in Rural Health and Medical Education. In his spare time he likes writing and sitting on top of mountains, sometimes doing both at the same time.

"Put your head down, complete your tasks as quickly as possible, get the paperwork done, and move onto the next patient." This is a familiar scenario to many. These are the unspoken rules we learn to live by when stretched to our maximum.

Time to Care is the manifesto of healthcare workers striving for something more in a system that rewards numbers more than it does compassion. The book opens with some sobering statistics: a 2008 survey of 12,000 physicians in the USA found that 78% found medicine "less or no longer rewarding," 60% would not recommend medicine as a career, and that 49% planned to either reduce their patient numbers or stop practicing in the next 3 years[1], a crippling blow at a time when healthcare is more stretched than ever.

The author, Dr Robin Youngson, aims to address this and other prominent issues in healthcare ranging from physician burnout to building patient-focused systems. How? By following the principle that compassion comes before everything else.

In the pages that follow, Youngson compiles and presents the evidence that bringing the care back into healthcare benefits both practitioners and patients alike. Weaving patient stories with his own personal experiences as an anaesthetist, Youngson describes his journey on both sides of the fence we place between ourselves and our patients. From waiting room to boardroom, no perspective is left uncovered.

He recalls how powerless he felt when his own daughter was admitted to hospital following a serious car crash, but also celebrates how the little things made all the difference in her care. After the crash, any jolt of the hospital bed would bring pain to her broken, bruised body. But during transfer one of her nurses would stop and lift each wheel of the bed individually over joins in the floor to ensure no jolting was felt in the bed. It is such a little thing, and completely unprompted, but it made all the difference and was an excellent demonstration of going above and beyond.

He talks candidly about a patient who, despite her many comorbidities and high risk of fatality during a major surgery, could see the fear he had about her anaesthesia and the risks it would involve. She took the time to allay his fears, the exact opposite of what we would expect from a Doctor-Patient relationship. As this patient said after surviving her surgery, "Robin, I prayed you would survive my anaesthetic and you did!"

Through humorous anecdotes, poignant prose and a thoroughly researched body of evidence to support his claims, Youngson makes a compelling argument for changing the way we practice. He addresses the paradox that taking time to care leads to lower workloads in the long run, and how it improves our relationships with patients, leading to better outcomes. Practical tips on developing compassion and managing ourselves are seeded throughout, reminding the reader that sometimes, taking time to care for yourself is just as important as that directed towards those we care for. To quote, "I became a better doctor when I acknowledged my own human failings… when I judged myself harshly, I was also less kind to my patients". There is a lesson to be learnt from this, in that how we treat ourselves affects how we treat others.

Time to Care is a quintessential read for those about to embark on their clinical journey as much as it is for veterans of the medical system. I would even argue for making it part of the wellbeing curriculum at medical school, as the lessons contained have as much power in prevention as they do in cure of disenfranchised healthcare workers. We can all do with a little more care in our lives, not just for our patients but ourselves as practitioners. With that in mind, I believe everyone can find some tucked away in this book.

Conflict of Interest: None

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Do No Harm and Admissions by Henry Marsh

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Cam is a final year medical student at Waikato Hospital. Outside of medicine he can be found reading a book but he's probably watching Netflix.

You know Henry Marsh. He grilled you on an eponymous sign during a radiology meeting. His self-importance and time spent in hospital led to his divorce. His car gets towed because he is rushing to theatre and takes a reserved spot. Do No Harm and his follow up book Admissions breaks down that arrogant doctor we think we know and hope we don't resemble.

A surgeon once recommended "Do No Harm" to me but then tempered his praise by saying that "the author must be seriously depressed". Henry Marsh is shocking not because he is mentally ill, but because he breaks with medical culture and honestly admits to having emotions and flaws. In his writing, you feel his shame as he detours around the bed of a patient that he "wrecked" in surgery. His conflict over saving the life of a patient with an expected neurologic outcome that will be worse than death. His extreme anxiety as he teaches his trainee to clip an aneurysm. At times his honesty is awkward, his squabbles with bureaucrats and speech and language therapists make him sound petulant. Yet despite his flaws, Henry Marsh has a fundamental love of people, this is most obvious when he describes his attempts to bring modern neurosurgery to the Ukraine and Nepal.

Marsh's love of the brain and surgery bring much needed lightness to some of the bleaker case histories that are common on neurosurgical wards. His prose is often more poetic than academic.

> "*My sucker is moving through thought itself, through emotion and reason, that memories, dreams and reflections should consist of jelly, is simply too strange understand.* Do No Harm. "

> "*Much of what we think of as real is a form of illusion, a consoling fairy story created by our brains to make sense of the myriad stimuli from inside and outside us, and of the unconscious mechanics and impulses of our brains.* Admissions."

