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Demographic and psychological correlates of satisfaction with healthcare access in New Zealand
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This study found that the majority of New Zealanders were highly satisfied with their access to healthcare when needed (68.4%), while 25.3% were moderately satisfied and 6.1% expressed low satisfaction. Additionally, we found that younger individuals, those of Māori, Pacific, or Asian ethnicity, and those with higher deprivation and lower income were less satisfied with their healthcare access. Conversely, those with a partner, living in an urban area and non-parents showed greater satisfaction. Personality traits were also associated with differences in level of satisfaction. Those who scored higher on Extraversion, Agreeableness, Conscientiousness and Honesty-Humility, but lower on Neuroticism and Openness were found to express higher satisfaction.

Appendicitis presenting as the first manifestation of colorectal carcinoma: a 13-year retrospective study
Rebecca J Shine, Abigail Zarifeh, Chris Frampton, Jeremy Rossaak

This is the first study of its kind conducted in Australasia. This study found patients ≥45 years who present with appendicitis have significantly increased risk of underlying colorectal cancer. Until further research is conducted the authors recommend clinicians consider colonic investigation for older adults following a diagnosis of appendicitis.

Short-term outcomes following cytoreductive surgery and heated intra-peritoneal chemotherapy at Waikato
Jasen Ly, Linus Wu, Ralph Van Dalen, Simione Lolohea

This article presents Waikato’s experience with cytoreductive surgery and heated intraperitoneal chemotherapy for predominantly patients with pseudomyxoma peritonei. This rare disease arises from a growth within the appendix that perforates and leads to the accumulation of an abundance of mucin within the abdomen. Performed only elsewhere in New Zealand in Wellington, this is the largest series of the technique in New Zealand. The technique involves extensive surgery to remove all visible disease from within the abdomen, sometimes involving the removal of multiple organs, and is coupled with the addition of intraoperative heated chemotherapy for 90 minutes. This provides a cure for patients who would have otherwise had an ultimately fatal disease.

A cross-disciplinary assessment of student loans debt, financial support for study and career preferences upon graduation
Craig S Webster, Christopher Ling, Mark Barrow, Phillippa Poole, Marcus Henning

We explored relationships between student loans debt, financial support and career preferences upon graduation in 2,405 students across all healthcare disciplines offered at the Faculty of Medical and Health Sciences, University of Auckland. Students in health sciences, nursing and pharmacy typically accrue levels of student loans debt of around $15,000 to $29,999, while optometry students accrue debt around $15,000 higher. Medical students show debt distributed around both ends of the scale at $0 and $90,000 or more. All students typically access three sources of financial support during study. Career preferences at graduation were found to reduce to four categories for all health disciplines, and five significant effects were found, involving students in health sciences, medicine and pharmacy, relating the number of sources of financial support to a category of career preference. No significant effects were found related to level of student loans debt. Our results suggest that financial support is a more strongly determining factor in career choices than the level of student loans debt.
30-day mortality after percutaneous coronary intervention in New Zealand public hospitals (ANZACS-QI 18)
Andrew J Kerr, Michael Williams, Harvey White, Corina Grey, Yannan Jiang, Chris Nunn, on behalf of the ANZACS-QI investigators

Cardiovascular disease (CVD) is a leading cause of death in New Zealand, and the most common form of CVD is coronary artery disease. Various treatments are recommended for patients with coronary artery disease, including lifestyle changes, medication and interventional procedures. The most common interventional procedure performed on patients with coronary artery disease is percutaneous coronary intervention (PCI), which involves using balloons and stents to open up narrowed or blocked arteries. We used data from the All New Zealand Acute Coronary Syndrome Quality Improvement programme (ANZACS-QI) registry to provide hospitals in New Zealand with feedback regarding their own outcomes for these PCI procedures to allow them to examine the quality of their own care, compare it both with other New Zealand units and with international comparison data, and identify opportunities for improvement in their quality of care. After correcting for differences in the characteristics of the patients treated at each hospital we found that mortality rates in the first 30 days after a PCI are low and comparable across New Zealand public hospitals. The New Zealand outcomes are also comparable with the New York State experience.

Where to from here? Posthumous healthcare data, digital e(lectronic)-mortality and New Zealand’s healthcare future
Katie Hoeksema, Richman Wee, Alastair Macdonald, Parry Guilford, Jesse Wall, Jon Cornwall

Digitisation and utilisation of large healthcare data sets is becoming increasingly common around the world, with such use leading to benefits in healthcare and disease prevention. The largest and arguably most important healthcare data set will become posthumous healthcare data sets. New Zealand is increasingly digitising and centralising healthcare records, and there would be benefit to utilising posthumous healthcare records for research and management purposes. However, there is a lack of clarity surrounding the regulatory control around such data sets, and therefore it is unclear how to best utilise such data for the benefit of all New Zealanders. This paper explores an issue which is becoming increasingly relevant to all New Zealanders.
One in 15 American doctors contemplated suicide last year. Although accurate data are difficult to obtain, a reasonable estimate is that 400 medical students or medical doctors commit suicide annually in the US. The lifetime rate of depression among medical doctors is similar to that of the general population, however, the suicide rate (in the US) is disproportionately high: 1.5 to 3.8 times higher among male doctors and 3.7 to 4.5 times higher among female doctors as compared with the general population. This high suicide rate has been attributed to the high rates of burnout in doctors, a syndrome which most know is characterised by exhaustion, cynicism and reduced effectiveness. Physician burnout has been shown to influence not just physician safety but quality of care, patient safety, physician turnover and patient satisfaction.

This data was presented at a recent meeting in Seattle, which one of us attended last month. More surprising than that was that this was a surgical, not a psychiatric or general practice meeting. Usually surgical meetings are full of famous institutions telling us about how good they are at treating rare (or not so rare) conditions and about new toys which will allow you to do operations better, such as how a robot (at 3M$US) does an operation better than a laparoscope (20K$US), which is better than a pair of gloved human hands (7.5$US), or even more surprisingly that two robots (6M$US) are better than one. Suddenly all the chatter about new robots disappears as the very human topic of physician health and burnout dominates the podium to very full house. For the main session to be on burnout was a surprise—or was it?

Burnout is important. As most of us know, a doctor with burnout suffers from emotional exhaustion, depersonalisation and a sense of reduced personal accomplishment, and this is a problem for themselves, their family, their colleagues, their institution and most importantly their patients. As burnout evolves, the physician’s work performance deteriorates, errors are more common and patients may be harmed. Family members, friends and close colleagues may begin to note erratic and unusual behaviours. Coworkers may be subjected to non-professional interactions, including verbal abuse. The burned-out physician’s unpredictable behaviour, mood swings and propensity for errors can insidiously undermine, or even destroy, the ability of the medical team to function effectively. Left unchecked, the harmful consequences of burnout worsen, and damage to patient care and satisfaction are impaired, at times even leading to public disciplinary findings, thus hurting the reputation of the doctor, their colleagues and entire healthcare organisations. Although burnout is a systemic issue, most institutions operate under the erroneous framework that burnout and professional satisfaction are solely the responsibility of the individual physician.

Stress-induced burnout among medical students, physicians in training and practicing physicians is not new, but until recently it was generally assumed to be infrequent and controllable. Unfortunately, international studies suggest that at least one-third and up to half of doctors are experiencing or will experience professional burnout.

The term burnout first appeared in the literature in 1974 when American psychologist Herbert Freudenberger coined the term to describe the consequences of severe or prolonged stress and anxiety experienced by people working in the “healing professions”. He suggested their “high ideals” and the need to repeatedly sacrifice themselves to help others put them at risk of job-induced emotional and physical exhaustion. The term burnout, however, was soon being used to describe the results of stress in other occupations, not just in healthcare.

The origins of burnout were assumed to be rooted in the personal characteristics of a few susceptible individuals. As noted by Balch and Shanafelt, “one of the tragic paradoxes of burnout is that those who are most susceptible seem to be the most dedicated, conscientious, responsible and motivated.”
Individuals with these traits are often idealistic and have perfectionist qualities...".10 Those are the very traits sought by most medical schools, most training programmes and fellowships, most patients seeking a doctor, and most doctors seeking to hire a new associate. Idealism, perfectionism and a strong work ethic lead some physicians to “submerge themselves in their work and devote themselves to it until they have nothing left to give.”10

In the mid-1990s, Linzer et al11–13 identified four factors associated with burnout in primary care practices: 1) a lack of control over work conditions and decision making; 2) time pressure such that there was a perception by physicians that they were only valued for their productivity; 3) a chaotic and inefficient work environment that inappropriately used physicians to do clerical and other mundane tasks; and 4) a lack of alignment among physicians and executives regarding values, mission, purpose and compensation. A key finding in their study was that physician satisfaction was derived primarily from patient relationships, not compensation.

Shanafelt and Noseworthy14 proposed that the local work environment is a major factor in determining whether physicians are likely to develop burnout or, alternatively, to become fully engaged and dedicated to their work. They grouped drivers of physician burnout versus engagement into seven dimensions within the modern workplace: 1) workload and job demands, 2) efficiency and resources, 3) flexibility/control over work, 4) work–life integration, 5) alignment of individual and organisational culture and values, 6) social support/sense of community at work, and 7) the degree of meaning derived from work.

Rotherberger5 reports that based on a multivariate logistic analysis, seven factors were independently associated with burnout among the 7,905 surgeons who participated in the ACS survey: 1) subspecialty choice (higher risk among trauma, urologic, otolaryngologic, vascular, and general surgeons); 2) youngest child age ≤21 years; 3) compensation based entirely on billing/productivity; 4) spouse working as a healthcare professional; 5) a high number of nights on call per week; 6) a high number of years in practice; and 7) a high number of hours worked per week.15,16

Burnout develops gradually over time. Kraft17 summarised the work of Freudenberger,9 describing 12 stages of burnout: 1) a compulsion to prove oneself, 2) working harder, 3) neglecting one’s own needs, 4) displacement of conflicts, 5) revision of values, 6) denial of emerging problems, 7) withdrawal, 8) obvious behaviour changes, 9) depersonalisation, 10) inner emptiness, 11) depression and 12) burnout syndrome. These stages are not necessarily sequential, and not all are necessarily involved in a specific case. The duration of each stage varies, and sometimes several stages occur simultaneously. The onset of each case is unique, making it difficult to identify burnout early in its course.

Both proven and novel interventions are being promoted and assessed in a variety of healthcare and other settings. Many doctors have developed their own responses to dealing with the stresses of their work. Some have adopted a healthy lifestyle, including nutritious diets, exercise routines and sports activities. Others have turned to religion, meditation, yoga and mindfulness activities. Still others focus on their family, social interactions, volunteer work and hobbies (eg, traveling, reading non-medical books and writing journals).5

Anecdotal evidence suggests that these personal approaches are useful, but for physicians to be engaged and productive caregivers, the healthcare organisations must work to control or eliminate known drivers of burnout and must help enhance physician defenses and support systems.

A recent comprehensive systematic review and meta-analysis of 15 randomised controlled trials and 37 observational studies assessing the effect of interventions on burnout showed that both individual-focused and structural or organisational strategies decreased physician burnout.18 A review in the Lancet reports that the results substantiate that both individual-focused and structural or organisational interventions can reduce physician burnout.19 Although no specific physician burnout interventions have been shown to be better than other interventions, both strategies are probably necessary. However, their
combination has not been studied. The most commonly studied interventions have involved mindfulness, stress management and small group discussions, and the results suggest that these strategies can be effective approaches to reduce burnout domain scores. Duty hour limitation policies also appear effective.

The Mayo Clinic is currently applying nine organisational strategies to promote physician well-being.18 As stated by the authors, these are:18

1. Acknowledge and assess the problem. Acknowledging the problem of burnout and demonstrating that the organisation cares about the well-being of its physicians is a necessary first step toward making progress.

2. Harness the power of leadership. Although the importance of leadership for organisational success is obvious, its direct effect on the professional satisfaction of individual physicians is underappreciated. Recent evidence suggests that the leadership behaviors of the physician supervisor play a critical role in the well-being of the physicians they lead. To be effective, leaders must also recognise the unique talents of the individual physicians on their team and know what motivates them.20 Evidence suggests that physicians who spend at least 20% of their professional effort focused on the dimension of work they find most meaningful are at dramatically lower risk for burnout.

3. Develop and implement targeted interventions. Inefficiency in the practice environment (including clerical load) is a universal driver of dissatisfaction and burnout, but how it manifests and the specific factors that create inefficiency vary widely among surgical, primary care, radiology, and pathology work units (and among organisations).

4. Cultivate community at work. Physicians deal with unique challenges and have a professional identity and role that is distinct from other disciplines. Peer support has always been critical to helping physicians navigate these professional challenges. This support can be formal or informal and encompasses a wide range of activities, including celebrating achievements (eg, personal and professional milestones), supporting one another through challenging experiences (eg, loss of a patient, medical errors, a malpractice suit), and sharing ideas on how to navigate the ups and downs of a career in medicine.

5. Use rewards and incentives wisely. People can be motivated by rewards. To harness this principle, many healthcare organisations have linked physicians’ financial compensation to productivity. In some settings, physicians’ income is entirely based on productivity, and in others it is structured as a base salary with a productivity bonus. Physicians are not salespeople. Although some variation in productivity (eg, patient volumes and relative value unit generation) can be attributed to physicians’ experience, efficiency and skill, such variation is relatively narrow. Physicians in an equally efficient practice environment primarily increase productivity or revenue generation in three ways: (1) shortening the time spent per patient, (2) ordering more tests/procedures or (3) working longer. The first two approaches may erode quality of care and the third approach increases the risk of physician burnout and may, therefore, be self-defeating in the long run. Consistent with this notion, evidence suggests that productivity-based compensation increases the risk of physician burnout.

6. Align values and strengthen culture. Most healthcare organisations have an altruistic mission statement that centres on serving patients and providing them the best possible medical care. An organisation’s culture, values and principles in large part determine whether it will achieve its mission. It is critical for organisations to (1) be mindful of factors that influence culture, (2) assess ways to keep values fresh, and (3) periodically
take stock of whether actions and values are aligned.

7. Promote flexibility and work-life integration. The high work hours expected of a full-time position in medicine make it difficult for physicians to integrate their personal and professional lives. These challenges may be even more problematic for women physicians due to different cultural and societal expectations. Providing physicians with the option to adjust professional work effort (with a commensurate reduction in compensation) allows them to tailor their work hours to meet both personal and professional obligations.

8. Provide resources to promote resilience and self-care. Providing individual physicians with tools for self-calibration, resources to promote self-care, and training in skills that promote resilience are three tangible ways that organisations can help individuals care for themselves.

9. Facilitate and fund organisational science. Instituting operational efforts to reduce burnout and promote physician engagement will be the primary objective for most medical centres.

Other healthcare organisations can and should develop their own strategies by following these three generic action steps:

1. Recognise and acknowledge that physician burnout is a major threat to the healthcare system.

2. Use what we now know about the drivers of burnout (discussed above) to improve the workplace environment and build physician well-being.

3. Build an economic case to justify expenditures to remedy burnout.

Burnout is common and can be very destructive so we need to look after ourselves, we also need institutions to realise that we are not robots. Without appropriate organisational support and structure to deliver our care, not only do doctors suffer, but so does patient care, as well as the institutions within which we work.

As individual doctors we need to look after ourselves. This involves ensuring our work environment is a positive influence, and includes taking our annual leave, not working when we are sick, knowing our individual limits, sharing the load with colleagues and learning to say no. But above all, remembering, as healthcare providers, we are a team of human beings, not robots.

Competing interests:
Nil.

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REFERENCES:

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Demographic and psychological correlates of satisfaction with healthcare access in New Zealand

Carol HJ Lee, Chris G Sibley

ABSTRACT
AIMS: To explore the distribution of New Zealanders' satisfaction with their healthcare access and identify various demographic and psychological factors associated with this satisfaction.

METHODS: 15,822 participants responded to the 2014/15 New Zealand Attitudes and Values Study (NZAVS) survey. This survey included questions on participants' demographic and psychological characteristics, and an item asking for their level of satisfaction with "your access to healthcare when you need it".

RESULTS: The majority of participants were highly satisfied with their access to healthcare when needed (68.4%), while 25.3% were moderately satisfied and 6.1% expressed low satisfaction. Younger individuals, those of Māori, Pacific, or Asian ethnicity, and those with higher deprivation and lower income, exhibited lower satisfaction. Conversely, those with a partner, living in an urban area and non-parents showed greater satisfaction. These effects remained significant even after controlling for various psychological factors. In terms of personality, those high on Extraversion, Agreeableness, Conscientiousness and Honesty-Humility, but low on Neuroticism and Openness also expressed higher satisfaction. Lastly, higher self-rated health was associated with greater satisfaction.

CONCLUSION: The majority of New Zealanders are highly satisfied with their access to healthcare when needed, but a considerable number of people express some degree of dissatisfaction. This is broadly consistent with the New Zealand Health Survey (NZHS), and substantiates the finding that approximately 28–32% of New Zealanders experience low healthcare access. Our findings make a novel contribution to the literature by showing that the Big-Six personality traits are reliably associated with New Zealanders' satisfaction with their healthcare access.

One primary goal of the New Zealand healthcare system is ensuring that all groups have equitable access to adequate healthcare services.1 However, many studies continue to note group disparities in healthcare access.2–4 The Kiwis Count Survey, which investigates New Zealanders' level of trust and satisfaction with public services over time, indicates that the majority of New Zealanders are generally satisfied with their experience of health services (see Table 1).7 However, the 2015/16 NZHS found that 29% of New Zealand adults reported experiencing 'unmet need for primary healthcare'.5 In regard to group differences, Māori and Pacific peoples, those living in the most deprived areas, aged between 25–54 years, and women were found to exhibit higher rates of unmet need.3 Previous NZHS studies show similar findings,3,4 suggesting that certain groups are continuing to experience inequalities in healthcare access over time. Building on the NZHS, the current study uses a national probability sample of New Zealanders to explore the distribution of people's satisfaction with their healthcare access when needed. It also aims to identify various demographic and psychological correlates of people's satisfaction with access.

According to the 2015/16 NZHS, inability to get an appointment at their usual medical centre within a day (18%), and the cost of general practitioner (GP) consultations (14%) and after-hour services (7%) are
the most commonly reported barriers. However, the type or extent to which these barriers are experienced depends on one's demographic or psychological characteristics. For instance, women, those of Māori or Pacific ethnicity, with high deprivation and aged between 25–44 years were found to be more likely to report GP cost as a barrier to healthcare. Smokers and those with high levels of psychological distress were also found more likely to defer primary healthcare due to costs. As for those living in rural areas, longer travel times have been associated with a lower rate of healthcare utilisation.

Group disparities in the quality of healthcare service received have also been noted. The 2006/7 NZHS found that Māori, Pacific and Asian adults, and those living in deprived areas were less likely to report being ‘treated with respect and dignity all the time’, while Māori women and those from the most deprived areas were less likely to report being ‘listened to carefully all the time’. Additionally, the 2015 Kiwis Count Survey found that younger people, females and those of Pacific or Māori ethnicity showed lower levels of overall satisfaction in public services, which included healthcare. These findings have important implications, as experiences of low-quality healthcare experiences may negatively affect people's perception of medical professionals, leading to low healthcare utilisation, and eventually decrease their healthcare access.

The persistence of racial discrimination and cultural barriers in the health setting are likely contributing to Māori experiences of low-quality healthcare. Doctors were found to spend less time consulting Māori, and are less likely to order further tests for or build rapport with Māori patients. Consequently, a considerable proportion of Māori perceive that health professionals are disrespectful and do not appreciate Māori cultural values. Similarly, Pacific and Asian peoples commonly encounter language and cultural barriers to appropriate healthcare. Due to their lack of cultural competence, some New Zealand doctors are unable to effectively communicate with or provide culturally relevant care for Pacific and Asian peoples.

In addition to cultural factors, some studies have investigated the link between various psychological factors and satisfaction with healthcare. For example, Goldzweig et al found that cancer patients with higher levels of psychological distress tended to report lower patient satisfaction. Moreover, Breemhaar et al found that having greater gratitude and an external locus of control was associated with increased healthcare satisfaction. Extending on past research, the current study aims to investigate the effect of the Big-Six personality traits on people's satisfaction with healthcare access. These traits consist of; Extraversion, Agreeableness, Conscientiousness, Neuroticism, Openness to Experience and Honesty-Humility (see Table 2). Personality traits have previously been associated with differences in health status or healthcare need, but little is known about their influence on people's satisfaction with their healthcare access. Although a study in the Netherlands found that the Big-Five personality traits (without Honesty-Humility) showed marginal associations with patient satisfaction with hospital care (including accessibility), this relationship has not been investigated using a population-based sample, and it remains an open question whether such research generalises to the unique context of New Zealand.

Therefore, the present study uses a large probability sample of New Zealanders to explore the distribution, and demographic and psychological correlates of people's satisfaction with their healthcare access when needed. We assess the association between satisfaction ratings and a wide range of variables including gender, ethnicity and the Big-Six personality traits. To our knowledge, this study is the first to investigate the relationship between the Big-Six personality traits and satisfaction with healthcare access in New Zealand. Ultimately, we aim to identify those with low satisfaction with their healthcare access and in need of improved healthcare services.
Table 2: Interpretation of each Mini-IPIP6 factor, including example traits, and likely adaptive benefit and costs resulting from high levels of each personality dimension (adapted from Sibley et al., p. 144, which was in turn adapted from Ashton and Lee15 p. 156).

