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Management of coronary artery disease in patients on dialysis

Helen Pilmore, Mark Webster, Karishma Sidhu, Gajan Srikumar

Coronary artery disease is common in patients with end-stage renal failure (ESRF). We assessed survival and cardiovascular outcomes in patients with ESRF undergoing coronary angiography and then having coronary artery bypass graft (CABG) surgery, percutaneous coronary intervention (PCI) or medical management. Two hundred and eighty-eight patients had a total of 382 diagnostic coronary angiograms. There was no significant difference in survival between treatment modalities in the entire cohort, nor in the 108 patients with severe coronary artery disease. Similarly, there was no difference in the incidence of major adverse cardiac events, comparing medical management with revascularisation.

Morbidity from intentional self-harm among Pacific peoples in New Zealand 1996–2015

Jemaima Tiatia-Seath, Roy Lay-Yee, Martin Von Randow

There has been no investigation of the statistical trend for Pacific intentional self-harm and outcomes over time. The aim of this study was to describe trends in intentional self-harm for Pacific peoples in New Zealand by reviewing official data over the period 1996–2015. This information highlights specific areas for prevention, training, campaigning and further Pacific-centred research.

Outcome of acute hospital admission for non-specific low back pain: what is the role of MRI?

Eric TA Lim, Jean-Claude Theis

Low back pain is a common condition affecting people worldwide. Most cases are being managed non-operatively. We deduced that the use of MRI could possibly aid in the early diagnosis and possibly result in significant reduction in healthcare costs, including hospital admission. Current guidelines in managing low back pain can be adapted to be used in the hospital setting to ensure timely and appropriate treatment for patients.

Office design and health: a systematic review

Ann Richardson, John Potter, Margaret Paterson, Thomas Harding, Gaye Tyler-Merrick, Ray Kirk, Kate Reid, Jane McChesney

We undertook a review of recent research into the effects of workplace design, comparing individual with shared workspaces, on the health of employees. Our review found that, compared with individual offices, shared or open-plan office space is not beneficial to employees' health, with consistent findings of deleterious effects on staff health, wellbeing and productivity. The findings of our review are consistent with those of earlier reviews. These findings have public health implications for the New Zealand workforce. Decisions about workplace design should include weighing the short-term financial benefits of open-plan or shared workspaces against the significant harms, including increased sickness absence, lower job satisfaction and productivity, and possible threats to recruitment and retention of staff.

Characteristics of and differences between Pasifika women and New Zealand European women diagnosed with breast cancer in New Zealand

Charis Brown, Chunhuan Lao, Ross Lawrenson, Sandar Tin Tin, Michelle Schaaf, Jacquie Kidd, Anne Allan-Moetaua, Josephine Herman, Reena Raamsroop, Ian Campbell, Mark Elwood

Pasifika women were diagnosed with more advanced breast cancer and with a poorer prognosis. The presence of advanced cancer is associated with less breast screening, higher deprivation, age and some biological factors. For those of screening age, adherence to the screening programme and improvements in access to earlier diagnosis for Pasifika women under the current screening age have the potential to make a substantial difference in the number of Pasifika women presenting with late-stage disease.

A retrospective audit of the characteristics and treatment outcomes in patients with diabetes-related charcot neuropathic osteoarthropathy

Joanne Dixon, Joshua Coulter, Michele Garrett, Rick Cutfield

Charcot neuropathic osteoarthropathy occurs in people with diabetes and diabetes-related nerve damage of the feet. It presents as a red, hot and swollen foot and requires immediate medical attention and treatment. It can often take several weeks before the right diagnosis is made, leading to delays in treatment and long-term damage to the foot. People with long-standing diabetes and nerve damage in the feet should be aware of this condition and seek medical attention quickly if they notice these symptoms.

Paediatric testicular tumours in a New Zealand centre

Timothy Little, Shareena Lala, Vipul Upadhyay

Testicular tumours in children are rare. Our experience in managing such tumours is similar to that published by other major centres for paediatric surgery across the world. There may be scope to develop the practice of testicle-sparing surgery (ie, not removing the whole testicle when there is a tumour), but this has not been our practice thus far. Overall, survival rates are excellent.

Potential for public health success in tackling the hepatitis C virus epidemic

Ian Sheerin

There is potential to control and possibly eliminate the hepatitis C virus epidemic in New Zealand and in Australia. It can cause more advanced liver disease, liver cirrhosis and liver cancer but it is potentially preventable and curable. There is inadequate public health policy attention to preventing new infections and reducing barriers. There is a need for increased investment to reduce barriers, improve coordination and community awareness and to collaborate to engage with the affected population who can be stigmatised and marginalised.