In both books, Henry romanticises the "good old days of medicine. When the doctor was a hospital's supreme authority, house officers never left the hospital, and doctors treated other doctor's family members for free. He worries that medicine is becoming a job rather than a vocation and that work hour restrictions make us worse doctors. This is not a serious policy prescription but rather a surgeon on the edge of retirement pining for a more honourable time. A time when after operating on a local GP's wife who died soon after surgery he still received the traditional payment of wine.

Neurosurgeons that write books for a general audience often fall into one of three categories. The future politician who carefully crafts his heroic public image, see *Gifted Hands* by Ben Carson. The pious who interpret their experiences through a religious lens, see *Proof of Heaven* by Eben Alexander. And the artists who accidentally became surgeons, see *When Breath Becomes Air* by Paul Kalanithi. Thankfully, Henry Marsh's books falls squarely in the latter category.

Conflict of Interest: None

How to Fix a Broken Heart: Waikato Cardiothoracic Unit Mitral Valve Workshop Review

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[2]St George's University of London, United Kingdom

Ye is a fourth year medical student at Middlemore Hospital. She is interested in various fields within surgery and medicine, and is enthusiastic about research for the advancement of medicine. In her spare time, she enjoys cross country running and playing violin. Von Paolo is a fifth-year medical student at Auckland City Hospital. EJ is a fourth year medical student at St George's Hospital. Chey is a final year medical student at Auckland City Hospital.

SODOTO: ***See one, do one, teach one*** – these are the three essential steps described in Kolb's model of experiential learning. Kolb described the learning process to occur through absorbing concepts and continuously reforming them through experience.[1] Patients provide us with the best learning opportunities, as these interactions help us amalgamate information into a story that makes sense. Similarly, surgical skills are acquired through repetition and experience, making simulation training valuable for learning. Unfortunately, medical students have a paucity of surgical skills training.[2] To mitigate this shortcoming, Mr David McCormack invited several medical students to the Mitral Valve Workshop, hosted by the Waikato Cardiothoracic Unit. The workshop taught skills in cardiothoracic surgery in a fun, practical way, and offered a invaluable insight into this specialty and what common operations entail.

The afternoon was broken down into three informative sessions and two practical sessions, all dedicated to the mitral valve: its anatomy, imaging, and surgical techniques involved in its repair and replacement. The sessions encompassed all aspects of the SODOTO framework, which helped us learn about the mitral valve and its repair. As students, we are commonly taught concepts in isolated blocks, but in this workshop the bigger picture was emphasised throughout the session.

"Anatomy is repetition" and is essentially the fundamental basis of surgery. The afternoon commenced with Mr McCormack recapping the anatomy of the mitral valve. We reviewed its location, relationships to other structures, components, and functional anatomy using illustrations, diagrams and photos. The cardiovascular anatomy from preclinical years, which was once a distant memory, came flooding back. The next speaker was cardiologist and intensivist, Dr Pranesh Jogia. Dr Jogia guided us through mitral and aortic valve imaging, with an emphasis on transesophageal echocardiography. These imaging tools enable surgeons to have a thorough understanding of the patient's anatomy, which allows for effective preoperative planning. Dr Jogia's talk showcased the importance of interdisciplinary communication, which is a crucial aspect of delivering the best care for cardiothoracic patients. The theory behind the anatomy and imaging of the mitral valve prepared us for the "see one" part of the experiential learning cycle.

Associate Professor Adam El Gamel, who is an expert in the field of aortic valve replacements, mitral valve annuloplasty, coronary artery bypass surgery and more, was next to speak. He led us through the steps involved in mitral valve annuloplasty, using videos of operations as a learning aid. The videos highlighted both technical surgical skills and clinical decision-making under pressure.

Assoc Prof El Gamel also elucidated the concepts involved in mitral valve replacement, while emphasising the burden of Rheumatic Heart Disease (RHD) on the Waikato population. We learned about bioprosthetic valves versus mechanical valves. Mechanical valves require patients to be on warfarin for life to prevent complications related to thrombosis, whereas bioprosthetic valves work well but need re-operation before mechanical valves barring any complications. Despite the advantages and complications of each valve type, survival outcomes for bioprosthetic and mechanical valves are no different.[3] This presentation highlighted the importance of research to achieve optimal patient outcomes. Mitral valve repair and replacement are common procedures performed at the Waikato Cardiothoracic Unit. A common indication for this operation in New Zealand is mitral regurgitation secondary to RHD. In New Zealand, RHD is seen at a rate of 3.5 cases per 1000[4], with an average of 159 deaths attributed to RHD per year.[5] In contrast, other OECD countries report 0.3 cases per 1000.[3] Other indications for mitral valve repair or replacement that are prevalent in New Zealand include infective endocarditis and ischaemic heart disease.[6] This workshop delivered the population health aspect of the mitral valve, an important part of all medical fields, highlighting the need for surgeons to speak up about public health issues.