<table>
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<th>Factor</th>
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<th>Example traits</th>
<th>Likely adaptive benefits of high levels (in evolutionary history)</th>
<th>Likely costs of high level (in evolutionary history)</th>
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<tr>
<td>Extraversion</td>
<td>Engagement in social endeavours</td>
<td>Sociability, leadership, exhibition</td>
<td>Social gains (friends, mates, allies)</td>
<td>Energy and time; risks from social environment</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>Ingroup cooperation and tolerance; reciprocal altruism in HEXACO model</td>
<td>Tolerance, forgiveness, (low) quarrelsomeness</td>
<td>Gains from cooperation, primarily with ingroup (mutual help and nonaggression)</td>
<td>Losses due to increased risk of exploitation in short-term exchanges</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>Engagement in task-related endeavours</td>
<td>Diligence, organisation, attention to detail</td>
<td>Material gains (improved use of resources), reduced risk</td>
<td>Energy and time; risks from social environment</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>Monitoring of inclusionary status and attachment relations; kin altruism in HEXACO model</td>
<td>Anxiety, insecurity, (low) calmness</td>
<td>Maintenance of attachment relations; survival of kin in HEXACO model</td>
<td>Loss of potential gains associated with risks to attachment relations.</td>
</tr>
<tr>
<td>Openness to Experience</td>
<td>Engagement in ideas-related endeavours</td>
<td>Curiosity, imaginativeness, (low) need for cognitive closure and (low) need for certainty</td>
<td>Material and social gains (resulting from discovery)</td>
<td>Energy and time; risks from social and natural environment</td>
</tr>
<tr>
<td>Honesty-Humility</td>
<td>Reciprocal altruism (fairness)</td>
<td>Fairness, sincerity, (low) entitlement and (low) narcissism</td>
<td>Gains from cooperation, (mutual help and non-aggression)</td>
<td>Loss of potential gains that would result from the exploitation of others (and in particular outgroup members)</td>
</tr>
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Source: 2015 Kiwis Count Survey.7
Method

The NZAVS is a longitudinal panel survey that aims to track changes in New Zealanders’ attitudes and life circumstances over time. This not-for-profit study was first started by Professor Chris Sibley in 2009, and is funded from various not-for-profit research grant agencies and internal funding from the University of Auckland.

Sampling procedure

The Time 1 (2009) NZAVS recruited participants by randomly sampling from the New Zealand electoral roll (response rate: 16.6%). A booster sample was recruited at Time 3 (2011) through an unrelated survey posted on a major New Zealand newspaper website. Further booster samples were recruited from the 2012 and 2014 electoral roll in subsequent waves (response rates: 6.2–12.33%, retention rates: around 60% across waves). The Time 6 (2014/15) NZAVS sample, containing 15,822 participants, was used for this study (retention rate: 57.2% over five years, 81.5% from previous year). Although the Time 1 response rate of 16.6% may seem low, it is in keeping with other international studies. The Pew Research Centre, for example, have reported that their general survey response rates have been declining, with their 2012 telephone poll response rate being 9%. However, research by Pew and others highlight that after applying sample weighting, telephone surveys are still found to provide an accurate reflection of the general public on social and economic measures. Similarly, the NZAVS applies sample weighting on demographics and its validity in monitoring changes in New Zealanders’ political attitudes over time has been well-demonstrated.

Participants

15,822 participants (10,003 female, 5,800 male; 19 missing) completed the Time 6 questionnaire. Participants’ mean age was 49.34 years (SD=14.04, range 18–95; 9 missing). The medians of the annual household income quartile groups were $33,900, $73,000, $110,000 and $190,000 (1,143 missing). Additionally, 74.6% (259 missing) were parents, 74.7% (640 missing) were in a committed romantic relationship and 77% (188 missing) were employed. Education (1,114 missing) was coded as a 10-point ordinal variable ranging from 0 (none) to 10 (PhD/equivalent degree, M=5.05, SD=2.85).

Measures

Participants were asked to “rate your level of satisfaction with the following aspects of your life in New Zealand” on a number of statements, which included “your access to healthcare when you need it (eg, doctor, GP)”, on a scale of 0 (completely dissatisfied) to 10 (completely satisfied). This scale was developed for the NZAVS.

Participants also provided demographic information, including their ethnicity, relationship status and annual household income. Ethnicity was measured using the standard New Zealand Census item, in which participants indicated their identification with one or more ethnic groups. Participants were priority coded into four mutually exclusive ethnic groups (order of prioritisation: ‘Māori’, ‘Pacific’, ‘Asian’, ‘European/Pākehā’, other ethnic groups coded as missing). Big-Six Personality traits were measured using the Mini-IPIP scale. Deprivation was measured using the 2013 New Zealand Deprivation Index, while socio-economic status was measured using the socio-economic index. Subjective health satisfaction was measured using three marker items from the Short-Form Health Questionnaire.

To estimate representative population proportions, the NZAVS uses a post-stratification weight that corrects for sample bias in gender and ethnic group identification. As the Time 4 (2012) sample included regional booster samples, weights from Time 4 onwards included regional information. In this study (using Time 6 data), the weighting procedure weighted men and women from each of the four primary ethnic groups separately as well as region of residence based on data from the 2013 New Zealand Census.

For descriptive purposes (see Table 3), the following scale ranges were used to describe high satisfaction (ratings of 8–10; 68.6% weighted, 69.4% unweighted), moderate satisfaction (ratings of 4–7; 25.3% weighted, 24.7% unweighted) and low satisfaction (ratings of 0–3; 6.1% weighted, 5.9% unweighted) in this study.
mean score was 7.84 (SD= 2.21) after applying weighting (M=7.89, SD=2.19 before weighting).

Statistical analyses
A step-wise regression predicting people’s satisfaction with healthcare access was conducted on M plus. ‘Model one’ only included demographic predictors, while ‘Model two’ included both demographic and psychological predictors. This method allowed us to examine the extent to which psychological variables may explain or attenuate the effect of demographic variables on people’s satisfaction with healthcare access. Missing data for exogenous variables were estimated using Rubin’s procedure for multiple imputation procedure with parameter estimates averaged over 1,000 data sets (thinned every 200th iteration).

Results
As illustrated in Figure 1 and Table 4, most participants expressed high satisfaction with their healthcare access (68.6%), but almost one-third of participants (31.4%) indicated some degree of dissatisfaction. In terms of ethnic differences (see Figure 2 and 3), all ethnic groups showed a positively skewed distribution of satisfaction scores, but Europeans/Pākehā exhibited a significantly greater rate of high satisfaction, and lower rate of low satisfaction compared to ethnic minorities. While Māori, Pacific and Asian peoples showed similar levels of high satisfaction (around 61–63%), Asian peoples reported a significantly higher rate of moderate satisfaction compared to all other ethnic groups. Overall, Māori exhibited the lowest rate of high satisfaction and highest rate of low satisfaction. (Refer to Appendix for satisfaction ratings within district health boards).

Figure 1: Satisfaction with healthcare access among the general New Zealand public (weighted on gender, ethnicity and region of residence).

Table 3: Operationalisation of satisfaction groups in this study.

<table>
<thead>
<tr>
<th>Group</th>
<th>Operationalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High satisfaction</td>
<td>Ratings of 8 to 10 on an 11-point scale assessing people’s satisfaction with their “access to healthcare when they need it (eg, doctor, GP)”</td>
</tr>
<tr>
<td>Moderate satisfaction</td>
<td>Ratings of 4 to 7 on the same scale as above</td>
</tr>
<tr>
<td>Low satisfaction</td>
<td>Ratings of 0 to 3 on the same scale as above</td>
</tr>
</tbody>
</table>
Table 4: Weighted percentage of high, moderate and low satisfaction across ethnic groups.

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>High Satisfaction</th>
<th>Moderate Satisfaction</th>
<th>Low Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>European/Pākehā</td>
<td>71.8%</td>
<td>23.4%</td>
<td>4.8%</td>
</tr>
<tr>
<td>(N=10,810)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>61.1%</td>
<td>27.9%</td>
<td>11.0%</td>
</tr>
<tr>
<td>(N=1,932)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>63.4%</td>
<td>26.9%</td>
<td>9.7%</td>
</tr>
<tr>
<td>(N=889)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>62.2%</td>
<td>31.5%</td>
<td>6.3%</td>
</tr>
<tr>
<td>(N=1,960)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>68.6%</td>
<td>25.3%</td>
<td>6.1%</td>
</tr>
<tr>
<td>(N=15,758)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Different subscript letters for proportions indicate significant differences across columns. Percentages for ‘Total’ included those who did not identify with the four primary ethnicities.

Figure 2: Box plots showing the distribution of satisfaction with healthcare access by ethnic group.

Figure 3: Satisfaction with healthcare access across priority-coded ethnic groups (Europeans/Pākehā, Māori, Pacific and Asian peoples) after applying sample weighting.
Regressions predicting satisfaction with healthcare access

**Model one:** As presented in Table 5, age showed a curvilinear effect ($b = .014, b^2 = .001$), whereby satisfaction scores increased with age and showed a steeper rate of growth among those of older age. Compared to Europeans/Pākehā (reference group), Māori ($b = .381$), Pacific ($b = .262$) and Asian peoples ($b = .288$) all exhibited lower satisfaction with their healthcare access. Those with a higher (log) household income ($b = .185$) or socio-economic status ($b = .006$) were more satisfied, while those with higher deprivation ($b = .044$) were less satisfied with their healthcare access. Having a partner ($b = .596$) and living in an urban area ($b = .192$) were associated with greater satisfaction, while being a parent ($b = .106$) was associated with lower satisfaction with healthcare access. Gender, religion, education and employment did not show a significant effect.

**Model two:** The effect of gender was significant after including psychological variables in our model. Compared to women, men expressed greater satisfaction with their healthcare access ($b = .107$). Most demographic variables continued to show relatively strong associations with satisfaction scores in Model two. For example, Māori ($b = .356$), Pacific ($b = .271$) and Asian peoples ($b = .266$) were still found to express lower satisfaction than Europeans/Pākehā. Although the strength of relationship slightly decreased, having a partner ($b = .520$) also remained significantly associated with higher satisfaction.

Furthermore, being high on the personality traits, Extraversion ($b = .091$), Agreeableness ($b = .108$), Conscientiousness ($b = .108$) and Honesty-Humility ($b = .056$) were associated with increased satisfaction with healthcare access. In contrast, being high on Neuroticism ($b = .172$) and Openness ($b = .037$) were associated with decreased satisfaction. Those with higher subjective health ratings also exhibited greater satisfaction with their healthcare access ($b = .305$). Overall, having a partner and higher subjective health exhibited the strongest association with people's satisfaction ratings.

**Table 5: Step-wise regression predicting satisfaction with healthcare access: Model one (without psychological predictors) and Model two (with psychological predictors).**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>SE</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>t</th>
<th>bivariate r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.952</td>
<td>2.820</td>
<td>3.775</td>
<td>4.786</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-0.001</td>
<td>0.036</td>
<td>-0.072</td>
<td>-0.008</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.009</td>
<td>0.011</td>
<td>0.011</td>
<td>0.771</td>
<td>0.077</td>
<td></td>
</tr>
<tr>
<td>Age squared</td>
<td>0.102</td>
<td>0.053</td>
<td>-0.001</td>
<td>0.111</td>
<td>0.077</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>-0.057</td>
<td>0.262</td>
<td>-0.502</td>
<td>-0.266</td>
<td>-0.097</td>
<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>0.021</td>
<td>0.097</td>
<td>-0.033</td>
<td>0.244</td>
<td>0.045</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-0.027</td>
<td>0.085</td>
<td>-0.130</td>
<td>-0.235</td>
<td>-0.026</td>
<td></td>
</tr>
<tr>
<td>Income (log)</td>
<td>0.098</td>
<td>0.177</td>
<td>0.143</td>
<td>0.541</td>
<td>0.142</td>
<td></td>
</tr>
<tr>
<td>NZ Deprivation</td>
<td>0.055</td>
<td>0.047</td>
<td>0.058</td>
<td>0.647</td>
<td>0.128</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>0.014</td>
<td>0.004</td>
<td>0.026</td>
<td>0.143</td>
<td>0.073</td>
<td></td>
</tr>
<tr>
<td>Socio-economic status</td>
<td>0.044</td>
<td>0.001</td>
<td>0.003</td>
<td>0.445</td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>0.012</td>
<td>0.061</td>
<td>0.036</td>
<td>0.121</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Partnered</td>
<td>0.118</td>
<td>0.043</td>
<td>0.030</td>
<td>0.128</td>
<td>0.147</td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>-0.021</td>
<td>0.032</td>
<td>-0.019</td>
<td>-0.252</td>
<td>0.029</td>
<td></td>
</tr>
<tr>
<td>Religion</td>
<td>0.012</td>
<td>0.035</td>
<td>0.017</td>
<td>0.146</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Urban area</td>
<td>0.041</td>
<td>0.027</td>
<td>0.116</td>
<td>0.497</td>
<td>0.055</td>
<td></td>
</tr>
</tbody>
</table>

*Note: N=15756, *p < .05, **p < .01. Coding: 0=women, 1=men for ‘Gender’, 0=no 1=yes for ‘Māori,’ Pacific,’ Asian,’ Employed,’ partnered,’ parent,’ ‘religion,’ 0=rural and 1=urban for ‘Urban area,’ 0=low and 1=high for NZ Deprivation and Education. Model fit statistics for ‘Model 2’: $R^2 = .125$ (p < .001), AIC=67409.917, BIC=67593.876.
Discussion

Using a nationally representative sample of New Zealand adults, the present study investigated people's satisfaction with their access to healthcare when needed. We assessed the distribution of people's satisfaction with their healthcare access and examined its association with a broad range of demographic and psychological factors. Results from our analyses reveal group inequalities in healthcare access.

Over two-thirds of New Zealanders (68.4%) were highly satisfied with their access to healthcare when needed, while 25.3% were moderately satisfied and 6.1% expressed low satisfaction. These findings are broadly consistent with previous NZHS studies, which found that around 28% of New Zealand adults reported an ‘unmet need for primary healthcare’. This indicates that more than a quarter of New Zealanders express some degree of dissatisfaction in their healthcare access. Such dissatisfaction can be linked to a wide range of factors, including difficulty making appointments, transport, costs and perceptions of unfair treatment.

Our results revealed considerable ethnic differences in levels of satisfaction with healthcare access. Relative to Europeans/Pākehā, ethnic minorities exhibited a higher rate of low satisfaction (4.8% versus 6.3–11.0%) and a lower rate of high satisfaction (71.8% versus 61.1–63.4%). Compared to Māori and Pacific peoples, Asian peoples showed a smaller proportion of low satisfaction but higher proportion of moderate satisfaction (27.9%, 26.9% and 31.5% respectively). These findings are somewhat consistent with the 2015/16 NZHS, in which Māori (39.3%) and Pacific peoples (34.2%) reported higher rates of one or more ‘unmet need for primary healthcare’ than Asian peoples (22.8%) and European/Pākehā and Others (28.4%). However, it is important to note that the NZHS asked for instances of ‘unmet healthcare need’ in the past year due to various reasons (eg, cost, transport), while our study asked for participants’ general levels of satisfaction with their healthcare access when needed.

After controlling for various demographic and psychological factors, Māori, Pacific and Asian peoples were found to express lower satisfaction with their healthcare access than Europeans/Pākehā. This result can be linked to findings that ethnic minorities are more inclined to experience language, information and cultural barriers to healthcare, and the lack of cultural competence among medical professionals. Our findings further suggest that perceptions of low healthcare access among ethnic minorities cannot be fully explained by population differences in socio-economic or personality factors. Hence, in order to increase healthcare access for ethnic minorities, it is essential to develop tailored health interventions that target the unique cultural barriers encountered by these groups.

Similar to previous studies, those with lower income or socio-economic status and high deprivation exhibited decreased satisfaction with their healthcare access. Those who did not have a partner, were a parent or living in a rural area also expressed lower satisfaction. In contrast, age showed a curvilinear effect whereby satisfaction scores increased as age increased with a steeper rate of growth among those of older age. This may be because older people in New Zealand tend to receive focused support services and are less likely to defer primary healthcare due to costs. The effect of these demographic factors remained significant even after we controlled for individual differences in personality traits and subjective wellbeing. Interestingly, women were only found to express lower satisfaction compared to men after controlling for psychological factors.

Our study provides a novel contribution to the literature by revealing that the Big-Six personality traits are associated with New Zealanders’ satisfaction with their healthcare access. Specifically, those high on Extraversion, Agreeableness, Conscientiousness and Honesty-Humility expressed greater satisfaction, while those high on Neuroticism and Openness exhibited lower satisfaction with their healthcare access. As Conscientious people tend to engage in positive health behaviors and have good health, their higher rate of satisfaction is not surprising. On the other hand, those high on Neuroticism may be more inclined to express low satisfaction perhaps due to their higher susceptibility to various illnesses and increased healthcare need. Our findings
suggest that recognising differences in patients’ personality traits may help doctors identify and respond appropriately to those in need of greater reassurance and support.

Lastly, those who had a more positive subjective wellbeing showed higher satisfaction with their healthcare access. Put another way, those with negative perceptions of their own health, and hence higher healthcare need, tend to exhibit the lowest level of satisfaction with their healthcare access. This finding increases insight into the previously identified link between poor self-rated health and greater health decline,29 indicating that reduced healthcare access may be an important contributor to the health deterioration of those with negative subjective health. Further research on these novel effects is needed to identify the more accurate motives driving people’s attitudes towards healthcare services.

Caveats

The cross-sectional nature of our study is a major limitation, as we cannot imply causation from our results. Furthermore, our single item measure was unable to assess the specific reasons why people express high or low satisfaction, or account for potential differences in interpretation of the term ‘access’. According to Levesque, Harris and Russell,30 ‘healthcare access’ involves multiple subcategories, including one’s ability to seek or reach healthcare services as well as the appropriateness of the service received. It is vital that future studies employ more comprehensive measures of ‘healthcare access’ and examine the specific barriers experienced by diverse groups to inform the development of more effective healthcare interventions for target populations.

Concluding comments

This study investigated people’s satisfaction with their access to healthcare when needed using a national probability New Zealand sample. The majority of New Zealanders expressed high satisfaction, while over a quarter expressed moderate or low satisfaction. Those of Māori, Pacific or Asian ethnicity, younger age and those with higher deprivation and lower income exhibited lower satisfaction. Conversely, those with a partner, living in an urban area and non-parents showed greater satisfaction. After controlling for psychological factors, the effect of these demographic factors remained significant, and women were additionally found to express lower satisfaction. Furthermore, those high on Extraversion, Agreeableness, Conscientiousness and Honesty-Humility, but low on Neuroticism and Openness, and those with positive self-rated health expressed greater satisfaction. Our study presents novel findings regarding the effect of the Big-Six personality traits on New Zealanders’ satisfaction with healthcare access, and help identify target populations in need of healthcare interventions.
Appendix
Distribution of satisfaction ratings within district health boards
(Y-axis: percentage of participants, X-axis: healthcare access satisfaction scores from 0 (completely dissatisfied) to 10 (completely satisfied)).
Competing interests:
All authors report grants from Templeton World Charity Foundation during the conduct of the study.

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URL:

REFERENCES:


30. Levesque JF, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations.
Appendicitis presenting as the first manifestation of colorectal carcinoma: a 13-year retrospective study

Rebecca J Shine, Abigail Zarifeh, Chris Frampton, Jeremy Rossaak

ABSTRACT

AIM: Appendicitis in older adults may present as the first sign of underlying colorectal cancer. We aim to determine whether there was a difference in the rate of diagnosis of colorectal carcinoma for patients ≥45 years following a presentation with appendicitis, compared with New Zealand standardised rates.

METHOD: Retrospective study of patients ≥45 years with a confirmed diagnosis of appendicitis from 2003 to 2015 inclusive. The rate of colorectal carcinoma diagnosed during the 36-month follow-up period was calculated and compared to standardised rates, as per the New Zealand cancer registry.

RESULTS: Six hundred and twenty-nine patients were included for analysis, 15 had a diagnosis of colorectal cancer in the follow-up period. Patients ≥45 years had a 6.3-fold (CI 3.6–10.2) increased risk of colorectal carcinoma than predicted given the population demographics. Those patients aged between 45–60 years had a 17-fold (95% CI 8–32.2) increased standardised risk ratio.

CONCLUSION: This is the first study of its kind conducted in Australasia. This study found patients ≥45 years who present with appendicitis have significantly increased risk of underlying colorectal cancer. Until further research is conducted the authors recommend clinicians consider colonic investigation for older adults following a diagnosis of appendicitis.

Colorectal cancer (CRC) rates in New Zealand are among the highest in the Western world, with an overall rate of ~50/100,000 person years and between 1,100 and 1,200 deaths each year. Early diagnosis and treatment are paramount to improving outcomes for colorectal cancer. However, symptoms can be vague, and patients often have advanced disease at presentation.

Acute appendicitis in older adults is relatively uncommon and could represent the first presentation of an underlying colorectal carcinoma, affording the opportunity for earlier diagnosis and treatment. Colorectal carcinoma may cause acute appendicitis either by way of direct obstruction of the appendiceal lumen or as a result of adjacent inflammation and oedema. Also, a partial downstream colonic obstruction may result in increased luminal pressures and thus predispose to acute appendicitis. Alternatively, immune-mediated lymphoid hyperplasia associated with malignancy may lead to appendiceal obstruction and appendicitis.

In the early 1980s, a number of small studies and case reports indicated increased rates of CRC in older patients presenting with appendicitis. Interest waned with the advent of computed tomography and laparoscopic surgery in the management of appendicitis with the theory one could visualise the cecum through these interventions. However, a Taiwanese study in 2006 reported an almost 40-fold increase in odds ratio for underlying colorectal cancer in patients over 40 presenting with acute appendicitis. Given the higher rates of colorectal cancer and a predominance of left-sided malignancies in the western world, it is difficult to interpret the results of the Taiwanese study in the New Zealand population.
A recent survey presented at the New Zealand Association of General Surgeons (NZAGS) conference (March 2016) has shown a significant dichotomy in practice among general surgeons with regards to colonic investigation in older adults following appendicitis. The survey found almost a 50:50 split with regards to colonic investigation following appendicitis in older adults, indicating the current uncertainty and limited evidence relating to this issue.

The aim of this study was to determine whether there was a difference in the rate of diagnosis of colorectal carcinoma for patients ≥45 years in the 36 months following a presentation with appendicitis to the Bay of Plenty DHB, compared with the New Zealand population standardised rates.

Methods

All patients ≥45 years with a certain pathological or radiological diagnosis of appendicitis from January 2003 to April 2015 inclusive were eligible to be included in the study. Cases were identified through a database code for ‘Appendicitis’ or related codes from the Bay of Plenty District Health Board’s (BOPDHB) admission and theatre database. Diagnostic and demographic data for all patients were extracted, and this information was cross-referenced with the pathological (PATHLAB) database for ‘appendicitis’ and ‘colorectal cancer’ in patients ≥45 years to ensure no cases were missed. Each case was then reviewed both electronically and from paper charts for date of diagnosis of appendicitis, subsequent colonoscopy date and findings, pre-existing risk factors for colorectal cancer and, for those patients diagnosed with colorectal cancer, histology, staging and date of diagnosis. Stage of colorectal cancer was defined according to the American Cancer Society TNM staging 7th edition.