An osteoarthritis model of care should be a national priority for New Zealand

Jennifer Baldwin, Andrew Briggs, Warwick Bagg, Peter Larmer

Osteoarthritis affects one in ten New Zealand adults, however at present drugs and surgery are the focus of treatment rather than conservative options such as weight loss and exercise. Developing an osteoarthritis model of care for New Zealand would lead to better delivery of conservative treatments, as has occurred in Australia, the UK and Europe. Currently the Ministry of Health's Mobility Action Programme (MAP) is supporting community-based teams of health professionals to improve early, conservative treatment for osteoarthritis. The MAP could provide a basis for developing an osteoarthritis model of care, however policy support is needed to put this into action.

Improved health and welfare will flow from reductions in drinking

Jennie Connor

New Zealand has a new government, elected on a commitment to refocus public policy on supporting and improving the lives of New Zealanders, with health, welfare and equity high in their priorities. Optimism is on the rise.

Services responding to health and welfare needs are often distinct, but the root causes of problems greatly overlap. One substantial contributor to poor physical and mental health, difficult family environments, ethnic and social disparities, and crime is New Zealand's pathological relationship with alcohol. This is an area where great gains can be made at little cost to the country.

Hazardous drinking prevalence has been going up every year since the brief dip that accompanied the economic downturn, and is now sitting at about 20% of all New Zealanders over 14 years of age.[1] This is no surprise given there has been no effective restraint on the commercial drivers of drinking for many years.

Alcohol has a substantial effect on the population because it is an extraordinary drug. It is intoxicating, toxic, carcinogenic,[2] addictive and legal. Intoxication drives our desire to drink, whether we are light or heavy drinkers, addicted or not. Intoxication is also directly responsible for most of the injury deaths attributable to drinking—largely unintentional injuries and suicides—that make up over 40% of all alcohol-related deaths in New Zealand.[3] Effects on the drinkers' physical health, which also include serious chronic conditions, represent the most measurable of all of alcohol's impacts at present, and result in at least 800 premature deaths a year.[3] However, the large and obvious burden of alcohol's harm to people other than the drinker encompasses physical, mental, social and intergenerational harm.[4]

The Social Aspects and Public Relations Organisations (SAPROs) of the alcohol industry,[5] and politicians who take a highly individualistic approach to health-related behaviours, maintain that individuals should just choose to drink safely, and they pretend that the population can be taught to do this despite empirical evidence to the contrary.[6] They also contend that alcohol-related harm is due to a minority of problem drinkers. However, it is not drinkers who are the problem, it is the product that is the problem.

Of more than 200 individual health conditions known to be caused by alcohol[7] a couple deserve a special mention. Using the methods from the Global Burden of Disease Study it has been estimated that the leading cause of alcohol-related death for New Zealand women (Māori and non-Māori) is breast cancer, and that a substantial proportion of alcohol-attributable breast cancer arises in women who drink at a level that is socially acceptable and considered "safe"; up to two standard drinks per day.[8] The second compelling illustration of no safe level, is fetal alcohol spectrum disorder (FASD). The neurotoxicity of alcohol for a fetus is well known, but the sensitivity of the fetus by gestation and by dose of alcohol is not well understood. Knowing that more than 40% of pregnancies are unplanned, how do we reduce the number of children, and families, affected by FASD when almost all women of reproductive age drink?

We all bear the cost of harm from alcohol; those of us who are affected personally or professionally, and every taxpayer. There are no recent costings of the externalities of alcohol in New Zealand, but surely when we know that they amounted to five billion dollars a year a decade ago[9] we have enough information. Harm from alcohol is related to how much we drink and how

often we drink it, not just as individuals but as a community. Achieving any reductions in the average volume or frequency of drinking will have health and social benefits for the population and will also reduce the enormous drain that alcohol imposes on public resources, releasing funding for essential public services.

Alcohol consumption can be modified to reduce health and social harm. The pathological relationship we have with alcohol is actually between policy makers and alcohol companies, and it can be changed with political will.

The Law Commission's review of alcohol legislation led by Sir Geoffrey Palmer that reported in 2010,[10] provided a blueprint for a suite of synergistic evidence-based policy interventions to reduce harm. Its recommendations concurred with international alcohol policy experts[6] but were spurned by the government of the time. What New Zealand got instead, in the Sale and Supply of Alcohol Act 2012, was evidence-free and industry-friendly. The only substantial policy change established voluntary Local Alcohol Policies, an untested devolvement of responsibility for determining availability of alcohol to Territorial Authorities, that was predicted to be complex and costly.[11] It has turned out to involve protracted planning processes duplicated all over the country, each ending in a legal battle between public agencies and better-resourced supermarket lawyers.