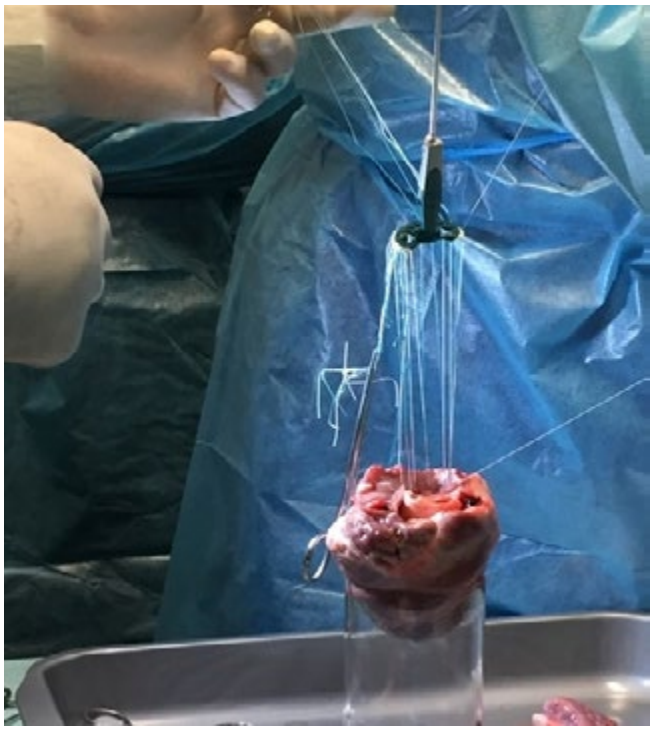

Figure 1. Annuloplasty
Sutures are threaded through the mitral valve into the ring, ready to be pushed downwards and secured.

In the first practical session, we gathered around Mr Nick Odom, an experienced cardiothoracic surgeon, as he demonstrated a mitral valve repair; prosthetic ring is sutured around the mitral valve annulus to increase its ability to support the valve. The resulting reconstructed valve had a narrower orifice, increasing leaflet coaptation and preventing regurgitation. We watched as he threaded the double ended suture through the mitral valve, and secured the ring down with hand ties. As we witnessed Mr Odom fix a broken heart, we completed the "see one" step of the experiential learning cycle.

Then it was our turn – we excitedly sat down next to our pig heart to commence the operation. Forceps in one hand and needle holder in the other, we carefully pierced the trigone at the golden ninety-degree angle. Through cycles of pronation and supination, we threaded the sutures around the valve. The sutures were threaded through the prosthetic ring in a horizontal mattress fashion. To complete the annuloplasty, the ring was pushed down onto the valve and secured with surgical knots (Figure 1). With the support of various demonstrators, we completed the "do one" step of the experiential learning cycle.

As part of the second practical session, we watched Assoc Prof El Gamel as he demonstrated a mitral valve replacement. The steps in valve replacement were similar to that of an annuloplasty. The second time around, our confidence increased and we noticed a difference in the quality of our work (Figure 2). Anatomy is repetition – perhaps surgical skills are too. This exercise verified how practice and experience can pave the way to success in surgical skills. At the completion of our valve replacement, we propelled saline down the left atrium to test the success of our operation. We watched our valve leaflets fill with saline; just like a hot air balloon as taught in preclinical anatomy. Through repetition and individualised feedback from the surgeons, we fixed our first broken-hearted pig.

The mitral valve workshop was a highly rewarding, enjoyable and fun learning experience, putting us in the shoes of a cardiothoracic trainee. It gave us an insight into the specialty, allowing us to decipher whether cardiothoracic surgery is a possible career option. While primarily aimed at junior doctors, the workshop catered to students too, with ample one to one interaction with cardiothoracic surgeons as tutors. The workshop demonstrated how daunting and technical procedures can be mastered through an eager attitude, patience, and supportive guidance. Through meeting fellow medical students of different year groups and countries, we fostered collegiality, mentorship, and friendships.

But then you may be wondering, how did we complete the "teach one" step of the experiential learning model? Throughout the entire afternoon, students helped each other and exchanged knowledge and skills acquired at different clinical campuses. This workshop nurtured the tradition of helping one another, as collegiality will prove to be useful throughout our entire career.

The mitral valve workshop provided an opportunity to learn surgical skills and delve into the world of cardiothoracic surgery in a supportive environment, and in a fun, hands-on manner. We highly recommend taking up opportunities like these, especially for those of us who are surgically inclined. Learning by seeing, doing and teaching ensures that we are equipped with the skills necessary to tackle surgical rotations in the future.