The study focus was to identify patients who had colorectal cancer at the time of presentation with appendicitis, with the theory being that the tumour may have precipitated the appendicitis. For this reason, a 36-month follow-up period was elected. This was chosen to minimise the bias that would be created by a longer follow-up, as patients may ‘develop’ a new cancer during a longer follow-up that was unrelated to the episode of appendicitis. A 36-month follow-up period was thought most appropriate as cancers existing at the time of appendicectomy would likely have become symptomatic and been diagnosed by three years, and those that may have developed subsequently would be less likely to be diagnosed.

A rate ‘per person years’ was determined for each patient dependent on the duration they were included in the study (duration until diagnosis of CRC, death, or for 36 months maximum) and from this, the ‘observed rate’ for this study population was established. An ‘expected rate’ of colorectal carcinoma was calculated for each patient based on age, gender, year of diagnosis and ethnicity (Māori or non-Māori) status as extracted from the New Zealand cancer register ICD codes 9 and 10. The ‘standardised rate ratio’ was then calculated as the ratio of ‘observed’ rates over the ‘expected’ population rate. The Poisson approximation was used to estimate the 95% confidence limits for the standardised ratio estimates.

Results

A total of 667 patients were identified initially from the BOPDHB database with a diagnosis of acute appendicitis within the study period. This was cross-referenced with the PATHLAB database, and no additional patients were identified. 38 patients were excluded (25 with a normal appendix on histology, 10 patients had an alternative diagnosis such as diverticulitis or undifferentiated abdominal pain and three patients had acute appendicitis diagnosed intra-operatively during a bowel resection for an already known colorectal cancer). Two patients were diagnosed with colorectal cancer >36 months after their admission for appendicitis, and these patients were included only as ‘appendicitis’ patients. The average follow-up period was 30.36 months as patients presenting towards the end of the study period did not have a full 36-month follow-up period.
Table 1: Demographic profile.

<table>
<thead>
<tr>
<th>Demographic profile</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (median, range)</td>
<td>57 years (45–97 years)</td>
<td></td>
</tr>
<tr>
<td>45–59 years</td>
<td>358</td>
<td>57.1%</td>
</tr>
<tr>
<td>60–79 years</td>
<td>227</td>
<td>36.2%</td>
</tr>
<tr>
<td>80+ years</td>
<td>42</td>
<td>6.7%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>330</td>
<td>52.5%</td>
</tr>
<tr>
<td>Female</td>
<td>299</td>
<td>47.5%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>528</td>
<td>83.9%</td>
</tr>
<tr>
<td>Māori</td>
<td>72</td>
<td>11.4%</td>
</tr>
<tr>
<td>Asian</td>
<td>14</td>
<td>2.2%</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Table 1 highlights the demographic profile for this patient group, which is representative of the BOPDHB population during this period. ‘Acute appendicitis’ was the most common histological finding, although an alternative neoplastic process other than colorectal carcinoma was found in 4.1% of specimens (Table 2). Thirty-six patients had their appendicitis managed non-operatively, 14 of whom (39%) went on to have either a CTC or colonoscopy at the request of the consultant surgeon. One of these patients had a diagnosis of caecal carcinoma detected at the time of colonoscopy four weeks later, the CT of this patient had shown an inflammatory mass and acute appendicitis. There was no protocol or guideline in place in BOPDHB at the time of this study to dictate whether patients had colonic investigation after non-operative management of appendicitis, and this decision was at the surgeons’ discretion. Interval appendicectomy was not common practice, and only two patients who were managed non-operatively initially, went on to have further surgery—the patient who had cecal cancer detected and another who had an ongoing appendiceal abscess that was treated with a right hemicolectomy (histology benign).

Table 2: Findings, management and location of colorectal cancer.

<table>
<thead>
<tr>
<th>Initial findings, management and location</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix histology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute appendicitis</td>
<td>541</td>
<td>86%</td>
</tr>
<tr>
<td>Chronic appendicitis</td>
<td>19</td>
<td>3.0%</td>
</tr>
<tr>
<td>Mucinous cystadenoma</td>
<td>15</td>
<td>2.4%</td>
</tr>
<tr>
<td>Neuroendocrine tumour</td>
<td>4</td>
<td>0.6%</td>
</tr>
<tr>
<td>Acute appendicitis and benign polyp</td>
<td>7</td>
<td>1.1%</td>
</tr>
<tr>
<td>Acute appendicitis and Adenocarcinoma</td>
<td>8</td>
<td>1.3%</td>
</tr>
<tr>
<td>No operation</td>
<td>36</td>
<td>5.7%</td>
</tr>
<tr>
<td>Pre-operative CT scan</td>
<td>263</td>
<td>41.8%</td>
</tr>
<tr>
<td>Colonoscopy (within 36 months)</td>
<td>74</td>
<td>11%</td>
</tr>
<tr>
<td>* Mean = 8 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up period</td>
<td>Mean = 30.36 Months</td>
<td></td>
</tr>
<tr>
<td>Location of CRC</td>
<td>N</td>
<td>(%)</td>
</tr>
<tr>
<td>Appendix</td>
<td>4</td>
<td>26.7%</td>
</tr>
<tr>
<td>Caecum</td>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>Ascending/transverse</td>
<td>2</td>
<td>13.3%</td>
</tr>
<tr>
<td>Sigmoid/rectum</td>
<td>3</td>
<td>20%</td>
</tr>
</tbody>
</table>

The expected risk of colorectal cancer was established for each patient in this study, dependent on their age, gender, ethnicity and year of diagnosis. From this, the ‘study-population’ expected rate of cancer was calculated. The expected number of colorectal cancers among this study population was two (0.4%). However, 15 patients (2.4%) were found to have colorectal cancer in the study period (Table 3). This equated
to a six-fold increased standardised risk ratio (SR 6.3, 95% CI 3.6–10.2) of underlying colorectal malignancy than would be expected given the population demographics. They were all European and predominantly male (male n=13, 86.6%) with a median age of 59 (46 to 84) years. Right-sided malignancies accounted for 74%. Ten of the 15 patients had cancer located in the cecum or appendix (six and four respectively), two in the ascending/ transverse colon and three located in the sigmoid/rectum (Table 2). The median duration to diagnosis was 12.7 months with a range of one to 30 months. Within the age group 45 to 60 there was a 17.3-fold increased standardised risk ratio (CI 8.02–32.79) as shown in Table 3. Across all age ranges there was an increased risk, though this did not reach statistical significance for patients over 80 (SR 2.09, CI 0.1–10.3).

Eight patients (53%) with CRC were diagnosed as a result of the histology from the initial specimen. Of these, four patients had cancer arising from the appendix, and the other four were found to have cecal cancer that involved the base of the appendix. Of the remaining two patients with cecal cancers; one was the patient managed non-operatively who was diagnosed on colonoscopy one month later (performed for appendiceal abscess on initial CT), the other presented 28 months later with abdominal pain due to a T4 cecal cancer.

After excluding those patients diagnosed on initial histology, Table 4 demonstrates 7/621 (1.1%) patients were subsequently diagnosed with CRC. This represented a three-fold increased standardised risk ratio (SR 2.96, 95% CI 1.2–5.8). Patients age 45–60 continued to have more than a six-fold increased risk (SR 6.52, 95% CI 1.7–17.7) of underlying colorectal cancer, with an incidence of 2.2%.

Of the 629 patients included in the study, only 74 (11%) had a colonoscopy/colonography within 36 months of appendicitis, with the average duration to colonoscopy being eight months (Table 2). The indications for colonoscopy for those patients found to have malignancy varied. Aside from the patient already mentioned above, five patients had ‘adenocarcinoma diagnosed on initial histology' and required complete colonoscopy. Two patients underwent surveillance colonoscopy for chronic colitis (ulcerative and chronic) and were diagnosed with CRC two and six months post-appendicitis. One patient presented with PR bleeding 12 months later and was found to have a

### Table 3: The number of expected and observed colorectal carcinoma cases by age group.

<table>
<thead>
<tr>
<th>Age range</th>
<th>Expected number</th>
<th>Observed number</th>
<th>Standardised risk ratio (SR)</th>
<th>Confidence interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>2.37</td>
<td>15</td>
<td>6.4</td>
<td>3.67–10.2</td>
</tr>
<tr>
<td>45–60</td>
<td>0.46</td>
<td>8</td>
<td>17.27</td>
<td>8.02–32.79</td>
</tr>
<tr>
<td>60–80</td>
<td>1.43</td>
<td>6</td>
<td>4.20</td>
<td>1.70–8.73</td>
</tr>
<tr>
<td>&gt;80</td>
<td>0.48</td>
<td>1</td>
<td>2.09</td>
<td>0.10–10.30</td>
</tr>
</tbody>
</table>

### Table 4: The number of expected and observed colorectal carcinoma cases by age group after excluding those diagnosed on initial histology.

<table>
<thead>
<tr>
<th>Age range</th>
<th>Expected number</th>
<th>Observed number</th>
<th>Standardised risk ratio (SR)</th>
<th>Confidence interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>2.36</td>
<td>7</td>
<td>2.96</td>
<td>1.29–5.6</td>
</tr>
<tr>
<td>45–60</td>
<td>0.46</td>
<td>3</td>
<td>6.5</td>
<td>1.6–17.75</td>
</tr>
<tr>
<td>60–80</td>
<td>1.2</td>
<td>4</td>
<td>3.33</td>
<td>1.06–8.4</td>
</tr>
</tbody>
</table>

Expected number = Expected number of colorectal cancers derived from the national age, gender, year of diagnosis and ethnicity population rates.

Observed number = Actual number of cancers observed.

Standardised risk ratio = Ratio of the number of observed over the expected colorectal carcinoma cases based on national age, gender, year of diagnosis and ethnicity population rates.
T3 rectal cancer. One patient presented six months later with a large bowel obstruction secondary to a T3, N2 rectosigmoid cancer and underwent completion colonoscopy post-Hartmann's procedure. Finally, the last patient with a CRC presented 28 months later with change in bowel habit, and a colonoscopy found a T2, N2 tumour at the splenic flexure.

The four remaining patients diagnosed with CRC did not have colonic investigation within BOPDHB. One patient underwent an acute right colectomy for an appendiceal abscess that contained malignancy and then moved out of area; another was diagnosed with metastatic disease on staging CT scan after appendiceal histology found malignancy and was palliated. The third patient was diagnosed with a T4, N0, M0 cecal cancer two and a half years later and ultimately died from their disease. This patient did have a colonoscopy eventually, but it was >36 months after diagnosis and eight months post-diagnosis of CRC. Finally, the last patient diagnosed with CRC on appendiceal histology was too co-morbid to undergo any further investigations or surgery.

**Discussion**

Patients aged between 45–60 years presenting with acute appendicitis had more than a 17-fold increased risk of an underlying CRC than would be expected given the study population demographics. Throughout all age groups, there was an increased risk of CRC with an overall risk six times greater than expected. This study supports the hypothesis that a presentation with appendicitis in patients ≥45 years may constitute a sign of underlying colorectal malignancy. After excluding those diagnosed on initial histology there remained an increased risk especially in the age group 45–60 with over a six-fold increased risk of underlying malignancy.

It may be stated if the patient has had a reassuring pre-operative CT scan then no further investigation is required, however, in this study seven patients who were ultimately diagnosed with colorectal cancer underwent a pre-operative CT scan, only two of which raised the suspicion of colorectal cancer. A CT scan is a poor diagnostic tool with only 70% sensitivity for detecting colonic malignancies in an unprepared bowel and even less so in the setting of acute appendicitis.\(^\text{11,12}\)

Shears first entertained the relationship of right-sided colon cancer presenting with acute appendicitis in 1906.\(^\text{5}\) Since then there have been a number of small case reports highlighting this relationship.\(^\text{4–6,8}\) This study supports the work by Lai HW et al in demonstrating an increased risk of underlying colon cancer in older adults with appendicitis. Our study has a lower risk than was identified in this Taiwanese study, which found an almost 40-fold increased odds ratio of colon cancer in over 40-year-olds.\(^\text{6}\) However, that study did not control for age, gender or ethnicity as was done in our study and compared only to the overall national incidence of colorectal cancer in Taiwan in the year 2000, and is therefore likely to have overstated the relationship. It also had a longer follow-up period of five years and may have bias associated with this.

Although appendiceal adenocarcinoma is rare, with an expected incidence of 0.08–0.2%,\(^\text{13,14}\) within this study population, four patients (0.6%) were diagnosed with adenocarcinoma of the appendix. The study may be criticised for including these patients in the analysis as 60–70% will present with symptoms suggestive of appendicitis\(^\text{12}\) and the diagnosis will ultimately be confirmed by histology. However, appendiceal adenocarcinomas are included in the ICD codes 9 and 10 for CRC as per the New Zealand Cancer Registry and therefore were included in the case definitions for this analysis as they are included in the baseline population rate used for comparison.

Synchronous colonic neoplasms are found in up to three percent of patients with appendiceal tumours,\(^\text{13}\) and this in itself should warrant complete colonic investigation before definitive surgery.

Eight patients of the 10 patients with right-sided malignancies were diagnosed as a result of the histological findings from the initial surgery, which included 70% of the cecal tumours. This supports the hypothesis that an underlying colorectal cancer, especially a right-sided cancer, can lead to appendicitis. Of the two remaining patients with right-sided malignancies; one was diagnosed one month later on follow-up colonoscopy, and the other was diagnosed 28 months later with abdominal pain due
to a T4 cecal cancer. The remaining five patients (33%) were detected a median of 12 months later, suggesting these cancers were also present at the time of appendicitis. After excluding those patients diagnosed on initial histology, there remained a three-fold increased risk among remaining patients (1.1% observed rate of CRC, expected rate 0.38%), and a six-fold increased risk in patients aged 45–60 years (2.2% observed rate, excepted rate 0.13%).

Seventy-four percent of tumours were located on the right side (Table 2) with the majority within the cecum. This distribution differs from that of the general population for colonic tumours in New Zealand, with right-sided tumours making up less than 30% of all colorectal malignancies. This supports the theory of obstruction of the appendiceal lumen, either through direct tumour contact or inflammatory change around the tumour. However, the majority of these tumours were diagnosed as a result of initial histology or early after diagnosis due to abnormal imaging, indicating our current detection of these lesions is relatively safe. The remaining five tumours located in the transverse and recto-sigmoid region still represent higher than expected numbers (Table 4). As mentioned earlier, the hypothesis of immune-mediated lymphoid hyperplasia leading to appendicitis has been raised previously and may account for this increased rate, however, given the numbers are small in this study it is difficult to make any clear conclusions.

Limitations included the nature of the study design, being a single-centred study, which limits its generalisability. However, despite variation in CRC rates throughout New Zealand, the Bay of Plenty has an age-standardised rate equivalent to national rates, and the results of this study should therefore be comparable to those of the general population. The study could also be susceptible to a type two statistical error, given the smaller study size with a rare event as the outcome studied. However, the results are similar to and supported by other studies in this area.

Thorough cross-referencing between electronic clinical records and the pathology database mitigated some of the potential limitations due to the retrospective database nature of the study. Also, patients were included in this study up until January 2015, and consequently some patients had only a short period of follow-up. If anything, this would minimise the findings of this study as it may have missed a CRC diagnosis for these patients during the subsequent follow-up period.

It is also important to emphasise that given this is a retrospective non-randomised study the difference in CRC demonstrated in this population group could be due to a number of underlying factors that cannot be controlled for in this study design. However, this study is unique in that it standardised for age, gender and ethnicity, and therefore these attributing factors should be minimised.

The findings of this study support the hypothesis that appendicitis is associated with an increased rate of underlying colorectal malignancy and may be a sign of an undiagnosed colorectal cancer. This increased risk may be attributed to those patients with appendiceal/cecal cancers with the majority of patients these diagnosed on initial histology or abnormal imaging. All patients diagnosed with colorectal cancer as a result of their initial histology warrant completion colonoscopy prior to definitive surgical intervention.

In those whom the histology from appendicectomy was benign, colonic investigation is more controversial. Three patients were ultimately diagnosed with CRC due to classic symptoms attributed to bowel cancer; large bowel obstruction, PR bleeding and change in bowel habit (six, 12 and 28 months later respectively). Two patients were diagnosed through surveillance programmes for colitis, which has a known increased risk of CRC, and one patient presented >2 years later with abdominal pain due to a T4 caecal cancer. After excluding those diagnosed on initial histology, there remained a three-fold increased SR (1.1% incidence) in patients >45 years and a six-fold increased risk in patients aged 45–60 (2.2% incidence). Given the numbers are small within this population group, it is difficult to make any definitive conclusions. The association of distal CRC attributing to appendicitis could be theoretically explained by either distal partial colonic obstruction or immune-mediated lymphoid hyperplasia within the appendix, however, with small study
numbers susceptible to type two error it would be a bold statement to recommend universal colonic investigation for these patients until further prospective studies are completed.

This is the first study of its kind conducted in Australasia. The study reinforces the limited evidence that appendicitis is associated with increased risk of underlying CRC in middle-aged and older adult patients. In patients ≥45 years who present with symptoms of appendicitis, the possibility of a co-existent colonic neoplasm should always be kept in mind, and clinicians should pay particular attention to any factors that may raise the suspicion of CRC. If a patient is managed non-operatively or the histology of the initial specimen reveals malignancy, these patients should all be offered colonic investigation. In adult patients with benign histology following appendicitis, the authors recommend clinicians consider colonic investigation, taking into consideration individual risk factors and symptoms, particularly for those in the age range of 45–60 years.

Competing interests:
Nil.

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URL:

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Short-term outcomes following cytoreductive surgery and heated intraperitoneal chemotherapy at Waikato

Jasen Ly, Linus Wu, Ralph Van Dalen, Simione Lolohea

ABSTRACT

AIM: Pseudomyxoma peritonei is a rare disease that affects 1–2 per million population per year. Treatment with cytoreductive surgery with heated intraperitoneal chemotherapy (CRS with IPC) has been well described. The purpose of this study was to look at the short-term outcomes following CRS with IPC for all such patients treated in Waikato.

METHOD: Records for all patients presenting to surgery for CRS with IPC were retrospectively reviewed. CRS with IPC was performed in accordance with the techniques described by Sugarbaker. Data recorded included patient characteristics, characteristics of surgical treatment and early post-operative outcomes.

RESULTS: Sixty-eight patients underwent 72 procedures. Fourteen patients were deemed unresectable at surgery and were treated palliatively. The median age was 57 with the majority being female (59%). The median time, from the decision made for surgery to CRS with IPC, was three months. The median prior surgical score was 1 and the median peritoneal cancer index (PCI) was 19.5. The median operating time was 9.08 hours (5.43–15.20). The majority of patients (76%) had pseudomyxoma peritonei, while the remainder had a combination of other appendiceal, colorectal, ovarian, gastric and primary mesothelial primaries. The major complication rate was 24% and the 30-day mortality rate was 1.4%. The median hospital stay was 12 days.

CONCLUSION: Short-term outcomes following CRS with IPC at Waikato are comparable to those published in the literature. Further follow-up is anticipated for the publication of survival and recurrence data.

Cytoreductive surgery with heated intraperitoneal chemotherapy (CRS with IPC) has been well established as a standard of care for the treatment of pseudomyxoma peritonei. Previously recognised as a fatal disease, the potential for cure through this technique can be attributed to Sugarbaker and the work performed by other high-volume centres. Traditional debulking procedures resulted in no chance for cure and, except for palliation, can largely be considered historical with survival rates as low as 34% and 15% having been reported at three and five years. With CRS with IPC, a recent multi-institutional review published in 2012 demonstrated survival rates of 63% and 59% at 10 and 15 years, together with major complication and mortality rates as low as 24% and 2% respectively.

Classically, pseudomyxoma peritonei has been divided into low- and high-grade subtypes with numerous classification systems having been described previously such as that by Ronnett, Misdraji and Bradley. Commonly cited in the literature is that by Ronnett whereby pseudomyxoma peritonei is classified as either disseminated peritoneal adenomucinosis (DPAM) or peri-toneal mucinous carcinomatosis (PMCA), with numerous studies demonstrating a significantly poorer overall survival with the high-grade subtype (PMCA). The more recent WHO and AJCC equivalent describes pseudomyxoma...
peritonei as either low-grade or high-grade mucinous adenocarcinoma, and this reflects the slow but malignant potential of the disease, and the ultimately fatal outcome without treatment.\(^8\)

While much of the literature describes CRS with IPC in relation to the treatment of pseudomyxoma peritonei, there is increasing evidence to support the use of the technique for peritoneal metastases secondary to other malignant diseases. This includes both colorectal cancer and peritoneal malignant mesothelioma, and to a lesser degree metastatic ovarian and gastric cancer.\(^16-19\)

Waikato is one of only two centres in New Zealand receiving nationwide referrals for cytoreductive surgery. Recently, Wheeler et al published their experience of 25 patients with pseudomyxoma peritonei over a 12-year period at Wellington Hospital from 1997 to 2011.\(^15\) They demonstrated an overall five-year survival rate of 64%, and had 17 Clavien-Dindo grade 3 or 4 complications in seven of the 25 patients, with no 30-day mortality. In slight contrast, Waikato has been performing cytoreductive surgery with the addition of heated intraoperative intraperitoneal mitomycin C, similar to the techniques described by Sugarbaker and that by other major centres performing cytoreductive surgery internationally.\(^20\) The technique was first introduced at our institution in 2008 and the following study examines our experience with CRS with IPC over the subsequent seven-year period to 2014.

**Method**

A prospective database of all patients referred for treatment to both Waikato (public) and Braemar (private) hospitals since 2008 was kept by a single surgeon. This database was retrospectively analysed from a combination of clinic letters, patient progress notes and pathology, radiology and operative reports. The information was divided into three categories and included pre-operative patient characteristics, characteristics of surgical treatment and post-operative outcome. Pre-operative patient characteristics included basic demographic features, mode of presentation, time since the decision to operate to surgery, prior surgical score, number of prior operations, prior chemotherapy and histology. Characteristics of surgical treatment included the peritoneal cancer index, number of visceral resections, number of peritonectomies, completeness of cytoreduction score, type of IPC, stoma formation, intraoperative transfusion requirement and duration of operation. Post-operative outcome included post-operative complications, 30-day mortality and duration of hospital stay.