The Law Commission (LC) recommended population-based approaches to reducing hazardous consumption, including changes to tax on alcohol, reduction in hours and days of sale, curbing displays in supermarkets, an incremental reduction in alcohol advertising and sponsorship, and returning the legal alcohol purchase age to 20. It also signalled that a minimum unit price for alcohol should be considered, and the BAC limit for driving needed to come down. Having failed to respond to this advice, in 2014 the National-led government convened a Ministerial Forum on Alcohol Advertising and Sponsorship to reconsider LC findings about curbing marketing, but their recommendations have also been ignored. Consistent with the LC, this forum clearly articulated the need to restrict marketing and ban the sponsorship of sport, to protect health, particularly of the young.[12]

Policies that increase the price of alcohol are important because alcohol consumption is predictably sensitive to price even among people with plenty of disposable cash, and in hazardous drinkers, of which New Zealand now has 720,000.[1]

Increasing excise tax is the most tested intervention to reduce harm from alcohol.[6] The Law Commission recommended a 50% increase in excise tax, which would have increased the price of a drink by 10% and reduced consumption by 5%. In addition to excise tax, a minimum unit price for alcohol, which sets the lowest price a standard drink can be sold for, can be set to remove the cheapest products from the market, and offers the greatest health benefit to the most disadvantaged.[13] Scotland has been successfully fighting legal challenges from the industry for the right to use minimum pricing since 2012, and is close to being able to implement it, along with Wales[14] and Ireland, where it is incorporated in their new Public Health (Alcohol) Bill.[15]

The focus of healthy alcohol policy on population-level interventions is not ideological but empirical. However, it is certainly consistent with our new government's stated values. These policies are based on evidence of what is most capable of achieving change in population health status and reducing disparities. This is because they alter the environment in which our largely unthinking decisions about alcohol are made. Very importantly, these policies are not stigmatising and they are not victim-blaming. It's the same deal for everyone, and all get benefits.

Our new policy makers have a lot of important commitments to attend to, but alcohol policy is time-sensitive. Provisions in the previous version of the Trans-Pacific Partnership Agreement would have made it impossible for the government of any partner country to introduce regulation of the alcohol marketplace without being subject to litigation from alcohol corporations. New Zealand is currently engaged in negotiating new "trade" treaties with similar provisions. In order to effectively protect and improve health and welfare in New Zealand, we need the freedom to adopt healthy alcohol policy.

Competing interests:
Nil.

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Management of coronary artery disease in patients on dialysis

Helen Pilmore, Mark Webster, Karishma Sidhu, Gajan Srikumar

ABSTRACT

AIMS: Coronary artery disease is common in patients with end-stage renal failure (ESRF). However, there is little evidence that revascularisation improves outcomes, compared with medical management. This study assessed survival and cardiovascular outcomes in patients with ESRF undergoing coronary angiography and then having coronary artery bypass graft (CABG) surgery, percutaneous coronary intervention (PCI) or medical management.

METHODS: Survival and major adverse cardiac events (MACE) were examined in all patients with ESRF who underwent coronary angiography at Auckland City Hospital between 2003 and 2012. Outcomes of patients who underwent revascularisation (CABG or PCI) were compared with those managed medically.

RESULTS: Two hundred and eighty-eight patients with ESRF had a total of 382 diagnostic coronary angiograms. Ninety-one (32%) patients underwent revascularisation (61 PCI, 30 CABG), with the other 197 (68%) treated medically or requiring no specific cardiac treatment. The median survival was 3.3 (IQR 2.1–5.3) years in patients undergoing CABG, 2.9 (IQR 1.5–5.4) years in patients treated with PCI and 2.9 (IQR 1.3–5.5) years in patients managed medically. There was no significant difference in survival between treatment modalities in the entire cohort, nor in the 108 patients with triple vessel disease. Similarly, there was no difference in the incidence of major adverse cardiac events, comparing medical management with revascularisation.

CONCLUSION: There was no apparent survival advantage with revascularisation by either CABG or PCI, compared with medical management, in patients with ESRF undergoing coronary angiography. This study confirms the poor prognosis of patients with ESRF and coronary disease. Observational studies cannot control for all potential confounders; randomised trial data are needed to guide optimal management of this high-risk patient cohort.