Mr David McCormack is always happy to assist students! Please do not hesitate to get in touch with him if you want to be invited to further courses, organise an elective or see operations. Get in touch with him via his email: David.McCormack@waikatodhb.health.nz

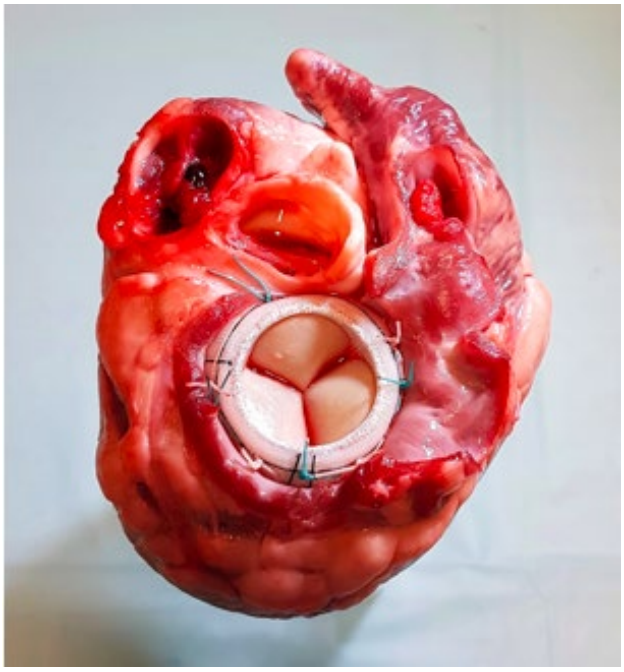

Figure 2. Mitral Valve Replacement
A completed prosthetic mitral valve replacement

Conflict of Interest: Chey Haran is the NZMSJ Editor-in-Chief. This article has gone through a double blinded peer-review process applied to all articles submitted to the NZMSJ and has achieved a standard required for publishing. The authors have no other conflicts of interests to declare.

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Welcome to the first edition of the New Zealand Medical Student Journal's and New Zealand Medical Students' Association's joint Creative Writing Competition! This collaboration aims to promote the creative talent we have bubbling away in our medical schools and to hopefully inspire readers to give it a shot themselves.

Anyone can enter so send your entries through to reviews_editor@nzmsj.com for a chance to be published in future editions of the journal. Any creative piece is considered (not just poetry) so let your ideas flow! Now read on below to see this issue's successful writers.

The patient patient

Melanie Jones
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Melanie is a fourth year medical student who grew up sailing the South Pacific before being based in the Bay of Islands. She has interests in public health and surgery.

It was afternoon when I walked by
In a hurry, but not to do anything
Excuse me
You said
Are you my doctor

No sorry
I'm just
A medical student
I said
Trying to speak loudly
But not knowing
What was loud enough to hear
But quiet enough
To not be patronising

In my head
I thought
I need to stop saying that I am just
A medical student
A kind registrar told me off
For making myself seem more
Worthless
Than I already feel

Oh
You said
No one
Has come today

I stared
Blankly
You are not
On my list
I thought
You are not
My
Patient

I said
What time do they normally come around
Although I knew
They should have already come

Maybe you had been
In the bathroom
Or at a
Procedure
And the team was too
Busy
To wait
Or come back
I thought

But you wouldn't
Know
You'd feel forgotten
I know

Normally the morning
I don't know
I don't even know
The day
You said

I'm so sorry
About that
I tried to
Explain
Worrying
Did I force
Genuine care
Too much

But I am
Sorry

That you had to be
A patient patient
Waiting
Feeling
Forgotten

I'll get your nurse
And ask them to page
Your doctors
I hope
They can help
And
That I have helped
And that I
Will
Help

Like the doll she clings to

Lauren Smith
Dunedin School of Medicine, University of Otago

Lauren Smith is a fourth year medical student at Dunedin School of Medicine. She has been writing poetry for the past eight years but has recently developed inspiration within the walls of the hospital. She has a previous degree majoring in Functional Human Biology and is hoping to pursue poetry outside of Medical School.

Her legs as thin as the frame
she uses to guide her frail body
Each turn of the wheels
an unravelling string
of opportunity

Her eyes lit like the day
the earth stood still
when her gaze impressed the woman
who sung her into existence

Her voice caught within her
wrinkled cheeks and
dream-like thoughts but she grins
as if her mum played peek-a-boo
her world simple

She claps as if understanding
the gravity of walking the length
of what seems like the country
compared to the metre
we once clung to

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Dunedin School of Medicine
PO Box 56
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We are currently accepting submissions for Issue 26 due for publication in May 2018.