Referrals for treatment were received from other centres throughout New Zealand as well as from within the Waikato region. Patients were seen at the outpatient clinic in Waikato and investigated with a combination of CT scans, colonoscopy, staging laparoscopy and tumour markers if not already performed in the referring centre. Details of their mode of presentation as well as number and type (as denoted by a prior surgical score) of previous surgery were usually documented in the outpatient clinic or referral letter. Once the decision had been made that a patient was a candidate for surgery, they were placed on the waiting list, consented for CRS with IPC and were given an anaesthetic appointment for review. The prior surgical score as described by Sugarbaker is a score from PSS-0 to PSS-3 and was assigned to patients according to the extent of previous surgery performed (PSS-0: biopsy only or laparoscopy plus biopsy, PSS-1: prior exploratory laparotomy, PSS-2: exploratory laparotomy with some resection, PSS-3: attempted complete cytoreduction).\(^21,22\)

Patients were admitted to hospital the day before surgery and given full bowel preparation. Cytoreductive surgery was performed by three surgeons according to the techniques described by Sugarbaker.\(^21,22\) The patients were positioned in the modified Lloyd Davis position with the left arm abducted such that fixed table-based retraction could be used for exposure as well as for formation of the ‘coliseum’ for IPC. Intraoperatively, all patients were given a peritoneal cancer index (PCI) score, which is derived from the summation (up to 39) of the lesion size score (LSS 1:<0.5cm, LSS 2: 0.5–5cm, LSS 3:>5cm or confluent nodules of tumour) in the 13 abdomino-pelvic regions as described by Sugarbaker.\(^21,22\) For pseudomyxoma peritonei, a completeness of cytoreduction score of either 0 or 1 was attempted, while for other malignancies
a completeness of cytoreduction score of 0 was attempted. This score relates to the extent of residual disease present (CC-0: no disease, CC-1:<0.25cm, CC-2:0.25–2.5cm, CC-3>2.5cm).21,22 If the disease process was deemed incurable, palliative debulking was either attempted or the procedure was abandoned without intraperitoneal chemotherapy.

Once cytoreduction was complete, a ‘coliseum’ was set up for the instillation of intraperitoneal chemotherapy, before the construction of anastomoses. Ring-based fixed table retraction was used to which the skin was sutured with interrupted 1–0 nylon to prevent spillage of chemotherapy. Layers of opsite were then placed over the ring-based retractor and abdominal wall to fashion the watertight ‘coliseum’. Tubing consisted of one inflow tube and three outflow tubes, a temperature probe and a smoke evacuator. Mitomycin C was delivered by a perfusionist for 90 minutes at 41–42ºC at a dose of 10mg/m² for women and 12.5mg/m² for men. The dose was reduced by 33% in those who had received heavy prior chemotherapy, had marginal renal function, were aged over 60, had extensive prior intraoperative trauma to the small bowel surfaces or who had prior radiotherapy. The addition of cisplatin was used for patients with malignant mesothelioma and gastric cancer. Once chemotherapy was complete, the construction of any anastomoses was performed, drains were placed, the abdomen was closed, and any stomas were fashioned. Chest drains were not routinely inserted unless there had been a definite diaphragmatic perforation.

Post-operatively, patients were transferred to a high dependency unit for 48–72 hours. The use of TPN was not routine as has been described in other centres.15,23 DVT prophylaxis was commenced immediately post-operatively and included compression stockings, sequential calf compressors and prophylactic dose clexane. Diet and mobilisation were progressed according to clinical assessment. Urine output was monitored strictly, especially in cases where cisplatin had been used where a higher urine flow rate was achieved. Convalescent care at the referring hospital was considered upon discharge for patients outside of the Waikato region. Post-operative complications were recorded and classified according to the Clavien-Dindo classification.

Following discharge, patients were seen at six weeks and the post-operative histology was reviewed at a fortnightly pathology multidisciplinary team meeting, which was attended by pathologists, surgeons and a medical oncologist. Follow up consisted of four-monthly CEA, CA19-9
and CA125. CT scans were performed at one, two and three years. Patients with recurrent disease discovered on surveillance were discussed and considered for either no treatment, systemic chemotherapy or further CRS with IPC.

Results
Since 2008, 72 operations were performed on 68 patients with the intention of performing CRS with IPC. Fourteen patients were deemed to be incurable at the time of surgery and either had a palliative debulking procedure (8) or the procedure was abandoned (6). Fifty-eight cases of CRS with IPC were performed on 54 patients, 16 of which were performed in a private hospital (Braemar Hospital). Four cases were redo operations whereby further CRS with IPC was performed for four patients who developed recurrent disease.

Table 1: Demographic features.

<table>
<thead>
<tr>
<th>Number of patients</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>48</td>
</tr>
<tr>
<td>Private</td>
<td>20</td>
</tr>
<tr>
<td>Unresectable</td>
<td>14 (4 private, 10 public)</td>
</tr>
<tr>
<td>Redo</td>
<td>4 (2 public, 2 private)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age (range)</td>
<td>57 (30–80)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>28</td>
</tr>
<tr>
<td>Female</td>
<td>40</td>
</tr>
<tr>
<td>Median BMI (range)</td>
<td>28 (20–45)</td>
</tr>
<tr>
<td>Median ASA</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of presentation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal pain</td>
<td>32</td>
</tr>
<tr>
<td>Abdominal distension</td>
<td>18</td>
</tr>
<tr>
<td>Abdominal mass</td>
<td>7</td>
</tr>
<tr>
<td>Surveillance</td>
<td>11</td>
</tr>
<tr>
<td>Hernia</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2: Number by referral location.

<table>
<thead>
<tr>
<th>Referral centre</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Waikato</td>
<td>26</td>
</tr>
<tr>
<td>Auckland</td>
<td>13</td>
</tr>
<tr>
<td>Christchurch</td>
<td>7</td>
</tr>
<tr>
<td>Dunedin</td>
<td>5</td>
</tr>
<tr>
<td>Whangarei</td>
<td>4</td>
</tr>
<tr>
<td>Hawke’s Bay</td>
<td>2</td>
</tr>
<tr>
<td>Timaru</td>
<td>1</td>
</tr>
<tr>
<td>Invercargill</td>
<td>2</td>
</tr>
<tr>
<td>Taranaki</td>
<td>2</td>
</tr>
<tr>
<td>Tauranga</td>
<td>4</td>
</tr>
<tr>
<td>Rotorua</td>
<td>2</td>
</tr>
<tr>
<td>Palmerston North</td>
<td>2</td>
</tr>
<tr>
<td>Wellington</td>
<td>2</td>
</tr>
</tbody>
</table>

Patient characteristics
Referrals were received from all throughout New Zealand, although a reasonable proportion were from within the Waikato region (36%). Mode of presentation was most commonly abdominal pain (44%) or distension (25%). There were 28 (41%) men and 40 (59%) women with a median age of 57 years (30–80) and BMI of 28 (20–45). Median ASA was 2. From the time the decision was made that a patient was a candidate for CRS with IPC, patients received their operations at a median of three months, ranging from one to 12 months. The median number of prior operations was one, and the median prior surgical score was one. Fourteen patients received systemic chemotherapy prior to being operated on, five of whom turned out to be incurable. Five of these 14 patients (one of whom was incurable) had pseudomyxoma peritonei, five had colorectal cancer (two of whom were incurable), two had ovarian cancer (one of whom was incurable), one had gastric cancer and one had an adenocarcinoid of the appendix.
Characteristics of surgical treatment

Of the 58 operations where CRS with IPC was performed, the median PCI at laparotomy was 19.5 (3–39). The PCI for those with incurable disease was not well documented and therefore not included. Table 3 shows the completeness of cytoreduction for each histological type.

Heated intraoperative intraperitoneal chemotherapy with mitomycin C was used in 54 cases, while mitomycin C with cisplatin was used in the four cases of peritoneal mesothelioma and gastric cancer. The median operative time was 9.08 hours (range 5.43–15.20 hours). The median number of visceral resections was two and the median number of peritonectomies was four. Thirty of the 58 cases treated with CRS with IPC required a stoma of some type (21 end ileostomies, seven loop ileostomies, two end colostomies). Twenty-three patients required a blood transfusion with a median of four units of red blood cells, five units of fresh frozen plasma, one unit of platelets and two units of cryoprecipitate.

Table 3: Total numbers by histological type and completeness of cytoreduction.

<table>
<thead>
<tr>
<th></th>
<th>Complete</th>
<th>Incomplete</th>
<th>Total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomyxoma peritonei</td>
<td>40</td>
<td>8</td>
<td>48</td>
</tr>
<tr>
<td>Appendix adenocarcinoma</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Adenocarcinoid</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Peritoneal mesothelioma</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Ovarian cancer</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mixed</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Post-operative outcome

Thirty patients (42%) experienced complications, three of which occurred in the 14 incurable patients (one medication side effect, one relook laparotomy for a wound complication and one death). Seventeen patients (24%) had either grade 3 or 4 Clavien-Dindo complications. One out of the 72 cases died within 30 days as above (incurable patient), giving an overall 30-day mortality rate of 1.4%. Of 11 cases requiring a return to theatre (15.2%), the reasons were anastomotic leak (3), bowel obstruction (1), gastric perforation (1), enterotomy (1), bleeding (1), bile leak (1), wound complications (2) and removal of a drain end (1). The median duration of hospital stay was 12 days (range five to 104 days), although was only 8.5 days (five to 21 days) for those who had incurable disease.

Table 4: Number of patients with complications, grouped by most severe complication by Clavien-Dindo grading.

<table>
<thead>
<tr>
<th>Clavien-Dindo grading</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>6</td>
</tr>
<tr>
<td>Grade 2</td>
<td>6</td>
</tr>
<tr>
<td>Grade 3a</td>
<td>5</td>
</tr>
<tr>
<td>Grade 3b</td>
<td>11</td>
</tr>
<tr>
<td>Grade 4a</td>
<td>1</td>
</tr>
<tr>
<td>Grade 5</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
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</table>

Discussion

Pseudomyxoma peritonei is a rare disease, but worldwide there has been increasing experience with treatment with CRS with IPC, with good long-term outcome.11,12,24-26 In this article, we presented our early experience with the technique, not only for patients with pseudomyxoma peritonei, but also for a small series of patients with adenocarcinoid of the appendix, malignant mesothelioma and metastatic colon, gastric and ovarian cancer.

Traditionally, CRS with IPC has been considered a morbid, expensive and time-consuming procedure. The potential for multiple major visceral resections and peritonectomy procedures, long operating times and intensive post-operative care has led to criticisms regarding the safety, cost effectiveness and general acceptance of the technique.27-30 Overcoming these issues at our own institution has therefore required a significant collaborative effort between administrative, nursing, medical and allied health staff. At the present time, our experience with CRS with IPC is also no doubt early by international standards, and there is a recognised learning curve associated with the procedure that improves with experience and translates to decreased morbidity and improved survival over time.3,5,12 This relates not only to surgical expertise, but also importantly to patient selection, interpretation of pathology, anaesthetic, nursing and medical post-operative care.33

To date, we have had a series now of 58 cases over a seven-year period that have been treated with CRS with IPC. Our short-term outcomes with respect to operative times, transfusion requirements and hospital stay are comparable to those published.1,4,15,24,25,34 We had a 30-day mortality rate of 1.4%, comparable to that published by Moran’s group of 5% in their early experience of 123 patients, and a major complication rate of 24%.24 In 2009, Chua et al published the morbidity and mortality outcomes of 24 institutions, 11 of which were considered high-volume tertiary centres with between 103 and 460 cases at the time of publication.27 Overall mortality rates ranged from 0 to 17%, with sub analysis of high-volume centres demonstrating mortality rates of between 0.9 to 5.8%. The most common causes of death were sepsis and multi-organ failure from surgical complications. The overall rate of grade 3/4 complications ranged from 0 to 52%, and for high-volume centres ranged from 12 to 52%, with the most common complications being sepsis, fistula, abscess, ileus, perforation, anastomotic leak, DVT/PE, haematological toxicity and renal insufficiency. Rates of reoperation ranged from 0 to 23% in the perioperative period, which in our series was 15.2%.

At our institution, we have only ever used heated intraoperative intraperitoneal chemotherapy (HIPEC) with mitomycin C, adding cisplatin for patients with malignant mesothelioma and gastric cancer. The main advantages of HIPEC are even exposure of the peritoneal surface to chemotherapy before the formation of adhesions and the
ability to use hyperthermia. Heat theoretically decreases the interstitial pressure of the tumour tissue to increase penetration of the chemotherapeutic agent, increases the cytotoxicity of the chemotherapeutic agent and has a direct cytotoxic effect on tumour tissue.\textsuperscript{34,36} The systemic absorption of mitomycin C is also limited because of its high molecular weight and in our series we encountered no complications related to cytotoxicity, though both renal and haematological toxicity have been reported. In the literature, renal toxicity ranged from 1.3–5.7% and haematological toxicity between 4.6–18.6%.\textsuperscript{30} The principal disadvantages of HIPEC are the increased operative times, the need for specialised perfusion equipment and personnel, and the limited number of heat stable chemotherapeutic agents available for use.\textsuperscript{21,22}

The alternatively described technique is early post-operative intraperitoneal chemotherapy (EPIC), either alone or in combination with HIPEC.\textsuperscript{34,38} EPIC requires less operative time, equipment and personnel, has a broader range of available agents, and patients can receive multiple cycles of treatment beginning as early as the day after surgery. Port complications may, however, interfere with the ability to complete the intended duration of EPIC, and post-operative adhesions may interfere with chemotherapy distribution. Patients may also develop uncomfortable abdominal distension and special precautions are required during the administration of chemotherapy, which is undertaken on either the ward or in ICU.

Due to the relatively short follow-up data of our series at the time of publication, we did not examine the survival outcomes for our cohort of patients. In the multi-institutional review by Chua et al in 2012 of 2,298 patients with pseudomyxoma peritonei, the median overall survival was 16.3 years with 3-, 5-, 10- and 15-year survival rates of 80%, 74%, 63% and 59% respectively.\textsuperscript{1} Studies which reported on overall survival and performed multivariate analyses of associated factors found that older age, major post-operative complications, debulking surgery (CC 2/3), prior chemotherapy and high-grade subtype were independent predictors of poorer overall survival.\textsuperscript{1,11,12,26}

We also did not report on the number of recurrences at the end of the follow-up period, though we did include four patients in our study who had repeat CRS with IPC for recurrent disease. In the above study by Chua et al, the median progression-free survival was reported as 8.2 years, with prior chemotherapy, the high grade subtype, major post-operative complications, higher PCI and debulking surgery being predictors of poorer progression-free survival on multivariate analysis.\textsuperscript{1} Repeat CRS with IPC in selected patients has been shown to be feasible, and in some patients’ third time and even fourth time CRS with IPC may be possible with improved survival.\textsuperscript{37} In this particular study by the Sugarbaker group, recurrence was most frequently noted in the small bowel initially and then in the pelvis at subsequent CRS with IPC, with focal recurrences being more common than diffuse. Patients were generally operated on within a few months of diagnosis, translating to better performance status, lower reoperative PCI, and tumours that were relatively easier to remove by complete cytoreduction. While timely surgery may be possible for patients from within the Waikato region, it may be difficult to achieve for patients referred from elsewhere in New Zealand.

Current evidence suggests that CRS with IPC also has a role in the treatment of other malignancies with peritoneal surface disease,\textsuperscript{16–19,38–41} and our series includes patients with adenocarcinoid of the appendix, appendix adenocarcinoma, malignant mesothelioma and metastatic colon, gastric and ovarian cancer. Emerging evidence into the use of the technique is particularly important in colorectal cancer, in whom patients are traditionally expected to have a dismal prognosis and are generally treated with a palliative intent. In a recent systematic review, however, the potential for a doubling in the median survival of patients with peritoneal disease treated with CRS with IPC was demonstrated compared to systemic chemotherapy.\textsuperscript{19} Only patients with a relatively lower PCI are considered to benefit from treatment (<20), and the main problem at the present time is in identifying which patients will benefit from CRS with IPC, and in establishing suitable scoring systems and algorithms for referral and treatment. Currently the peritoneal surface disease severity score (PSDSS) is one such prognostic scoring system\textsuperscript{42–44} that has been incorporated into a suggested algorithm for
treatment. In addition there is a move to try to identify patients with colorectal cancer at high risk for peritoneal recurrence in whom a staged relook could be performed with a view to offering them CRS with IPC. In a study by Elias et al, 41 patients were treated in this manner, with 23 going on to have CRS with IPC, giving an overall five-year survival of 90%.

This study demonstrates our institution’s short-term outcomes following CRS with IPC. By comparison, we have yet to gain the volume and experience achieved by other international centres performing CRS with IPC, though we hope to achieve this with time and in the near future will report on our overall and disease-free survival outcomes. Furthermore, as CRS with IPC has been accepted as standard of care for patients with pseudomyxoma peritonei, we anticipate that this increased awareness will lead to an increase in the number of referrals. Coupled with increasing interest in CRS with IPC for colorectal cancer, this will mean the need for a more streamlined and protocolised national referral process, proper patient selection, prompt patient treatment, clear guidelines for post-operative follow up, equal accessibility to discussion and treatment of recurrent disease, and further audit and review of our outcomes.

Competing interests:
Nil.

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REFERENCES:


A cross-disciplinary assessment of student loans debt, financial support for study and career preferences upon graduation

Craig S Webster, Christopher Ling, Mark Barrow, Phillippa Poole, Marcus Henning

ABSTRACT

AIM: To explore relationships between student loans debt, financial support and career preferences upon graduation for all healthcare disciplines offered at the Faculty of Medical and Health Sciences, University of Auckland.

METHODS: The Faculty Tracking Project is a longitudinal study which invites students to complete a questionnaire at the beginning and end of their educational programmes, including questions on debt, financial support and career preference. Our analysis comprised three phases: (1) a descriptive analysis of data related to debt and financial support; (2) a principal component analysis in order to find related categories of career choice; and (3) logistic regression models to determine how career preference categories could be explained by either levels of student loans debt or financial support.

RESULTS: Data from 2,405 participating students were included. Students in health sciences, nursing and pharmacy typically accrue levels of student loans debt of around $15,000 to $29,999, while optometry students accrue debt around $15,000 higher. Medical students show debt distributed around modes of $0 and $90,000 or more. All students typically access three sources of financial support during study. Career preferences at graduation reduced to four categories for all health disciplines. We found five significant effects, involving students in health sciences, medicine and pharmacy, relating the number of sources of financial support to the four categories of career preference. No significant effects were found related to level of student loans debt.

CONCLUSIONS: Our results suggest that financial support is a more strongly determining factor in career choices than the level of student loans debt. The four-category framework for student career preferences appears to be a useful model for further research.

A student's career choices may be influenced by many factors, including personal interest, financial compensation, the cost and perceived level of difficulty of the training programme and lifestyle preferences. A number of these factors appear to be particularly relevant in the case of students studying towards a career in healthcare. This is due to the typically higher fees and often greater number of years of study required in healthcare compared to other undergraduate programmes. This can place a financial burden on healthcare students, which may also negatively impact on their wellbeing. Some evidence suggests that the rising cost of healthcare education is causing some medical students to seek specialties perceived to be more highly paid. These specialties are often in cities, thus their selection potentially undersupplies primary healthcare and rural locations.
In New Zealand, primary healthcare workers from a range of professional backgrounds are responsible for the provision of comprehensive and continuous patient care, thus forming the foundation of an effective health system. New Zealand’s aging population places further demands on primary healthcare providers and there is a growing need to encourage a significant proportion of graduates to specialise in primary healthcare. This is especially the case in rural areas where healthcare workers are already in short supply.

To date, the relationship between student debt at graduation and future career choices has almost exclusively been studied in medical students. The results of such studies have been mixed, however, with some finding no significant relationship between debt levels, career choices and specialisation—even in relation to students with higher levels of debt. Furthermore, two studies found that students with lower debt levels were less likely to select a career in primary care. Other analyses suggest that debt levels of medical students are manageable even if they select a career in the primary healthcare sector. These conflicting findings may in part be due to the confounding influence of socioeconomic status, and age upon entry into educational programmes.

There are very few reports of the influences of debt or income on career choice in other health professions. In one national study of dentists in Canada, almost half reported incurring substantially more debt during their education than they had anticipated, but in two-thirds this did not affect their career choice. A study of psychologists in New Zealand found that participants borrowed more when they anticipated greater earnings in their intended career, but overall took longer to repay their student loan than they had anticipated. However, we know of no research which has considered the wider context of healthcare education by taking a cross-disciplinary approach when considering the relationship between student debt levels and career choice. Such a cross-disciplinary approach is important in terms of gaining insight into how best to provide the range of healthcare workers needed in New Zealand, and the Faculty Tracking Project (as described below) allows such comparisons to be made, across disciplines, using comparable data. Therefore, our present aim was to conduct an exploratory study analysing relationships between student debt, sources of financial support and career preferences upon graduation for all healthcare disciplines offered in the Faculty of Medical and Health Sciences at the University of Auckland.

**Methods**

Data for the present study were drawn from the existing database of the Faculty Tracking Project at the University of Auckland for all participating disciplines. The Faculty Tracking Project is a longitudinal study that began in 2006, and invites students to complete a questionnaire upon entry to, and exit from, their health education programmes. In the present study only exit questionnaire data were used, and all identifying student information was removed upon extraction of data from the database. The New Zealand Government student loans (GSLs) scheme is available for domestic students, and such loans may be used to cover compulsory student fees, course-related costs up to the value of $1,000 and living costs up to $177 per week. In questionnaires, participants were asked to disclose their total student loans debt, the sources of financial support accessed during their study and their career preferences upon graduation. Specific questions are apparent from our reported results, and copies of the discipline-specific questionnaires are available from the corresponding author.

In 2012, the Faculty Tracking Project became part of the Australian Medical Schools Outcomes Database and Longitudinal Tracking Project (MSOD). This change involved the substantial redesign of the questionnaire form for medicine, particularly involving the way career preferences are coded. This presented difficulties with the planned inferential data analysis regarding career preference in terms of data continuity. Therefore we have included data for medicine related to income and debt for the seven years from 2006 to 2012, but have excluded the career preference data collected using the new form in 2012. Optometry was recruited to the Tracking
Project in 2013, and these data have been included in the initial descriptive analysis of the study for comparison purposes. For the disciplines of health sciences, nursing and pharmacy we have included data from the eight-year period from 2006 to 2013 (see Discipline column, Table 1). This study was conducted under the ethics approval of the Faculty Tracking Project granted by the University of Auckland Human Participants Ethics Committee.