The incidence of end-stage renal failure (ESRF) is increasing worldwide. Although renal transplantation improves survival compared with dialysis, cardiac disease remains a leading cause of death in patients after a kidney transplant.[1] Patients who are assessed for renal transplantation often undergo non-invasive cardiac testing to determine their suitability both for the transplant procedure and to determine their risk of cardiac events in the post-transplantation period. If provocative cardiac stress tests are positive, patients generally undergo diagnostic coronary angiography. Some patients with disease in major coronary vessels will undergo revascularisation by percutaneous intervention (PCI) with stenting or coronary artery bypass grafts (CABG). These patients may then be considered for a possible renal transplant.

Coronary angiography is also undertaken in patients with chest pain and in those presenting with an acute coronary syndrome. Although there is little data specifically in patients with ESRF, in the wider population with coronary disease an early invasive strategy with revascularisation as appropriate is better than an initial conservative approach in patients with non-ST elevation myocardial infarction,[2] and primary PCI is better than thrombolysis in those presenting with ST elevation myocardial infarction.[3]

In patients on dialysis, mortality after coronary revascularisation is significantly

higher than that of the general population. In an analysis of a large cohort of dialysis patients using USRDS data, two-year survival following CABG and PCI was much lower in dialysis patients compared to that reported in the general population, with a two-year survival after CABG of only 55%.[4]

Overall, the benefits of coronary artery revascularisation are unclear in patients with ESRF, and there is little data comparing revascularisation with medical management. We examined the outcomes of dialysis patients undergoing angiography, comparing survival of those managed medically with those undergoing revascularisation. We assessed both current mortality and major adverse event rates to better understand outcomes in this high-risk population.

Methods

A retrospective analysis was conducted on patients with ESRF on dialysis undergoing coronary angiography at Auckland City Hospital between 2003 and 2012. All patients undergoing angiography during this period were identified. Those on dialysis were identified from the ANZDATA registry, and cross checked with patients in the cardiac catheterisation laboratory database. Only patients with angiograms undertaken after commencement of dialysis were included. Patients were excluded if they commenced dialysis during the same admission or after the last angiogram, or if a diagnostic coronary study was not performed, eg, those having only a right heart study.

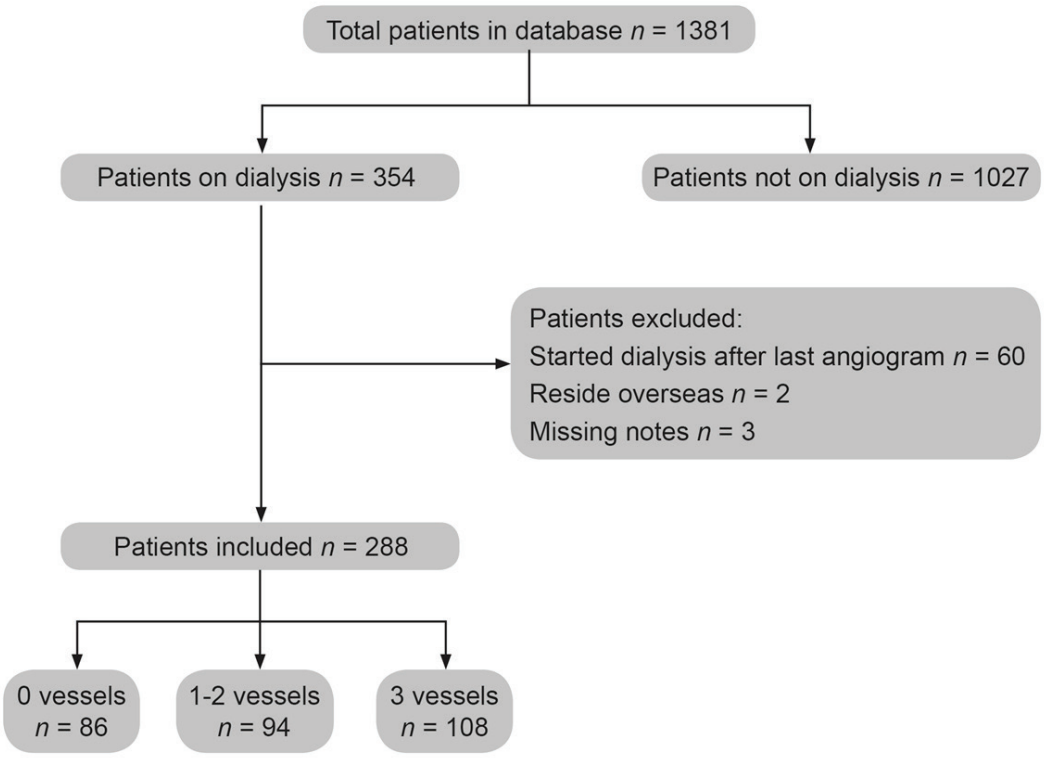
Demographic data including age, gender, ethnicity and angiogram dates were obtained from the cardiology database. Data for mortality, cause of renal failure and date of dialysis were provided by the ANZDATA registry. A manual review of hospital records was undertaken to collect data on the presence of diabetes, angiogram results, left ventricular ejection fraction, intervention, listing for transplant, previous transplant and cardiovascular outcomes. Angiography data included indication, number and identification of major vessels diseased (left main, left anterior descending, circumflex/major obtuse marginal and right coronary) and the left ventriculogram ejection fraction (if undertaken). The number of vessels diseased was assessed as the number of major coronary arteries with a greater than 50% diameter stenosis. Indications for angiography were divided into myocardial infarction (ST elevation or non-ST elevation), chest pain (including angina), transplant assessment and other indications (arrhythmia, valvular heart disease, syncope and unknown indications). Intervention data included categorising the management occurring as a result of the initial coronary angiogram as either medical management, PCI or CABG. All decisions regarding proceeding with medical therapy or CABG in patients with triple vessel disease were made by the cardiology service in association with cardiac surgical services and were assessed on an individual basis. Medication use was assessed using the discharge summary at the time of coronary angiography. Patients were assessed for use of aspirin, beta blockers, statins, angiotensin converting enzyme (ACE) inhibitors/angiotensin receptor blockers (ARBs) and additional antiplatelet agents. Patients were assessed as to whether they were listed for transplantation after angiography, and whether they underwent kidney transplantation. Major adverse cardiovascular events (MACE) were defined as myocardial infarction, stroke, amputation or peripheral revascularisation occurring any time after the coronary angiogram.