Data analysis
Our planned data analysis comprised three distinct phases. First we conducted a descriptive and exploratory analysis of all data related to student loans debt and financial support. Second, we conducted a principal component analysis within each of the four disciplines of health sciences, medicine, nursing and pharmacy in order to identify factors of similar career preferences. This was necessary because the career choices listed in the questionnaire for each discipline were different in type and number (between eight and 19 choices)—thus significantly complicating subsequent analysis and comparisons between disciplines without some reduction in factors. Third, we conducted two separate logistic regressions to explore how career preference factors could be explained by either levels of student loans debt or numbers of sources of financial support (SPSS, IBM Corporation, New York). We also considered how career preference factors could be explained by levels of financial support with debt as a covariate. We designated p<0.05 as statistically significant, and given the exploratory nature of our study we did not correct for multiple comparisons.21,22

Results
Data from a total of 2,405 students were included in our study—this comprised 199 health sciences students, 890 medical students, 572 nursing students, 710 pharmacy students and 34 optometry students. There was a high questionnaire response rate for medical, nursing, optometry and pharmacy students (81–95%), but this was considerably lower for health sciences students (47%).

Phase one
Student debt levels
Levels of student loans debt were reported using eight categories in increments of $15,000 each, spanning the range from $0 to $90,000 or more. Figure 1 shows the distributions of debt for all disciplines included in our study. The most common level of debt was the same for health sciences, nursing and pharmacy students, peaking in the $15,000 to $29,999 range. Optometry students reported modal debt in the next highest debt category, at $30,000 to $44,999. By contrast, levels of student loans debt reported by medical students showed a much flatter distribution with a nadir in the range in which other disciplines showed their peaks, and peaks at both extreme ends of the scale, namely $0 and $90,000 or more.

Figure 1: Histogram of the distribution of student loans debt at completion of the educational programme for each participating discipline.
Owing to the different distributions of student loans debt and the fact that some categories contained only a small number of respondents, we elected to use two categories for the analysis of debt levels—namely low and high debt, defined as debt less than $30,000 and greater than $30,000 respectively. Using two categories in this way allowed us to use binary logistic regression in phase three of our study in order to explore the relationships with career preferences. We chose $30,000 as the threshold between categories because approximately half the overall respondents fell into each category. However, compared with student loans debt overall (Figure 1), the proportions of low to high debt between disciplines varied significantly (p<0.001, chi square—Table 1). This effect was due to the fact that proportionally more students in medicine and optometry had high debt, while proportionally more students in health sciences, nursing and pharmacy had low debt (post hoc testing, Table 1).

Sources of financial support
Sources of financial support reported on the Tracking Project questionnaire comprised support from parents, student loans, student allowance, part-time employment, partner’s income, savings, scholarships and other. Students were asked to indicate the total number of sources of financial support that they had accessed during their studies. Despite different debt levels, the most common number of sources of financial support was the same for all disciplines, with a mode of three sources (range 0–8 for medicine, 0–7 for health sciences and nursing, 0–6 for pharmacy and 1–6 for optometry). For the purposes of further analysis we elected to create two categories for the number of sources of financial support—namely low (three or less sources) and high (four or more sources). Despite similar modal numbers of sources of financial support, the proportions of low to high numbers varied significantly between disciplines (p<0.005, chi square—Table 1). This effect was due to the fact that

<table>
<thead>
<tr>
<th>Discipline (sample period)</th>
<th>Debt** (p&lt;0.001, chi square)</th>
<th>Sources of financial support (p&lt;0.005, chi square)</th>
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<tbody>
<tr>
<td></td>
<td>Low (&lt;$30,000)</td>
<td>High (&gt;=$30,000)</td>
</tr>
<tr>
<td>Health science (2006–2013)</td>
<td>Participant n=199</td>
<td>Within discipline %</td>
</tr>
<tr>
<td></td>
<td>138* 70%</td>
<td>59 30%</td>
</tr>
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<td>Medicine (2006–2012)</td>
<td>Participant n=890</td>
<td>Within discipline %</td>
</tr>
<tr>
<td></td>
<td>242 28%</td>
<td>625* 72%</td>
</tr>
<tr>
<td>Nursing (2006–2013)</td>
<td>Participant n=572</td>
<td>Within discipline %</td>
</tr>
<tr>
<td></td>
<td>400* 73%</td>
<td>147 27%</td>
</tr>
<tr>
<td>Pharmacy (2006–2013)</td>
<td>Participant n=710</td>
<td>Within discipline %</td>
</tr>
<tr>
<td></td>
<td>463* 69%</td>
<td>212 31%</td>
</tr>
<tr>
<td>Optometry (2013)</td>
<td>Participant n=34</td>
<td>Within discipline %</td>
</tr>
<tr>
<td></td>
<td>8 24%</td>
<td>26* 76%</td>
</tr>
<tr>
<td>Total</td>
<td>Participant n=2,405</td>
<td></td>
</tr>
</tbody>
</table>

*Significant post hoc effect (z-score >1.96).
**Missing values indicate participants who declined to disclose their level of student loans debt.
proportionally more students in medicine had a high number of sources of financial support, while proportionally more students in pharmacy had a low number of sources of financial support—with other disciplines showing no significant effects (post hoc testing, Table 1). Given the small number of optometry respondents, this discipline was not included in further analysis.

Phase two

Principal component analysis of career preferences

In order to use regression analysis to investigate possible relationships between debt levels, financial support and career preferences upon graduation, we first attempted to find whether career preferences factored into similar types in order to reduce the number of factors for analysis. Students indicated their career preferences in the questionnaire by recording strong interest, some interest or no interest in each potential career choice. For our analysis we coded this level of interest numerically, using a value of 2 for strong interest, 1 for some interest and 0 for no interest. Of the 890 medical students included in the study, 145 from the year 2012 were excluded due to differently coded data.

The principal components method was used to perform factor analysis extraction in order to identify career choice factors using the level-of-interest score as the clustering factor. Initial analysis demonstrated that between three and five categories of career preference were evident across the different disciplines. In order to consolidate categories further we used Varimax rotation, suppression of loadings below 0.3, and the rule that category membership of possible career options was determined by the loading with the highest absolute value. This approach lead to the emergence of four distinct career preference categories for each discipline, with acceptable levels of total variance explained (between 46% and 68%—Table 2).  

Phase three

Relationships between career categories, student loans debt and financial support

We used a binary logistic regression model to explore relationships between levels of student loans debt, financial support used during study and categories of career preference (outputs for regression models are shown in Table 3). The first model explored student loans debt and its relationship to the four career preference categories across all disciplines, but demonstrated no significant results (Table 3). Conducting the same exploratory regression model in relation to sources of financial support used during study and categories of career preference demonstrated six significant effects. Having a low number of sources of financial support meant that health sciences students favoured a career in Category 4, and medical students favoured a career in Category 1 (Table 3). Alternatively, having a high number of sources of financial support meant that medical and nursing students favoured a career in Category 4, and pharmacy students favoured a career in Categories 1 and 2 (Table 3). Although student loans debt appeared not to be a determining factor in these effects, it could nevertheless be a moderating factor. We therefore also conducted the second regression model with student loans debt included as a covariate. This approach increased the percentage of total variance explained in the model—for example, in medicine, the variance explained doubled from 4% to 8% (Table 3). Only one effect failed to reach significance with the addition of debt as a covariate (the effect for nursing), suggesting that we may have additional confidence in the five remaining effects for health sciences, medicine and pharmacy.
Table 2: Principal component analysis of career preferences based on level of interest reported by students.*

<table>
<thead>
<tr>
<th>Career options on questionnaire</th>
<th>Career preference categories</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<td><strong>Health science (total VE</strong> <strong>64%)</strong></td>
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<td></td>
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<tr>
<td>Health promotion</td>
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<td>Postgraduate study</td>
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<td><strong>Medicine (total VE 46%)</strong></td>
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<td>Medicine (general)</td>
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<td>Medical sciences</td>
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<td>Pathology</td>
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<td>Surgery (subspecialty)</td>
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<tr>
<td><strong>Nursing (total VE 57%)</strong></td>
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</tr>
<tr>
<td>Academic research</td>
<td></td>
<td>.469</td>
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</tr>
<tr>
<td>Surgery (general)</td>
<td></td>
<td>.820</td>
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<tr>
<td>Surgery (subspecialty)</td>
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<td>.811</td>
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<tr>
<td>Theatre</td>
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<td>.645</td>
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<td></td>
</tr>
<tr>
<td>Medicine (general)</td>
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<td>.843</td>
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<tr>
<td>Medicine (subspecialty)</td>
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<td>Paediatrics</td>
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<td></td>
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<tr>
<td>Obstetrics and gynaecology</td>
<td></td>
<td>.517</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency care</td>
<td></td>
<td>.425</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pharmacy (total VE 68%)</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Postgraduate study</td>
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<td>.886</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Academic research</td>
<td></td>
<td>.881</td>
<td></td>
<td></td>
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<tr>
<td>Management</td>
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<td>.758</td>
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<tr>
<td>Regulatory affairs</td>
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<td>.691</td>
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<tr>
<td>Industry</td>
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<td>.651</td>
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<td></td>
</tr>
<tr>
<td>Community</td>
<td></td>
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<tr>
<td>Hospital</td>
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<td></td>
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</tr>
<tr>
<td>Veterinary</td>
<td></td>
<td>.989</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Career choices were clustered into categories using Varimax rotation with Kaiser normalisation, and the rule that category allocation was determined by the loading with the highest absolute value.

**VE—variance explained.
Table 3: Outputs of logistic regression models relating career category to student loans debt and financial support.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Career category number</th>
<th>Careers included in category</th>
<th>Debt, p value</th>
<th>Financial support, p value</th>
<th>Financial support with debt covariate, p value</th>
<th>Implications from significant effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health science</td>
<td>1</td>
<td>Health promotion, community outreach</td>
<td>0.634</td>
<td>0.332</td>
<td>0.299</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Academic research, postgraduate study, medicine</td>
<td>0.444</td>
<td>0.323</td>
<td>0.307</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Health policy, health management</td>
<td>0.970</td>
<td>0.584</td>
<td>0.665</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Pharmacy, nursing</td>
<td>0.977</td>
<td>0.039</td>
<td>0.046</td>
<td>Favoured by those with a low number of financial supports</td>
</tr>
<tr>
<td>VE*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicine</td>
<td>1</td>
<td>Medicine (general), medicine (subspecialty), geriatrics</td>
<td>0.069</td>
<td>&lt;0.001</td>
<td>0.001</td>
<td>Favoured by those with a low number of financial supports</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Postgraduate study, academic research, medical sciences, public health, pathology</td>
<td>0.146</td>
<td>0.074</td>
<td>0.069</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Surgery (general), surgery (subspecialty), radiology, anaesthesia, emergency medicine</td>
<td>0.317</td>
<td>0.149</td>
<td>0.304</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Paediatrics (general), paediatrics (neonatology), general practice, psychiatry, obstetrics and gynaecology</td>
<td>0.158</td>
<td>0.002</td>
<td>0.004</td>
<td>Favoured by those with a high number of financial supports</td>
</tr>
<tr>
<td>VE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing</td>
<td>1</td>
<td>Public health, primary healthcare, mental health, older person's health, academic research</td>
<td>0.918</td>
<td>0.621</td>
<td>0.911</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Surgery (general), surgery (subspecialty), theatre</td>
<td>0.567</td>
<td>0.416</td>
<td>0.559</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Medicine (general), medicine (subspecialty)</td>
<td>0.823</td>
<td>0.550</td>
<td>0.669</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Paediatrics, obstetrics and gynaecology, emergency care</td>
<td>0.500</td>
<td>0.045</td>
<td>0.076</td>
<td>Favoured by those with a high number of financial supports</td>
</tr>
<tr>
<td>VE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacy</td>
<td>1</td>
<td>Postgraduate study, academic research</td>
<td>0.863</td>
<td>0.013</td>
<td>0.029</td>
<td>Favoured by those with a high number of financial supports</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Management, regulatory affairs, industry</td>
<td>0.729</td>
<td>0.044</td>
<td>0.035</td>
<td>Favoured by those with a high number of financial supports</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Community, hospital</td>
<td>0.176</td>
<td>0.918</td>
<td>0.759</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Veterinary</td>
<td>0.589</td>
<td>0.961</td>
<td>0.821</td>
<td></td>
</tr>
<tr>
<td>VE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Variance explained
Discussion

Our exploratory study found a number of findings of interest, including some significant relationships between sources of financial support and career preferences upon graduation. Student loans debt in all disciplines showed a distribution with a single mode, except in medicine. Principal component analysis of career preferences upon graduation demonstrated that despite different kinds and number of career options in each discipline, choices were able to be clustered into four categories of related choices within each discipline. The career preferences included in each category resulting from our principal component analysis largely make intuitive sense in terms of the vocational similarities of the careers within each category and the dissimilarities between categories—thus making it plausible that a student with an interest in one career choice in a given category may also have more interest in others in the same category than those in different categories (Table 2). Career categories across disciplines also appeared to contain similar combinations of career options—for example, in the three disciplines where postgraduate study and academic research were career options, these always clustered together—suggesting emergent natural types of career choice. We had no a priori expectation that the disparate career choices included on the questionnaire for each discipline could be meaningfully reduced to a manageable number of categories, let alone the same number of categories for all disciplines. The fact that we were able to do this made subsequent analysis considerably less complicated, and also allowed for more comparable relationships to be explored across disciplines. Thus, the framework of career preference categories generated by this study is, in itself, a substantial outcome—it is evidence based, shows acceptable levels of variance explained, and would potentially form a useful basis for further analysis using other methods of understanding student choice and career pathways. It is conceivable it could also guide aspects of curriculum design or the placement options offered to students.

The peak in the debt distribution for health Sciences, nursing and pharmacy students at $15,000–$29,999 could be explained by the fact that the total tuition costs of these degrees are around $18,000–$24,000 (Figure 1). The higher peak for optometry is likely to be the result of the degree being of a greater length (five years) and the fees being around $1,500 more (from year two onward). In addition to this, there is a requirement for students to purchase equipment during their degree costing around $10,000. In medicine, the 15% of students showing no debt could potentially be explained by this group containing international students who do not have access to the New Zealand Government student loans scheme and those students who have more substantial parental support. The large number of medical students with debt in the higher range, on the other hand, is likely to indicate graduate students entering the medical programme, who may already have some student loans debt, and the six-year length of the degree programme with higher course fees (approximately $14,000 per year as opposed to $6,200 for health sciences, nursing and pharmacy).

Our results suggest that the number of sources of financial support more strongly determines career choice than the level of student loans debt per se. However, it is important to note that the level of student loans debt incurred under the Government student loans (GSLs) scheme is only a proxy for the total debt a student may incur during their studies. Learning more about the nature of the sources of financial support available to students may shed light on such effects. For example, students who have access to sources of income that they are not required to pay back (eg, scholarships or parental support) may be expected to be less encumbered by debt and make different career choices than those students who do have to pay back sources of financial support (eg, GSLs). Although students were asked to indicate all the sources of financial support used during their study, this did not allow us to ascertain the student’s main source of financial support or give an indication of the degree of support received from each source.

General practice is included in medicine’s career Category 4 in our results, which is a category favoured by medical students with a high number of sources of financial
support (three or more)—but this result, in itself, tells us little about possible career pathways to primary healthcare (Table 3). Category 4 in both nursing and medicine contains paediatrics, and obstetrics and gynaecology, and is favoured by students in both disciplines who have a high number of sources of financial support. It is also worth noting that Category 4 in health sciences likely represents an alternative route into professionally registered careers in pharmacy and nursing, and is favoured by students with a low number of sources of financial support (Table 3). Some further targeted data collection using additional questionnaires or interviews in students who indicate a preference for particular categories, could allow us to better understand such career choices. It is also unclear whether preference for certain career categories over others is related to the perceived remuneration associated with those careers. The significant effect in pharmacy involving a preference for Category 2 may suggest that this category, relative to the others in the discipline, offers higher paid opportunities. However, further research is needed to properly estimate the earning potential of each career category in our results (Table 3).

Although some of the results relating category of career preference with financial support were highly significant (Table 3), and the inclusion of debt as a covariate in these models increased the rates of variance explained, the final rates of variance explained remained relatively small. However, we chose the variables of student loans debt and financial support a priori, and there is no single acceptable level of variance explained in regression studies. Furthermore, smaller rates of variance explained remain useful when attempting to detect relatively weak signals in noisy systems—a type of system to which student career choice clearly belongs. Future work may allow more precise targeting of cohorts of student who are making specific choices and so increase the explanatory power of our models.

A strength of our study lies in the large number of participants included and the high questionnaire response rates, which were higher than that typically reported in questionnaire studies. To our knowledge, this kind of cross-disciplinary comparison study has not been conducted previously. Potential limitations of our research include the fact that we did not exclude international students from our analysis, and the somewhat limiting nature of some of the questions included in the questionnaire. International students do not have access to the New Zealand Government loans scheme—however, even students who do have access to the scheme may not take up GSLs. In the questionnaire, students were asked to select a range to indicate their level of student loans debt upon exit from their educational programme, rather than asking them to record a total value for their debt. Although this made the question easier for students to answer, it effectively transformed a continuous measure into a categorical one, thus likely reducing the discriminability of the variable in relation to other factors, and increasing the complexity of the data for analysis. In future work, categories of debt could be converted to a pseudo-continuous measure by taking the numeric mid-point of each category rather than using a binary approach as in the present study. The changes to the questionnaire for medicine in 2012, when the Faculty Tracking Project became part of the MSOD research project, presented difficulties with data continuity and analysis. This led us to exclude the data after these changes were made from our analysis. However, it is possible that in future work, a method of equating data across the two periods could be devised, therefore allowing all data in the database to be including in a larger-scale analysis. It is also worth noting that career preferences indicated upon exit from an educational programme may have little bearing on the jobs that students ultimately end up working in. However, including variables such as gender and ethnicity into career preference models in future work may further inform such models.

**Conclusion**

Students in health sciences, nursing and pharmacy typically accrue similar levels of student loans debt of around $15,000 to $29,999, while optometry students accure debt around $15,000 higher. Medical students demonstrate a flatter distribution of student loans debt, with debt distributed around both ends of the scale—that is, no
debt and $90,000 or more. Students typically access three sources of financial support during study. We have developed and demonstrated the efficacy of a four-category career preference framework to explore the relationship between student loans debt, financial support and career preferences upon graduation. Overall, we found five significant effects relating the number of sources of financial support to career preference categories involving students in health sciences, medicine and pharmacy. Our results suggest that the number of sources of financial support is a more strongly determining factor in career preference than the level of student loans debt per se, but this requires further study.

Competing interests: Nil.

Acknowledgements:
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URL:

REFERENCES:


30-day mortality after percutaneous coronary intervention in New Zealand public hospitals (ANZACS-QI 18)

Andrew J Kerr, Michael Williams, Harvey White, Corina Grey, Yannan Jiang, Chris Nunn, on behalf of the ANZACS-QI investigators

ABSTRACT

AIM: The aim of this report is to provide hospitals in New Zealand with data about their own outcomes for percutaneous coronary intervention (PCI) procedures and allow comparisons with other New Zealand units and with international data.

METHODS: All PCI procedures (n=5,033) were identified in nine public hospital catheterisation laboratories between 1 October 2014 and 30 September 2015. Risk-adjusted mortality rates were derived for each hospital and compared with the national rate.

RESULTS: The overall 30-day mortality rate after PCI was 1.23%. The national 30-day mortality rates were 3.28% for the subgroup of patients treated for a ST segment elevation myocardial infarct and 0.66% for those treated for other acute coronary syndrome (ACS) or non-ACS indications. There were no statistically significant differences in outcomes between the different New Zealand public hospital catheterisation laboratories, either overall or for each patient subgroup.

CONCLUSIONS: Mortality rates in the first 30 days after PCI are low and comparable across New Zealand public hospitals. The outcomes are comparable with international experience.

In response to calls for public release of hospital performance data and to support high-quality health care in New Zealand the Health Ombudsman1 and the Health Quality and Safety Commission (HQSC)2 in 2016 called for more transparent and public reporting of the performance of New Zealand healthcare services. The HQSC made several recommendations. These included public reporting of judiciously chosen, adequately risk-adjusted measures at the team, unit or organisational level rather than the individual clinician level, developing agreed national standards of data collection, relevant definitions and measures across New Zealand, and having standardised risk adjustment models to account for case complexity and risk.

Cardiovascular disease (CVD) is a leading cause of death in New Zealand and the most common form of CVD is atherosclerotic coronary artery disease. Various treatments are recommended for patients with coronary artery disease, including lifestyle changes, medication and interventional procedures. The most common interventional procedure performed on patients with coronary artery disease is percutaneous coronary intervention (PCI).

The All New Zealand Acute Coronary Syndrome Quality Improvement programme (ANZACS-QI) is a clinician-led initiative which was implemented in 2012 with New Zealand Ministry of Health (MOH) funding to support appropriate, evidence-based management of patients with acute coronary syndromes (ACS) and cardiac conditions.3 An important goal of ANZACS-QI is to improve the quality of care in relation to PCI in New Zealand.
Providing clinicians in New Zealand with data regarding their own outcomes for these procedures will allow them to examine the quality of their own care, compare it both with other New Zealand units and with international comparison data, and identify opportunities for improvement in their quality of care.

Methods

Overview
The ANZACS-QI programme utilises two complementary data sources to generate two overlapping cohorts:

1. The ACS-CathPCI Registry cohort, generated using web-based software that enables secondary care clinicians to systematically collect data on ACS patients, coronary angiography and PCI procedures in all New Zealand hospitals.

2. The ACS Routine Information cohort, derived directly from national health data sets, which includes mortality and rehospitalisation data.

While the ACS Routine Information cohort includes all New Zealand ACS patients, it is relatively limited in content. In contrast, the ACS-CathPCI Registry cohort captures more in-depth data on every ACS patient who has a coronary angiogram in New Zealand and all other patients having coronary angiography procedures. The two overlapping data sources were linked using the encrypted National Health Index number and used to report mortality within 30 days of hospital admission. This was done for this report by using the ANZACS-QI registry data to adjust for these differences to see what each hospital's mortality rate would have been if the hospital had a mix of patients similar to the national mix.

Cohort
The first complete CathPCI registry record for each patient, which recorded a PCI procedure between 1 October 2014 and 30 September 2015, was included in this analysis. There were 5,033 patients identified in nine public hospital catheterisation laboratories, of which 4,977 had complete data for analysis. Fifty-six patients had missing information on diabetes, creatinine and smoking status.

A further 102 (2%) patients undergoing PCI for ST elevation MI (STEMI) who had cardiogenic shock were excluded from the cohort for analysis. These patients are extremely high-risk, but for some, PCI may be their best chance for survival. Furthermore, the magnitude of the risk is not easily determined using registry data. Consistent with practice in the New York State PCI reporting methodology, these cases were excluded in an effort to ensure that physicians could accept these cases where appropriate without concern over a detrimental impact on their reported outcomes.

For the remaining 4,875 eligible patients, three subgroups were identified: (1) STEMI, (2) Other ACS (other suspected/known acute coronary syndrome), and (3) Non-ACS. The total number of patients in each subgroup was 1,068 (22%), 2,587 (53%) and 1,220 (25%), respectively. Initial analyses showed similar outcomes in the ‘other ACS’ and ‘non-ACS’ subgroups, so these groups were combined for reporting purposes.

Outcomes analysis
All-cause 30-day mortality was obtained from the MOH mortality data linked to each patient. The national mortality rate was calculated as the proportion of deaths in the total eligible cohort. Prior studies have identified potential confounding variables. Those used for risk adjustment for this report included: age, sex, ethnicity (Māori/Pacific/Other), current smoker, diabetes, prior coronary artery bypass grafting (CABG), elevated creatinine (≥150μmol/L), and worst Killip class in hospital (I to III), which is a measure of the severity of heart failure.

Following the statistical methodologies reported in New York State, the following key measurements were calculated:
• The observed mortality rate (OMR) in %, which is the observed number of deaths divided by the total number of cases and then multiplied by 100.

• The expected mortality rate (EMR) in %, which is the sum of the predicted probabilities of death for all patients divided by the total number of patients and then multiplied by 100. To calculate the EMR, logistic regression models were used to estimate the predicted probability of death for each patient. The odds ratio for each predictor/confounder in the model was also estimated. The results are shown in the Appendix.

• The risk-adjusted mortality rate (RAMR) is the best estimate, based on the regression model, of what the providers’ mortality rate would have been if the hospital had a mix of patients similar to the national mix. It is obtained by first dividing the OMR by the EMR, and then multiplying that quotient by the national mortality rate for the subgroup of patients.

The RAMR for each hospital was compared with the national rate. The 95% confidence interval (CI) for the RAMR indicates which catheterisation laboratories had significantly more or fewer deaths than expected given the risk factors of their patients. Catheterisation laboratories with significantly higher rates than expected after adjusting for risk are those with 95% CIs above the national rate. Catheterisation laboratories with significantly lower rates than expected have 95% CIs below the national rate.

The 95% CI for the RAMR was calculated using the Byar’s approximation to the Poisson distribution’ RAMRs for each hospital’s catheterisation laboratory are reported for the entire cohort and for two subgroups—‘STE’ and ‘other ACS and non-ACS’ separately.

**Report development**

This report was prepared by a working group of the ANZACS-QI group. It was then refined based on feedback received from the wider ANZACS-QI governance group and the Interventional Working Group of the New Zealand branch of the Cardiac Society of Australia and New Zealand. The report has been approved for release by these groups.

**Results**

In the 102 cases excluded due to cardiogenic shock, the mortality rate was 51% (n=52). There were 60 other deaths within 30 days of a PCI, 35 associated with STEMI and 25 with a non-STEMI diagnosis. Table 1 presents demographic and clinical characteristics of all eligible patients by sub-cohort and 30-day mortality.

**Table 1**: Eligible patients undergoing PCI between October 2014 and September 2015 (N=4,875).

<table>
<thead>
<tr>
<th></th>
<th>STEMI (N=1,068)</th>
<th>Other ACS and non-ACS (N=3,807)</th>
<th>Overall (N=4,875)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± SD</td>
<td>63±12</td>
<td>66±11</td>
<td>65±12</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>804 (75)</td>
<td>2753 (72)</td>
<td>3,557 (73)</td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>96 (9)</td>
<td>286 (8)</td>
<td>382 (8)</td>
</tr>
<tr>
<td>Pacific</td>
<td>46 (4)</td>
<td>152 (4)</td>
<td>198 (4)</td>
</tr>
<tr>
<td>Other</td>
<td>926 (87)</td>
<td>3,369 (88)</td>
<td>4,295 (88)</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>153 (14)</td>
<td>905 (24)</td>
<td>1,058 (22)</td>
</tr>
<tr>
<td>Prior CABG, n (%)</td>
<td>32 (3)</td>
<td>362 (10)</td>
<td>394 (8)</td>
</tr>
<tr>
<td>Serum Creatinine ≥150µmol/l, n (%)</td>
<td>33 (3)</td>
<td>174 (5)</td>
<td>207 (4)</td>
</tr>
<tr>
<td>Current smoker, n (%)</td>
<td>299 (28)</td>
<td>604 (16)</td>
<td>903 (19)</td>
</tr>
<tr>
<td>Worst Killip, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>923 (86)</td>
<td>3,570 (94)</td>
<td>4,493 (92)</td>
</tr>
<tr>
<td>Class II</td>
<td>89 (8)</td>
<td>157 (4)</td>
<td>246 (5)</td>
</tr>
<tr>
<td>Class III</td>
<td>56 (5)</td>
<td>80 (2)</td>
<td>136 (3)</td>
</tr>
</tbody>
</table>

The results show a significant difference in mortality rates between subgroups.
All Cath-PCI patients (N=4,875) None of the nine catheter laboratories had a RAMR significantly higher or lower than national rate (1.23%).

STEMI patients (N=1,068) No STEMI patient died during the study period at Middlemore or Tauranga hospitals. None of the nine catheterisation laboratories had a RAMR significantly higher or lower than the national rate (3.28%).

**Table 2:** Risk-adjusted 30-day mortality rate after PCI (overall) (total number of deaths=60, national rate=1.23%).

<table>
<thead>
<tr>
<th>Cathlabs</th>
<th>Number of patients</th>
<th>Observed deaths</th>
<th>Expected deaths</th>
<th>OMR</th>
<th>EMR</th>
<th>RAMR</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlemore</td>
<td>292</td>
<td>3</td>
<td>2</td>
<td>1.03</td>
<td>0.78</td>
<td>1.61</td>
<td>0.32 4.72</td>
</tr>
<tr>
<td>Auckland City</td>
<td>817</td>
<td>12</td>
<td>14</td>
<td>1.47</td>
<td>1.73</td>
<td>1.05</td>
<td>0.54 1.83</td>
</tr>
<tr>
<td>North Shore</td>
<td>586</td>
<td>2</td>
<td>5</td>
<td>0.34</td>
<td>0.85</td>
<td>0.49</td>
<td>0.06 1.78</td>
</tr>
<tr>
<td>Tauranga</td>
<td>181</td>
<td>2</td>
<td>1</td>
<td>1.10</td>
<td>0.68</td>
<td>1.99</td>
<td>0.22 7.20</td>
</tr>
<tr>
<td>Waikato</td>
<td>729</td>
<td>8</td>
<td>8</td>
<td>1.10</td>
<td>1.15</td>
<td>1.17</td>
<td>0.50 2.31</td>
</tr>
<tr>
<td>Wellington</td>
<td>785</td>
<td>14</td>
<td>10</td>
<td>1.78</td>
<td>1.25</td>
<td>1.75</td>
<td>0.96 2.94</td>
</tr>
<tr>
<td>Nelson</td>
<td>236</td>
<td>5</td>
<td>3</td>
<td>2.12</td>
<td>1.08</td>
<td>2.41</td>
<td>0.78 5.63</td>
</tr>
<tr>
<td>Christchurch</td>
<td>782</td>
<td>10</td>
<td>12</td>
<td>1.28</td>
<td>1.48</td>
<td>1.06</td>
<td>0.51 1.96</td>
</tr>
<tr>
<td>Dunedin</td>
<td>467</td>
<td>4</td>
<td>5</td>
<td>0.86</td>
<td>1.08</td>
<td>0.98</td>
<td>0.26 2.50</td>
</tr>
</tbody>
</table>

**Figure 1:** Risk-adjusted 30-day mortality rates (±95% confidence intervals) after All PCI in New Zealand public hospitals.
Other ACS and non-ACS patients (N=3,807)

None of the nine catheterisation laboratories had a RAMR significantly higher or lower than national rate (0.66%).

**Discussion**

This is the first report of mortality outcomes after PCI procedures in New Zealand. The overall 30-day mortality rate after PCI was low at 1.23%. There were no statistically significant differences in outcomes between the different New Zealand public hospital catheterisation labs.

Although the cohort subgroup definitions were slightly different, the New York State registry for 2010 to 2012 reported a similar overall 30-day mortality rate of 1% (vs New Zealand's 1.23%). Their 30-day mortality rate in emergency cases was 2.77% (vs New Zealand STEMI rate 3.28%) and in non-emergency cases 0.64% (vs New Zealand 'other' rate 0.66%).

In this analysis we chose to report outcomes at the overall catheterisation laboratory level. Each catheterisation laboratory services one or multiple New Zealand district health board (DHB) regions and all the hospitals which assess patients with STEMI.

### Table 3: Risk-adjusted 30-day mortality rate after PCI (STEMI) (total number of deaths=35, national rate=3.28%).

<table>
<thead>
<tr>
<th>Cathlab</th>
<th>Number of patients</th>
<th>Observed deaths</th>
<th>Expected deaths</th>
<th>OMR</th>
<th>EMR</th>
<th>RAMR</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlemore</td>
<td>29</td>
<td>0</td>
<td>1</td>
<td>0.00</td>
<td>2.77</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Auckland City</td>
<td>327</td>
<td>9</td>
<td>10</td>
<td>2.75</td>
<td>3.21</td>
<td>2.81</td>
<td>1.28 5.34</td>
</tr>
<tr>
<td>North Shore</td>
<td>46</td>
<td>1</td>
<td>2</td>
<td>2.17</td>
<td>3.71</td>
<td>1.92</td>
<td>0.03 10.69</td>
</tr>
<tr>
<td>Tauranga</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>2.41</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Waikato</td>
<td>139</td>
<td>5</td>
<td>4</td>
<td>3.60</td>
<td>2.80</td>
<td>4.21</td>
<td>1.36 9.82</td>
</tr>
<tr>
<td>Wellington</td>
<td>179</td>
<td>7</td>
<td>7</td>
<td>3.91</td>
<td>3.68</td>
<td>4.39</td>
<td>1.40 7.19</td>
</tr>
<tr>
<td>Nelson</td>
<td>49</td>
<td>3</td>
<td>1</td>
<td>6.12</td>
<td>2.58</td>
<td>7.78</td>
<td>1.56 22.72</td>
</tr>
<tr>
<td>Christchurch</td>
<td>204</td>
<td>9</td>
<td>8</td>
<td>4.41</td>
<td>3.74</td>
<td>3.87</td>
<td>1.77 7.35</td>
</tr>
<tr>
<td>Dunedin</td>
<td>76</td>
<td>1</td>
<td>2</td>
<td>1.32</td>
<td>2.86</td>
<td>1.51</td>
<td>0.02 8.39</td>
</tr>
</tbody>
</table>

### Table 4: Risk-adjusted 30-day mortality rate after PCI (Other ACS and non-ACS) (total number of deaths=25, national rate=0.66%).

<table>
<thead>
<tr>
<th>Cathlab</th>
<th>Number of patients</th>
<th>Observed deaths</th>
<th>Expected deaths</th>
<th>OMR</th>
<th>EMR</th>
<th>RAMR</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlemore</td>
<td>263</td>
<td>3</td>
<td>2</td>
<td>1.14</td>
<td>0.72</td>
<td>1.04</td>
<td>0.21 3.05</td>
</tr>
<tr>
<td>Auckland City</td>
<td>490</td>
<td>3</td>
<td>4</td>
<td>0.61</td>
<td>0.75</td>
<td>0.54</td>
<td>0.11 1.57</td>
</tr>
<tr>
<td>North Shore</td>
<td>540</td>
<td>1</td>
<td>3</td>
<td>0.19</td>
<td>0.62</td>
<td>0.20</td>
<td>0.00 1.09</td>
</tr>
<tr>
<td>Tauranga</td>
<td>162</td>
<td>2</td>
<td>1</td>
<td>1.23</td>
<td>0.39</td>
<td>2.10</td>
<td>0.24 7.57</td>
</tr>
<tr>
<td>Waikato</td>
<td>590</td>
<td>3</td>
<td>5</td>
<td>0.51</td>
<td>0.77</td>
<td>0.43</td>
<td>0.09 1.27</td>
</tr>
<tr>
<td>Wellington</td>
<td>606</td>
<td>7</td>
<td>4</td>
<td>1.16</td>
<td>0.70</td>
<td>1.09</td>
<td>0.44 2.24</td>
</tr>
<tr>
<td>Nelson</td>
<td>187</td>
<td>2</td>
<td>1</td>
<td>1.07</td>
<td>0.54</td>
<td>1.32</td>
<td>0.15 4.76</td>
</tr>
<tr>
<td>Christchurch</td>
<td>578</td>
<td>1</td>
<td>3</td>
<td>0.17</td>
<td>0.57</td>
<td>0.20</td>
<td>0.00 1.12</td>
</tr>
<tr>
<td>Dunedin</td>
<td>391</td>
<td>3</td>
<td>2</td>
<td>0.77</td>
<td>0.60</td>
<td>0.84</td>
<td>0.17 2.47</td>
</tr>
</tbody>
</table>
suspected coronary artery disease in those DHBs. The outcomes reported are determined by the cumulative impact of all health system processes and interactions from the initial presentation, through the inpatient care to the early post-discharge care. In the catheterisation laboratory the outcomes depend on multiple factors, including patient selection, equipment, nursing and radiographer performance, intensive care unit and surgical support as well as the abilities of the individual interventional cardiologist. Although there have been calls for the reporting of outcomes for individual operators, their performance is only part of the overall system of care, and both the HQSC and health ombudsman have recommended that the appropriate level for reporting to achieve improved quality of care is the overall team level.1,2

Comparison of outcomes between hospitals is also complicated because different hospitals treat different types of patients. Hospitals with sicker patients may have higher rates of complications and death than other hospitals. To allow comparisons between hospitals it is therefore necessary to take account of the differences in patient risk between hospitals. Appropriate risk adjustment requires accurate information regarding the most important determinants of outcome. For PCI these include measures of heart failure (Killip Class), renal function and type of ACS. Those with cardiogenic shock were excluded. The ANZACS-QI registry collects this information prospectively with consistent training, definitions and data entry templates, supported by regular audit.

The clinical data used for risk adjustment in this report is not available in the national administrative data sets, and without the ANZACS-QI registry this report would not be possible. In the longer-term integration of the clinical registries, data collection with the routinely collected electronic health record may streamline the collection of data for this and related reports.

There are challenges in statistically comparing the performance of catheterisation laboratories when the numbers of deaths are quite low. In our analysis we sought to overcome this by reporting the overall ‘All Cath-PCI’ outcomes as well as the subgroups. Despite this, the confidence intervals around the estimates are quite wide, particularly for catheterisation laboratories with smaller volumes. However, the numbers of outcomes per catheterisation laboratory are in a similar range to those reported in the New York State registry. There are several ways the numbers of outcomes could be increased, which can be explored but all have their limitations. Outcomes could be reported for a two- or three-year cohort, rather than a one-year cohort, however, processes and staff change over time and such reporting would be less relevant to current performance. Alternatively, one-year mortality rather than 30-day mortality could be reported. However, one-year outcomes would reflect both the care in the community as well as the immediate hospital performance and so differences would be more difficult to interpret. In addition, reporting would be delayed by nearly a year, thus losing immediacy.

The recent editorial in the New Zealand Medical Journal from the HQSC by Richard Hamblin et al summarises the evidence for potential benefits and risks of public reporting of medical procedures. For PCI in particular, in the US it has been found that patients who underwent a procedure in states with mandated public reporting of outcomes had similar predicted risks but significantly lower observed risks of death.8 However, the use of PCI after MI has been lower in states with public reporting, and while an initial report indicated no difference in mortality between the reporting and non-reporting states,9 a more recent report suggests evidence of higher overall mortality after MI in the states with public reporting. This higher mortality was particularly in those who did not undergo PCI.10 One possible reason for these lower rates of PCI and better results in those who do have PCI is that physicians in states with public reporting may be more reluctant to offer treatment to very sick patients, particularly those with cardiogenic shock. Without revascularisation treatment these patients have a mortality rate in excess of 50%.11 In our cohort there were only 102 such patients, but half of them died, accounting for just under a half of all PCI procedure-associated deaths. However, for these very high-risk patients an emergency procedure is often the best hope, and there is concern both in New Zealand
and internationally that if these patients were included in routine PCI outcome reporting that it would deter clinicians for accepting them for potentially life-saving procedures. To address this concern such patients have been excluded from reporting in more recent New York and Massachusetts reporting. In New York this change has been associated with an increase in the use of PCI for cardiac shock and an improvement in outcomes. Following the more recent New York State methodology we also excluded STEMI patients who presented with cardiogenic shock from our analyses.

There is another similar high-risk group which was not excluded. These are patients presenting after a cardiac arrest who subsequently die, not as a complication of the PCI, but of cerebral hypoxia occurring at the time of the cardiac arrest. In the New York state PCI registry reporting these patients are also excluded so clinicians are not deterred from accepting patients who might have cerebral hypoxia. This outcome has been added to the ANZACS-QI registry and such patients will be excluded in future reporting.

**Limitations**

In this report the focus was on short-term 30-day mortality. Later mortality and other events including readmissions and bleeding complications are also relevant and will be addressed in future reporting. Due to the anonymised linkage methodology used detailed case review to ascertain the cause of death and its relationship to the PCI procedure is not possible.

**Conclusions**

Mortality rates in the first 30 days after PCI are low and comparable across New Zealand public hospitals. The outcomes are comparable with international experience. Release of a consumer version of this report with appropriate interpretation is planned via the HQSC Atlas of Healthcare Variation website.

**Appendix**

The estimated odds ratios, 95% confidence intervals and associated p-values on model predictors were reported below for each analysis cohort.

All Cath-PCI patients (n=4,875)

**Table 1.1:** Logistic regression analysis to predict the probability of 30-day death.

<table>
<thead>
<tr>
<th>Model predictors</th>
<th>Odds ratios</th>
<th>95% confidence interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimate</strong></td>
<td></td>
<td><strong>5% confidence interval</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.953</td>
<td>0.518 1.755</td>
<td>0.8775</td>
</tr>
<tr>
<td>Other ethnicities</td>
<td>reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.970</td>
<td>0.808 4.802</td>
<td>0.1358</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.504</td>
<td>0.109 2.343</td>
<td>0.3824</td>
</tr>
<tr>
<td>Age (year)</td>
<td>1.033</td>
<td>1.006 1.061</td>
<td>0.0179</td>
</tr>
<tr>
<td>Current smoker</td>
<td>0.563</td>
<td>0.221 1.436</td>
<td>0.2294</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.905</td>
<td>1.054 3.442</td>
<td>0.0328</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>2.165</td>
<td>0.993 4.718</td>
<td>0.0520</td>
</tr>
<tr>
<td>Serum Creatinine ≥150umol/l</td>
<td>4.182</td>
<td>2.015 8.676</td>
<td>0.0001</td>
</tr>
<tr>
<td>Worst Killip Class I</td>
<td>reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worst Killip Class II</td>
<td>3.308</td>
<td>1.577 6.940</td>
<td>0.0016</td>
</tr>
<tr>
<td>Worst Killip Class III</td>
<td>7.513</td>
<td>3.727 15.144</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Non-ACS</td>
<td>reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEMI</td>
<td>4.482</td>
<td>2.081 9.652</td>
<td>0.0001</td>
</tr>
<tr>
<td>Other ACS</td>
<td>0.596</td>
<td>0.260 1.367</td>
<td>0.2217</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass grafting; ACS, acute coronary syndrome; STEMI, ST segment elevation myocardial infarct.
### STEMI patients (n=1,068)

Table 2.1: Logistic regression analysis to predict the probability of 30-day death.

<table>
<thead>
<tr>
<th>Logistic regression parameters</th>
<th>Odds ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
</tr>
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<td>Female</td>
<td>1.832</td>
</tr>
<tr>
<td>Other ethnicities</td>
<td>reference</td>
</tr>
<tr>
<td>Māori</td>
<td>3.679</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.221</td>
</tr>
<tr>
<td>Age (year)</td>
<td>1.029</td>
</tr>
<tr>
<td>Current smoker</td>
<td>0.277</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.195</td>
</tr>
<tr>
<td>Prior CABG</td>
<td>5.764</td>
</tr>
<tr>
<td>Serum Creatinine ≥150umol/l</td>
<td>5.445</td>
</tr>
<tr>
<td>Worst Killip Class I</td>
<td>reference</td>
</tr>
<tr>
<td>Worst Killip Class II</td>
<td>2.602</td>
</tr>
<tr>
<td>Worst Killip Class III</td>
<td>5.330</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass grafting; ACS, acute coronary syndrome; STEMI, ST segment elevation myocardial infarct.

### Other or non-ACS patients (n=3,807)

Table 3.1: Logistic regression analysis to predict the probability of 30-day death.

<table>
<thead>
<tr>
<th>Logistic regression parameters</th>
<th>Odds ratios</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Estimate</td>
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</tr>
<tr>
<td>Māori</td>
<td>0.566</td>
</tr>
<tr>
<td>Age (year)</td>
<td>1.036</td>
</tr>
<tr>
<td>Current smoker</td>
<td>1.589</td>
</tr>
<tr>
<td>Diabetes</td>
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</tr>
<tr>
<td>Prior CABG</td>
<td>0.953</td>
</tr>
<tr>
<td>Serum Creatinine ≥150umol/l</td>
<td>3.174</td>
</tr>
<tr>
<td>Worst Killip Class I</td>
<td>reference</td>
</tr>
<tr>
<td>Worst Killip Class II</td>
<td>4.614</td>
</tr>
<tr>
<td>Worst Killip Class III</td>
<td>13.389</td>
</tr>
<tr>
<td>Other ACS</td>
<td>0.566</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass grafting; ACS, acute coronary syndrome; STEMI, ST segment elevation myocardial infarct.
Competing interests:
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ANZACS-QI Project management: Kristin Sutherland, Charmaine Flynn (Northern coordinator), Maxine Rhodes (Southern coordinator).

Data management and analysis: Mildred Lee, Michelle Jenkins, John Faatui

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URL:
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Where to from here?
Posthumous healthcare data, digital e(lectronic)-mortality and New Zealand’s healthcare future

Katie Hoeksema, Richman Wee, Alastair Macdonald, Parry Guilford, Jesse Wall, Jon Cornwall

ABSTRACT
Ongoing improvements in digital data acquisition and storage has led to the phenomenon of e(lectronic)-mortality, where digital data can now exist for a potentially infinite period. Globally, many countries are facilitating the acquisition and researcher-led access to large-scale, population-based digitised healthcare data sets. Their utilisation has led to numerous positive advances in healthcare. New Zealand’s medical record system is becoming increasingly digitised, and as a consequence there will be an ever-increasing resource of posthumous healthcare data stored digitally, including genomic information. Such data could be utilised for research purposes, and developing such a consolidated resource could improve healthcare outcomes in our own nation and allow us to parallel global progress in healthcare research trends.

This viewpoint article explores the issues surrounding, and potential for utilisation of, a national resource of posthumous digital healthcare data. Currently, there appear to be no legal barriers to the large-scale acquisition and utilisation of posthumous healthcare data in New Zealand, however, previous legislation may not have been developed with developments in technology or e-mortality in mind. Ethically, culturally and socially there are many challenges to address, including issues surrounding obtaining consent, respecting privacy, management of incidental findings, maintaining anonymity and ensuring community support for such a resource. Despite the potential for widespread health benefits that utilisation of posthumous healthcare data in this country may facilitate, wide and ongoing consultation is required to examine how such a precious resource can be enabled for the downstream benefit of all New Zealanders.

Digitisation of health data, including medical records and genomic information, is becoming common practice in many countries around the world. With this improvement in digital technology, a new phenomenon has emerged because of the indefinite period that information can now be stored: an era of ‘e(lectronic)-mortality’ has arrived, where digital information can potentially exist, and be accessed, for an infinite period. As a consequence of these new developments there are major ramifications in many different areas, and particularly in regard to health research where large data sets are a rapidly developing reality.

Coinciding with recent advances in digital technology and information storage is the development and utilisation of genomic medicine. The parallel growth within both domains has serendipitously provided the foundation for large-scale studies involving digital health data. Globally, many studies are being conducted that allow scrutiny of health data from large populations to further an understanding in such areas as disease processes, drug interactions and epidemiology.1-3

New Zealand’s medical record system is increasingly becoming digitised in order to increase efficiencies in our health system. It is therefore timely to reflect
on the choices available in the context of the posthumous use of digital healthcare data. New Zealand’s digitised healthcare data, and in particular digitised genomic data, could be used posthumously and has useful potential to advance the diagnosis and treatment of diseases. Healthcare data digitisation has allowed large-scale genomic sets of data to be used for research that has societal benefit at a personal, community and nationwide level. Although large digitised healthcare sets are being developed and used in other countries, this is a ‘new’ resource in our country, and its potential adoption, utilisation and implementation as a resource in a specifically ‘New Zealand’ context requires consideration.

Science and medicine: current technology and the utility of digitised health data

Genomic data is derived from examination of a person’s DNA, with the information stored via digital file. Genome-wide studies can uncover associations between genetic variation and medical conditions that cannot be diagnosed from the bedside. It follows that the use of this technology has great potential to advance the diagnosis and treatment of diseases. Scientific progress using genomic information will develop most rapidly through widespread access to genomic data that is linked to healthcare information gathered by agencies and biobanks. Furthermore, this data has the potential to be shared across research projects in order to address a wide range of research questions.

Digitisation of healthcare records can potentially allow genomic data sets to be used for collaborative research, and this has potential for wider societal benefit. In order for this information to be widely applicable across multiple research fields and retain its value in the future, data is required to be presented in a standardised format. This may include information such as nutrition, medications and illness outcomes. Information that is presented in such a format can then be processed, collated and examined in a similar manner to produce high-quality outcomes. The subsequent use of digital, post-mortem health information in research could then be utilised to reveal genetic links to specific diseases and explore how effective different medications might be for different individuals. Expanding this technology to large-scale genomic data sets sequenced from entire genomes may elucidate secondary associations when pooled with data from other individuals, and has a direct medical application. This could mean potential improvements in selecting drugs to maximise their efficacy for individual patients, or advances in the diagnostic accuracy of rare conditions, which would translate to improvements in New Zealand’s healthcare, including research that specifically examines and provides benefits for Māori and Pacific populations. The use of human data in this digitised manner will also allow scientific and medical advances in New Zealand to parallel global progress.

Utilisation of digital healthcare data: global trends

Globally, many countries have initiated large-scale digitisation of healthcare records, and are using these for research purposes. Numerous research successes from investigations via genomics have been seen in many countries, with collaborative digital databases revealing genetic associations with multiple cancers, identified mechanisms for cancer development, revealed genetic causes of smoking behaviour and identified genes involved in body fat distribution. Over the last two decades, Iceland has used a large database to advance population genetics and uncover genes involved in various diseases. This project has been supported within the community, with half the population participating in research projects. The UK Biobank collects prospective lifestyle information, medical information and biological samples from 500,000 consenting adults, with consent permitting the use and retention of posthumous data.

In Estonia, the Human Genes Research Act (2000) was implemented to encompass the use of genotypes, phenotypes, health and geographical information, with participants giving broad informed consent. The national genetics research database in Iceland integrates genealogical and genetic
data under the Health Sector Database Act (1998), with existing medical records of citizens computerised and integrated into the database without requiring consent from the individuals. However, individuals can opt out of this project to withhold their medical information.13

The Biobank Act (2012) in Finland supports research using human biological material and technical records of the material, including global collaborations. Similarly, existing clinical and research samples can be transferred to the biobank provided the individual does not opt out, and there has so far been no indication that the person, if they were alive, would object to the use of the samples.14 In Poland, collection of human tissues and cells is governed under the Cell, Tissue and Organ Recovery, Storage and Transplantation Act, which also reversed the system of acquiring consent; consent is presumed and prospective donors can opt out of this system to retain their autonomy.15

In countries where an opt-out system is implemented, the relatives of the deceased are also entitled to oppose donation at the time of death to avoid additional psychological stress.16 While there have been many positive outcomes from large-scale utilisation of digitised healthcare information presented above, there are also issues that have generated debate on the nature of the informed consent and of appropriate use of the acquired data from large-scale and national healthcare-information databases.

Legal and ethical considerations

A major challenge associated with posthumous healthcare research is ensuring that the data is used in an appropriate way. The legal perspectives on the use of human data were established at a time when digital technology was in its infancy and e-mortality was not a relevant consideration, before digital storage and widespread genomic investigations were common. Current research policies address the use of genetic material of living participants, but few consider what happens to this data following the death of the individual and subsequent information disclosure for further research. It is therefore relevant to examine some of the issues surrounding the use of posthumous, digitised healthcare in New Zealand. These include the legal and ethical rights to use, consent, anonymity and issues underpinning the ethical right to use.

Considerations surrounding legal right to use

There are currently no legal barriers to the posthumous use of digitised healthcare information in New Zealand. Use of posthumous, digitised healthcare information may seem, at face value, to be a breach of privacy. However, the Privacy Act (1993), which aims to promote and protect individual privacy, defines an individual as a natural person other than a deceased natural person.17 Therefore, legally, a deceased individual cannot have their privacy breached when they are no longer alive to be harmed.18

The duration for which posthumous healthcare data can be used following acquisition is not specifically legally restricted. The Health (Retention of Health Information) Regulations apply to health information of an identifiable individual, and define an individual as a natural person, including a deceased natural person.19 The regulations state that health information must be kept for 10 years (Section 5). However, in the context of using posthumous health information for research, the maximum duration for which data can be stored and used is not specified in the above regulations or in the Standard Operating Procedures for Health and Disability Ethics Committees.20

The HIPC (Rule 9) states “A health agency that holds health information must not keep that information for longer than is required for the purposes for which the information may lawfully be used”.21 The Code acknowledges that there may be plausible reasons for which records can be retained after they are no longer relevant to their primary purpose, as long as there is still some lawful purpose. Information which is stored by health agencies is covered under the rules of disclosure under the HIPC for 20 years beyond the death of an individual. There is a further acknowledgement that health information can still be sensitive after a person has died. Therefore, healthcare information is currently held by health boards
and healthcare providers, who have a duty of care that encompasses use of the information. However, there is no legal barrier to the use of such information for research purposes, and no restriction to the length of time that such information can be used.22

Comprehensive collation of healthcare information increases the likelihood of discovering incidental findings, particularly when examining genetic data. The identification of incidental findings has impact on family members and relatives who may be affected, such as when diseases and heritable disorders are recognised. Procedures regarding disclosure of information and providing treatment to those individuals who are then classified as ‘at-risk’ should be established to manage this information, with decisions made in regard to how incidental findings would be used. In a survey conducted in Australia, the majority of citizens stated they would like to be informed of any incidental findings in their data, although the extent of desired information differed between individuals.23

Consent
An inherent difficulty with posthumous data is that patients are unable to consent after their death. While many legal and ethical guidelines exist regarding the acquisition and use of healthcare data for individuals that are alive, it is unclear how this applies to the use of posthumous digitised healthcare data. In the case of utilisation of public healthcare records, discussion with the wider public and consumer groups is required as to determine how consent processes should be implemented, with this including consideration of options such as opt-in and opt-out consent processes.

There is also the question of who has the authority to consent to the acquisition of genomic data on behalf of the deceased. The deceased have no way of implementing an action unless they have explicitly stated their wishes prior to their death, and people do not tend to make decisions regarding the posthumous applications of their medical information.21 The wishes of an individual regarding the course of action for their body after their death may differ from those of the family, yet as it stands the family has the final say.18 Currently in the US, a biospecimen can be used in a research capacity without explicit consent, provided the sample has already been collected for another purpose.25 Similarly, The Royal Liverpool Children’s Inquiry recommended that once informed consent has been obtained for a tissue specimen, consent should remain valid, provided the specimen is used for ethically approved research projects.26 This would prevent repeated requests to the next of kin for consent, and allow data to be used for new projects.

The above examples provide a consent pathway for downstream posthumous tissue use, however, this is only for current or previous research projects and does not provide the benefit of gaining access to data from a larger cohort. It does, however, suggest a precedent for gaining one consent during a person’s lifetime and having this support posthumous information use. Wide consultation is therefore required to examine what sort of consent framework could be implemented that would satisfy New Zealand’s culturally and ethnically diverse community.

Anonymity
Anonymity is difficult to adhere to as much genetic data is correlated with medical (and therefore personally identifiable) information. The HIPC (Rule 10) states “A health agency that holds health information obtained in connection with one purpose must not use the information for any other purpose unless the health agency believes... that the information is used in a form in which the individual concerned is not identified; or... is used for research purposes and will not be published in a form that could reasonably be expected to identify the individual concerned.”21 To effectively utilise digitised healthcare data, some elements of personal and medical information are required, however, issues surrounding the security and privacy of digital healthcare resources have been raised.22 The specific issues were in regard to the implementation of digitisation and integration of a large number of health records, and with particular reference to anonymisation. Anonymous data implies it has been collected and used without any associated personal identifiers, and useful genomic data may never be truly
anonymous. In addition, with the increase in publicly available data bases, large-scale data linkage between healthcare data and personal information also becomes more possible, further decreasing the potential for ‘true’ anonymisation. Data linking in New Zealand is already possible by use of the Information Data Infrastructure, a digital resource which stores data from a range of government and non-government organisations. There is therefore the necessity to differentiate between data being sufficiently anonymous for the purposes of legal and ethical standards, and data being ‘truly’ anonymous in a scientific sense, in order to inform guidelines for utilisation of digital healthcare information.

The development of a controlled, digitised database where medical records are integrated across the population provides an elegant solution to attenuate challenges associated with anonymity. Data is separated from any identifying information and coded in a secure database to ensure privacy to the individual in the future. Protection of electronic data is important, particularly when data may be shared globally. In Estonia, a chief processor only releases data in a coded form and any identifiable data cannot be accessed through an external network to ensure secure use and storage of genomic data. Similarly, digital data collected by the UK Biobank is separated from any identifying information by coding it in a restricted-access database.

Issues underpinning the ethical right to use

As presented, there appears to be no legal barrier to the use of posthumous, digitised healthcare information in New Zealand, though this does not mean it should be performed. The way scientific research is conducted and how findings are disseminated into the community influence the support or objection of the public. The Royal Liverpool Children’s Inquiry was conducted following the revelation that organs and tissues were being retained from deceased children and babies without the knowledge of the parents. During this inquiry, parents expressed that they would have considered donating tissue from their children for education or research if they had been approached in an open manner. However, the betrayal of trust without permission reduced the faith they have in the medical profession, signalling the important role of communication in generating support for healthcare research.

Community support and acceptance of an accessible digital healthcare database is essential to prevent ethical repercussions, with transparency and communication between researchers, healthcare professionals and the public regarding the acquisition and intended use of digitised healthcare data paramount to maintaining social support. Sharing information of the deceased without prior consent may violate their pre-mortem wishes, yet withholding such information from medical research may prevent a potential benefit that could be delivered to society. Therefore, the decision to allow use of healthcare information of the deceased must be weighed carefully, with full consideration of the range and scope of the potential benefits and risks associated with such access.

Conclusion

New Zealand has a history of being a pioneering country that brings about change through public, community and cultural support, and has already proven itself capable of undertaking large-scale research projects that span over decades. A small nation with an established health system coupled with the technology to support a digital database presents an ideal opportunity to develop a unique platform for biomedical research using posthumous, digitised healthcare data. Such a resource would assist our understanding of the relationship between genetics, environment and disease, facilitate improved drug administration and create new opportunities for prevention and treatment in healthcare, including those that benefit European, Māori and Pacific populations.

There are currently no apparent legal barriers prohibiting the utilisation, for research purposes, of posthumous digital healthcare data in New Zealand, and the barriers to its use appear largely ethical. However, this does not necessarily mean it should proceed on an organised basis, with decisions on consent, anonymity and ethical use requiring further consideration. Establishing and accessing such a resource will require strict oversight in order to prevent
misuse or exploitation, and to establish trust between those gathering the data, those utilising the information, and the public who will be contributing to it. Further discussion is required in order to explore the idea of utilising digitised healthcare data on a national scale in order to discover whether and how such utilisation should occur. If a decision to proceed is forthcoming, the implementation and introduction of appropriate systems to regulate e-mortal healthcare data in New Zealand’s unique cultural, social and ethnic environment can then be planned through appropriate consultation. Failure to undertake consultation and implement frameworks that are appropriately informed has the potential to undermine any trust in the relationship between those giving and those utilising digitised healthcare information. Undertaking wide and thorough consultation is therefore necessary to establish a robust and evidence-based platform that can guide stakeholder behaviour.

New Zealand currently has the opportunity to establish a system that effectively and efficiently utilises posthumous digitised healthcare data. Implementing a system that does this in an ethically and culturally appropriate manner will enable New Zealand to provide more effective healthcare for its citizens and remain at the forefront of healthcare research. There are inherent problems associated in the utilisation of such digital information following death, and undoubtedly new legal and ethical situations will continue to unfold with advancing technology. However, these should not be seen as permanent barriers to the implementation and use of a successful and effective system that allows posthumous digital healthcare data to be sensitively and effectively utilised. Similarly, the risks of allowing posthumous digital healthcare information to be utilised must also be considered in any decision about information use, including the potential range and scope of any proposed benefits. Wide and appropriate consultation should be undertaken in order for participants and end-users to contribute perspectives on a collective way forward and guide appropriate utilisation of this precious resource. The development of such a uniquely ‘New Zealand’ resource will likely provide benefit for all New Zealanders over time, with its establishment echoing global trends in healthcare research.

Competing interests:
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A 34-year-old male presented with a two-day history of fever and pain while swallowing. On examination the patient was febrile, dyspneic and his saturation was 88% on room air. The plain x-ray lateral view of the neck revealed ‘thumb sign’ (Figure 1) typical of acute epiglottitis. The patient was treated with ceftriaxone, dexamethasone and humidified oxygen and was closely monitored for any airway compromise. He recovered completely and is asymptomatic at five months of follow up. Acute epiglottitis is cellulitis of the epiglottis and adjacent tissue. The most common pathogen in unimmunised children is *Haemophilus influenzae* type b and in adults are Staphylococcus aureus and *Streptococcus pneumoniae*.

Non-infectious causes include thermal injury, trauma, caustic ingestion and foreign body impaction. Patients present with fever, odynophagia, muffled voice, drooling of saliva and stridor. Diagnosis is by lateral cervical spine x-ray, which shows the characteristic thumb sign, although it may be absent in early stages.

The differential diagnosis includes peritonsillar abscess, croup and retropharyngeal abscess.

Treatment is by third generation cephalosporins and steroids; other supportive measures include humidified oxygen.

The risk of death due to sudden airway obstruction is high, therefore close monitoring of these patients is of utmost importance.

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**Figure 1:** Plain x-ray of the neck lateral view showing a swollen epiglottis ['Thumb sign', arrow].
Competing interests: Nil.

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REFERENCES:
A villous adenoma of bladder/urachus origin located in the perineum

Calum Fraser, Frank Frizelle

A 60-year-old male with a background of congenital bladder extrophy presented with a painful pelvic mass after riding a push bike and sliding off the seat onto the cross bar. As a child (>50 years ago) he had undergone an abdominal perineal resection and formation of an ileal conduit, the records of which were not available.

The mass described was first noted by the patient as a non-painful lump in July 2013 and assessed with USS, which described a superficial perineal lump with complex cystic-solid characteristics communicating with a deeper tract and central pelvic cyst. No communication with other pelvic structures were identified. This was originally thought to be malpositioned seminal vesicles. MRI was recommended and this reported a 100x50x70mm multiloculated cystic lesion with components deep and superficial to the pelvic floor musculature. It was described as non-specific but had benign features without any identifiable solid component. A follow-up MRI in 2014 showed a small increase in the size of the lesion with unchanged characteristics.

At this time it was felt this represented a lymphatic malformation/lymphocele. The patient remained asymptomatic and a watch and wait approach was taken. Yearly monitoring continued to show a slow increase in size only (Figure 1).

When the patient developed pain in autumn 2016 after blunt trauma, a more definitive management option was explored. Blood tests including CRP and PSA were normal. After consideration of possible options, the decision was made to surgically excise the lesion (Figure 2).

Histology of the cystic perineal lesion showed macroscopic findings of an ovoid nodule of tan fibrous tissue 80x70x45mm. Microscopic findings showed mucin-filled spaces within fibrous tissue. There was no evidence of high-grade dysplasia or other features of malignancy. The features were

Figure 1: Last pre-operative MRI scan in 2016 showing the perineal cystic lesion.
of a villous adenoma of bladder/urachal origin. Excision with clear margins was thought to be curative.

The patient was discharged the following day and made a good recovery. The agreed course of follow up was with repeat MRI. He remains pain free and has developed no long-term complications.

Discussion

Villous adenomas of the urinary system are rare.\textsuperscript{1,2,4,6} There are no cases available in the literature describing these lesions of bladder/urachal origin found outside the urinary system in the perineum. They have been found in the bladder, urachus, renal pelvis, ureter and urethra, and have morphologic features similar to those of the colonic adenomas.\textsuperscript{1,3,4}

There are reports in the literature showing bladder/urachus villous adenomas associated with malignant tumours including adenocarcinoma, squamous cell carcinoma and urothelial carcinomas, which can metastasize or recur after initial management.\textsuperscript{2,3,5,6} It is therefore crucial to obtain tissue for histology to achieve a formal diagnosis and determine if further investigations are needed and what management is required.\textsuperscript{5,7} Good clinical outcomes have been observed in patients with isolated villous adenoma or villous adenoma plus adenocarcinoma in situ after complete surgical resection, with rarely any recurrence.\textsuperscript{5,7} Those cases with co-existing adenocarcinoma or other invasive malignancies do less well and may experience metastases or recurrence requiring further investigations and management options.\textsuperscript{3}

Learning points

In conclusion, villous adenomas of bladder/urachal origin found in the pelvis/perineum are rare with no previous examples described in the literature. These lesions can be slow to increase in size and patients can be asymptomatic. These lesions can often be associated with malignancy so histology is of high importance. This case report highlights that complete surgical excision of these lesions with clear margins can result in good clinical outcomes.
Competing interests: Nil.

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I would like to thank the patient for allowing them to share their case and imaging. I would like to thank Professor Frizelle for his assistance and time in putting this case report together.

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REFERENCES:
Neuraminidase inhibitors during pregnancy and risk of adverse neonatal outcomes and congenital malformations

Neuraminidase inhibitors such as oseltamivir or zanamivir are often used as treatment for, or prophylaxis against, influenza. However, doubts have been raised about the safety of their use in pregnant women.

This concern is evaluated in this population-based cohort study. It included almost 6,000 exposed infants and 700,000 unexposed infants. Exposure was defined as the mother having a prescription for either of these drugs during pregnancy. The study did not assess risks of adverse outcomes before gestational week 22.

The findings suggest that the use of neuraminidase inhibitors is not associated with increased risks of adverse foetal or neonatal outcomes.

BMJ 2017; 356:j629

Triggering of acute myocardial infarction by respiratory infection

There is increasing recognition that myocardial infarction (MI) can be precipitated by a respiratory infection, with evidence indicating that pneumonia, bronchitis and influenza confer an increased transient risk of MI. The authors of this paper note that most of the previous studies have been conducted without angiographic confirmation of the MI.

In their study, 578 patients with an angiographically confirmed MI were evaluated with respect to whether or not they had experienced a respiratory infection. Symptoms of respiratory infection were reported by 100 (17%) and 123 (21%) within seven and 35 days, respectively, prior to MI. The relative risk for MI occurring within 1–7 days after respiratory infection symptoms was 17.0

These findings confirm previous reports of the association.

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Rivaroxaban or aspirin for extended treatment of venous thromboembolism

The direct oral anticoagulant rivaroxaban is considered to be superior to warfarin in the management of these conditions. This study reviews and compares the effects of the long-term use of rivaroxaban and aspirin.

In this randomised trial, the researchers assigned 3,396 patients with venous thromboembolism to receive either once-daily rivaroxaban (at doses of 20mg or 10mg) or 100mg of aspirin. Both doses of rivaroxaban were found to be superior to aspirin in reducing the risk of recurrent thromboembolism. The risk of bleeding was similar in all three groups.

It was concluded that the risk of a recurrent event was significantly lower with rivaroxaban at either a treatment dose (20mg) or a prophylactic dose (10mg) than with aspirin, without a significant increase in bleeding rates.


URL:
The Hon. Mr. Russell, Minister of Public Health, when he attended the meeting of the Council on 12th June, expressed his pleasure at meeting the executive of a profession the members of which, at great sacrifice to themselves, had so willingly and ungrudgingly assisted the Government since the war started. He understood from the Chief Health Officer that one medical man was required for every 2000 of the population. Since the war started the proportion had been reduced to very near the danger-line, and the demand on the part of the military authorities for medical men still continued. The Hon. the Minister of Defence had stated that he could get the men he wanted for service in connection with the soldiers, and the matter was absolutely in his hands. But no account had been taken by the military authorities up to the present of the needs of the civil population, and the time had, in his (Mr. Russell's) opinion, come when the necessities of the civil population must be considered. He did not anticipate any difficulty as regards meeting the demands of the military authorities for the remainder of the war, but he could not shut his eyes to the fact that already they were feeling a tremendous strain with regard to the necessities of the civil population.

At the present time along about 300 miles of the West Coast of the South Island there was only one medical man, and although the population in that district was sparse it was impossible that a medical service over so extensive an area of country could be run effectively by one doctor, and the Inspector-General did not know where to look for another man. There were other places in New Zealand which previously were carrying two and three doctors fully employed, and which now had only one. Applications had been made to have the doctors’ residences connected by telephone with all sorts of outlying places, in order to meet urgent calls, but such a scheme was utterly impracticable. The question for him to consider now was how to set up a scheme by which in a large scattered district a medical man could be provided.

He could hardly expect busy men to leave their practices and their patients and their responsibilities in the cities to offer to go out into a scattered district voluntarily. Some men might be prepared to do it, but the question arose whether, in a matter of this kind, there should not be something in the nature of equality of sacrifice. This was why, in his letter to the Association dated 31st May, he had ventured to express the opinion that the voluntary system, even backed by an Advisory Board, was unworkable. So far as it was possible to utilise the services of the proposed Advisory Board he was prepared to accept it. The Minister of Defence said it would not be necessary to set up an Advisory Board simply to deal with military requirements.

As regards the civil services, he (Mr. Russell), with the session in view, felt bound to make provision for all contingencies. If he could not get medical men voluntarily, then some means must be provided for obtaining them compulsorily, and what he had in his mind was this: to set up machinery by Act of Parliament which could be utilised if necessity arose for mobilising the medical services of the country. It would be a very difficult Bill to draw up, but he would give his guarantee that every safeguard that could be suggested to prevent injustice would be provided. He would refer to a paragraph in the “British Medical Journal” which stated that at a conference of Local War Committees for Scotland the following resolution was adopted: “That this conference of secretaries of Local War Committees, being informed that further substantial calls are likely to be made on the profession, is of opinion that these calls can only be met by mobilising the whole profession.”
If this recommendation was given effect to it meant that every medical man came under the control of the Government for military service or home service until the war was over. In his opinion the conditions in New Zealand as regards sparseness of population and in other respects approximated to some extent those of Scotland. It was in the working out of the details of the problem that difficulties presented themselves. He would not feel disposed to say that a man who was making, say, £2000 a year should be sent to a district where his income would only be £500 a year for the remainder of the war, while another medical man in the same street who had been making only £300 a year should remain behind without making any sacrifice at all. The scheme must make provision, as far as possible, for equality of sacrifice. He was prepared to accept the policy of the Medical Association, and lay it down, if necessary, by statute, that, while the war was on, any doctor who newly registered in New Zealand must offer his services to the military authorities or the public health authorities at whatever salary might be determined before being allowed to enter into private practice.

Dr. Guthrie: Could such a provision be made retrospective and applied to men who have registered since the war began?

The Hon. Mr. Russell said that would be impossible. A hint had reached him the other day that if he were to utter one word there would probably be a hundred medical men over from America as soon as a ship could bring them, and no doubt members of the Council had noticed in the press that he had received a letter from the Japanese Consul at Sydney asking him the terms upon which medical men fully qualified, belonging to Japan, could come and join New Zealand, and he was sending an answer to that communication that day. It would be quite impossible to impose such a condition with regard to doctors who had come to New Zealand since the war started, though Parliament would probably agree that such a clause would be quite fair as applied to those who might come in hereafter. With regard to the remuneration of the men who might be sent compulsorily to districts requiring them, his idea was that it should be much on the same basis as that of medical officers on military service. A captain's pay was about £560 per annum. The Government would be prepared to guarantee that. Of course, if a doctor was making, say, £1000 a year out of the practice it would not be necessary for the State to pay anything, but the salary could be guaranteed.

A member: What about means of conveyance?

The Hon. Mr. Russell thought, where necessary, motorcar and upkeep of car might be provided. There would be no difficulty in getting from the Defence Department an estimate of what the position of a captain was worth, and his opinion was that where compulsion was applied the income of the civilian doctor who went into the field to work for the people of the country should be not less than that which the military were paid. That should be guaranteed. He thought they could start upon that basis.

In reply to questions, Mr. Russell said probably the basis he had mentioned was not high enough. If a doctor was sent into a district where the farmers were doing well he might make anything £1000 to £2000 a year. He was quite prepared to ask his colleagues to take into consideration the question of establishing a pension system for medical men who might die while on home service. He would be pleased to meet the Council again after they had considered the proposals he had placed before them.

The Chairman thanked the Minister for his kindness and consideration in attending the meeting and explaining the proposals of the Government, and the Minister withdrew.

URL:
Towards 3D culture models for the investigation of adipocyte/tumour interaction

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The tumour microenvironment (TME) encompasses the tumour and its surrounding area; it consists of many types of cells, extracellular matrix and also additional physical factors, including nutrient and oxygen gradients and mechanical rigidity. In traditional 2D cell culture, the impact of the TME on cancer cells is understudied, largely due to impracticality of incorporation of other cells. Using a two-dimensional (2D) transwell co-culture is one method of incorporating at least one other cell type. We have successfully used this system to show that adipocytes can interact with breast cancer cells in vitro and that this interaction enables breast cancer cells to survive chemotherapy doses that would otherwise be lethal.

Aim

The aim of this study was to further investigate adipocyte-breast cancer interactions by developing novel three-dimensional (3D) co-culture systems to grow human breast adipocytes and breast cancer cells together. Mature breast adipocytes were either encapsulated in 5% gelatin hydrogel alone or in a mixed co-culture with breast cancer cell lines (MCF7; ER+, PR+, HER-), (MDA-MB-231; ER-, HER-, PR-) and (HCC1954; ER-, PR-, HER+). Breast cell lines were also grown alone in 5% gelatin hydrogel. Cell viability and metabolic activity of the cells and the co-cultures was assessed using Alamar Blue assay, and immunofluorescence staining for ki67 was used to determine proliferation.

Results

The 3D cultured cancer cells, and 3D co-cultured adipocytes and cancer cells remained functionally viable after seven days of encapsulation in 5% gelatin hydrogels. After seven days, the breast cancer cells co-cultured with adipocytes appear more metabolically active and proliferative than the same cells grown alone.

Conclusion

Development of more physiological 3D models in which to test drug effects and study breast cancer-stromal cell interactions will improve our understanding of the mechanisms involved in breast cancer progression and may ultimately lead to improved outcomes for breast cancer patients.
PCR, mass spectrometry and massively parallel sequencing.

Results
In the course of work carried out at CHL in various pathology disciplines, some findings warrant further investigation, usually involving other laboratories within the organisation or with another diagnostic laboratory or university. In these instances, we liaise and collaborate with a diverse range of medical or research institutions and colleagues nationally and internationally to progress a diagnosis and report novel findings in peer-reviewed journals.

Conclusion
Collaboration and inter-laboratory discourse is essential for the provision of tertiary-level diagnostic care in the New Zealand health system.

Longitudinal monitoring of brain development in ovine NCL

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Aims
The neuronal ceroid-lipofuscinoses (Batten disease, NCLs) are fatal neurodegenerative childhood diseases caused by mutations in 13 different genes. Progressive brain atrophy is a defining feature, including in ovine CLN5 and CLN6 forms studied as human disease models. Ongoing gene therapy trials have shown remarkable efficacy indicated by longitudinal in vivo assessment of brain atrophy using intracranial volume (ICV) as a measure of brain size.

Methods
Computed tomography (CT) measurements of ICV and post mortem measurements of brain size yielded a 1:1 ratio of ICV:brain size in both affected animals (n=11) and controls (n=14). Longitudinal ICV changes in CLN5-/- (n=6) and CLN6-/- (n=6) animals and controls (n=12) were determined in a CT study over 3–19 months.

Results
In all animals, ICV development was non-linear. Controls reached maximum ICV at about 15 months and plateaued thereafter. In affected animals, ICV also increased initially but then declined progressively (p<0.05) between 5–13 months (CLN5-/- animals) and 11–15 months (CLN6-/- animals).

Conclusions
ICV is a good surrogate for brain size in growing and NCL-affected sheep. Longitudinal monitoring of ICV greatly simplifies in vivo treatment trials, as fewer animals yield robust data.

Sex hormones, mood, cognitive function and emotion processing in women

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Background and Aims
Conditions associated with abnormal levels of sex hormones (androgens), such as poly-cystic ovary syndrome (PCOS), are common clinical presentations of females referred to gynaecological endocrine clinics. These conditions are associated with many unwanted symptoms, including mood disturbance. Mood disturbance itself also has a number of features, including cognitive impairment and difficulties with emotion processing. Thus, there are likely to be many women in the general population who have depression and cognitive impairment as a result of untreated androgen dysfunction. There is limited research aiming to examine directly the relationship between androgen levels and mood disturbance in females, even though doing so could have significant benefit in choosing the most suitable treatment option for depressed females in mental health services who present with abnormal levels of sex hormones.

Development of a predictive model for pulmonary elastance

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Aims
Mechanical ventilation is a core intensive care therapy for patients suffering from respiratory failure. Lung stiffness and airway resistance are very different between patients and depend on their condition. Optimising mechanical ventilation for the individual patient without causing damage to the lung is complex in practice. Model-based ventilation can aid this clinical practice by providing a description of a patient’s lung elastance and airway resistance.
Methods
Previously, spring-mass-damper models have been used to describe lung mechanics. However, it has been found that elastance and resistance vary with pressure and flow throughout each breath. Basis functions have been developed to capture this behaviour. In addition, they appear to be able to predict the impact that changing PEEP levels will have on lung mechanics.

Results
Fitting a range of recruitment manoeuvres across four sets of patient data from the Christchurch ICU has shown good results. Prediction using elastance and resistance results from PEEP 14 to estimate behaviour at PEEP 18, 22 and 26 cmH₂O is also showing promising initial results with errors ranging from 2.5 to 9%.

Conclusions
Once verified on more patient data, this model will allow more robust ventilation treatment plans to be developed, maximising oxygenation while minimising lung damage.

In-silico modelling of aortic arch haemodynamics for surgical implant testing
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Cardiovascular diseases (CVD) are a leading cause of morbidity and mortality; 17.5 million people died from CVD in 2012, representing 31% of all global deaths (Organisation 2012). Healthy and dysfunctional haemodynamics in the aortic arch and its peripheral arteries are still not fully understood. Cardiovascular stents used to treat some forms of CVD cause poorly understood changes to haemodynamics and in some cases can cause damage. This presentation is about in-silico modelling of the aortic arch haemodynamics for different disease states and stent designs. The modelling will be accomplished by fabrication of compliant silicone phantoms and particle image velocimetry flow visualisation.
Two recent events in March 2017 (‘The Diabesity Crisis’ Symposium and the ‘Cost of Sugar’ Forum) hosted in Auckland by the Edgar Diabetes & Obesity Research Centre (EDOR) and two National Science Challenges: Healthier Lives and A Better Start aimed to be more than just another ‘talkfest’ about the related epidemics of obesity and type 2 diabetes (T2DM) in New Zealand.

The organisers asked a group of international and national speakers with expertise in epidemiology, endocrinology, genetics, Māori health, nutrition, physical activity, public health and clinical medicine to summarise the current state of knowledge and new research in order to identify priorities for action.

Given the ever-increasing number of obese children and adults in New Zealand, many with T2DM, developing a rational approach to prevention and management is essential. An important first step is the acceptance that obesity, if untreated, is a chronic progressive disease associated with the early development of comorbidities and reduction of life expectancy. Rachel Batterham, Tony Merriman and Dave Grattan all emphasised the role of genes and the powerful biological mechanisms which can explain how overweight and obesity develop as a ‘normal’ response to the current ‘obesogenic’ environment. Increasing awareness that obesity, like other major chronic diseases, results from an interaction between biology and environment helps to shift the dialogue from a position of blame to one of solution and the development of a more rational approach to management.

What then should we offer to the obese patient? An important message to be taken from Rachel Batterham’s presentation is that powerful biological mechanisms also hamper maintenance of initial weight loss achieved by energy restriction. So, approaches which provide long-term support and encouragement are essential. These include targeting physical activity, sedentary behaviour, sleep and diet in a multitude of ways, including limiting exposure to the temptation of consuming energy-dense foods (eg, the dessert menu in a restaurant).

The extent to which such support systems can be implemented in primary care or in other community settings depends upon the availability of resources, but surprisingly they have rarely been tested. However, we do know that a straightforward nurse-led support programme can be as effective, and indeed much less costly, than more intensive weight management programmes involving specialist guidance for maintaining weight loss.1 Kirsten Coppell discussed the evidence base for the provision of dietary advice by primary care practitioners. Several models have been reported to achieve weight loss, but there is little information regarding long-term outcomes or cost effectiveness.2

Currently, available drug treatments have little or no place in the management of obesity, so unsurprisingly the role of bariatric surgery was an important feature of Rachel Batterham’s contribution to the Symposium. The most widely undertaken procedure, laparoscopic sleeve gastrectomy, has a very low rate of complications (similar to that of gall bladder surgery) and as is the case with gastric bypass surgery, which is often still undertaken in people with diabetes, is associated with substantial weight loss as well as an appreciable improvement in comorbidities, notably T2DM. Typically there is an immediate post-surgical improvement in blood glucose levels. Dosage of hypoglycaemic agents (oral hypoglycaemics and insulin) is invariably reduced and often may no longer be necessary.

Current criteria for surgery in New Zealand are more rigid than in most Western countries, and while surgery is not appropriate for all obese patients, the criteria certainly warrant an urgent review, especially as they apply to obese patients with T2DM. In the UK it is recommended that all patients with recent onset T2DM and a body mass index (BMI) greater than 35kg/m² be assessed for
the possibility of bariatric surgery after non-surgical measures have been tried without sustained weight loss. This might be a useful starting point for the discussion about extending the criteria for surgery in New Zealand.

Callie Corrigan discussed issues relating to bariatric surgery, which are particularly relevant to Māori. Individuals will have a much more successful experience of bariatric surgery if they are supported by their whānau, especially the key decision makers around kai. The challenge for health professionals is to provide information and support, not only to individuals but also to their whānau. Information needs to be provided in accessible formats, taking account of Māori whakapapa and utilising oral and visual forms of communication as well as written ones. And to enable patients to move in a positive direction, support needs to be provided from a safe, comfortable and neutral place (without negative labels) that respects and values people. This can sometimes be as simple as having seats that are the right size. The capacity of the Māori health sector must be increased in order to develop more equal partnerships.

While bariatric surgery offers hope for people who have been unable to lose weight by other means, a greater long-term hope lies in developing medical therapies which mimic the mechanisms by which bariatric surgery achieves weight loss, reversal or improvement of comorbidities, and facilitates the maintenance of weight loss. Professor Batterham especially emphasised the central role of gut hormones as mediators of the benefit of bariatric surgery and as novel targets for the development of obesity therapies.

Measures aimed at stemming the tide of the ‘diabesity’ epidemic are of equal importance to therapeutic approaches. Given the dramatic increases in obesity and T2DM over a remarkably short period of time, there can be little doubt that while biological mechanisms explain predisposition, environmental factors must account for the current alarming statistics. Furthermore, successful maintenance of weight loss also requires an environment which is conducive to healthy food choices and regular physical activity. Widespread availability, relatively low cost and largely unrestricted advertising all contribute to overconsumption of sugar-sweetened beverages (SSBs) and energy dense foods, which are considered to be major contributors to excessive energy intakes.

Louise Baur provided strong evidence that intensive early childhood interventions can reduce the risk of excessive weight gain, especially in socio-economically disadvantaged groups who have high rates of obesity and little access to such programmes. However, the benefits are not sustained if the intervention is not maintained in the longer term. These findings are hardly surprising given the pervasive nature of the obesogenic environment, clearly illustrated by Louise Signal using the photographic records of a group of New Zealand children wearing cameras, which continuously recorded the environment to which they were exposed during their waking hours.

While diet is often considered the cornerstone of obesity management, behaviours on the other side of the energy balance equation are just as important. Dave Lubans summarised the effectiveness of different approaches to increasing physical activity and reducing sedentary behavior, particularly in adolescents. The potential benefits of resistance training for reducing adiposity and enhancing insulin sensitivity and the appeal of high-intensity interval training for overweight, but often very strong adolescents should not be underestimated. Reducing the decline in physical activity which typically occurs in adolescence and developing more innovative approaches to delivering physical activity sessions are major challenges with this age-group.

Unlike other types of sedentary behaviour such as screen time, sleep is a sedentary activity that is clearly good for health. Rachael Taylor highlighted the consistency of the evidence investigating the relationship between sleep and obesity in children, indicating that short sleepers have a two-fold greater risk of obesity than long sleepers. Moreover, the effect seems to persist into adulthood, indicating the potential for long-term benefits. Confirmation of sleep intervention as an effective obesity prevention tool is now urgently required. Given the observation that many of the adverse health outcomes associated
with poor sleep are also more common in Māori and Pacific children, it is also feasible that sleep interventions hold promise for reducing inequities in health. Regardless of their impact on weight, the physical and mental health benefits arising from a good night’s sleep are numerous. Other novel approaches to obesity prevention and management may lie within our gut. Rinki Murphy and Wayne Cutfield reviewed current evidence, largely from animal studies, suggesting that the gut microbiome may contribute to a wide range of disorders, including obesity and type 2 diabetes mellitus. Intervention from healthy donors increases diversity of the gut microbiome and has been shown to markedly improve insulin sensitivity in a pilot study of adults with type 2 diabetes mellitus. Professor Cutfield is currently undertaking a gut microbiome transfer study to treat severe adolescent obesity using a novel encapsulation method for gut microbiome transfer. Similarly, obesity and diabetes research is embracing the digital world; Lisa Te Morenga highlighted the opportunities offered by mHealth (mobile health) initiatives and emphasised the need to establish close relationships with those communities, which are the intended end-users of such programmes. Co-design of research projects and programmes by researchers and communities (or end-users) is essential.

In 2015, the New Zealand Government released a childhood obesity plan involving 22 initiatives aimed at risk reduction as well as managing childhood obesity. Speakers acknowledged these positive steps but Cliona Ni Mhurchu drew attention to several recommendations which are considered to be important components of public health approaches to reducing the risk of obesity internationally, are consistent features of comparable plans in other countries and are conspicuous by their absence in the New Zealand plan:

- An enforceable healthy school food policy
- A government-led code for advertising food to children
- A tax on sugar-sweetened beverages.

The New Zealand Health Promoting Schools (HPS) Initiative and the Heart Foundation’s Fuelled4Life programme supports school communities to be more proactive about their health and wellbeing but does not include an enforceable healthy school food policy. The current Code for advertising food and beverages to New Zealand children and young people is voluntary, and such industry-operated self-regulation rarely delivers benefit to public health.11 A tax on SSBs has been one of the most widely discussed obesity prevention measures internationally, and evidence is emerging from countries that have implemented such taxes that they are effective.12 Furthermore, revenue from a SSB tax could be used to support other health programmes.13

The issues relating to sugar were discussed in some detail at the ‘Cost of Sugar’ Forum chaired by Kim Hill. Jim Mann summarised the science relating to the adverse health consequences of free (or added) sugars: unequivocal evidence for the role of sugars as a cause of dental caries; convincing evidence that high intakes (especially of SSBs) contribute to excess weight gain in children and to overweight and obesity in adults and that restriction can reverse this; and accumulating evidence that fructose and fructose-containing sugars (sucrose and high fructose corn syrup) have particularly adverse effects in terms of increasing insulin resistance, T2DM, gout and fatty liver disease. The evidence relating to dental caries and body fatness was the major determinant of the World Health Organization’s (WHO) Recommendation that “free sugars should contribute no more than 10% total calories and ideally less than 5%”. Tony Blakely argued strongly that there was now sufficient evidence to implement a tax on SSBs in New Zealand despite the reservations expressed by Jacqueline Rowarth relating to the consequences of a global reduction of sugar intake for sugar producing countries, especially developing countries with marginal economies.

Callie Corrigan, Alex Brown and others present in the audience reminded us all of the critical importance of involving the community, especially the Tangata Whenua and those in high-risk groups when developing approaches aimed at tackling the ‘diabesity’ epidemic. Not only is there an obligation to do so, but without such involvement any overall initiative is likely to be unsuccessful.
The New Zealand Childhood Obesity Plan (2015) and the updated guidelines for Management of Obesity in Childhood (2016) list a number of important initiatives. However, the ‘Diabesity Crisis’ Symposium and ‘Cost of Sugar’ Forum suggested a number of further recommendations for immediate action to help stem the tide of the obesity and diabetes epidemic:

1. A tax on sugar-sweetened beverages (SSBs)
2. A government-led code for food advertising
3. An enforceable healthy school food policy
4. Review of eligibility criteria for bariatric surgery
5. Clear recommendations regarding the role of sleep in obesity prevention.

Competing interests:
Nil.

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