For patients with multiple angiograms, to avoid double counting outcomes and interventions, the first angiogram following commencement of dialysis was used for all subsequent outcome measures and intervention data.

Statistical analysis

Baseline data are reported as mean and one standard deviation (SD), or frequencies with percentages (%). Survival duration is reported as median with interquartile range (IQR). Kaplan-Meier curves were generated to depict the distributions of survival and freedom from MACE, by intervention. The survival curves were compared using the log-rank test. Survival rates at two years and five years after the first angiogram were compared between interventions using the two-sample Z test. Univariable and multivariable Cox proportional hazards regression were conducted to determine the risk factors for death and MACE. The Chi-squared test was used to assess the

Figure 1: Recruitment of the study population.



relationship between intervention and medication use. Statistical analyses were performed using the statistical package SAS version 9.3 (SAS Institute, Cary, NC). All p-values resulted from two-sided tests and a p-value of <0.05 was considered significant.

Results

Patient characteristics and angiogram results

One thousand seven hundred and fifty-six angiograms were undertaken on 1,381 patients with chronic kidney disease (CKD) Stages 3–5 identified in the cardiac catheterisation laboratory database (Figure 1). Three hundred and fifty-four patients were on dialysis. Sixty-five patients were excluded from the analysis, most because they commenced dialysis during the same admission or after their last angiogram.

Two hundred and eighty-eight patients, having 382 angiograms, were included in the study (Table 1). The mean number of angiograms per person was 1.3. The mean age at the time of the first angiogram following dialysis was 59+/-11 years. More than half (59%) of the patients had diabetes mellitus. Most coronary angiograms were undertaken after a diagnosis of myocardial infarction. However, 21% of patients underwent diagnostic angiography as part of assessment for kidney transplantation. The median follow-up was 3.1 years (range 2.0–10.7 years). Less than 30% of patients had no significant coronary artery stenoses while 37% had greater than 50% stenosis in all three coronary arteries.

Intervention

Ninety-one (32%) patients underwent revascularisation as their primary intervention following the initial angiogram (61 PCI and 30 CABG), 151 (52%) patients were treated medically and 46 (16%) patients required no specific coronary disease management.

Of the 60 (21%) patients who underwent diagnostic angiography as part of transplant assessment, 29 (48%) had evidence of coronary artery disease. Of these patients, eight (28%) underwent CABG, seven (24%) underwent PCI and 14 (48%) had medical management.

Table 1: Baseline characteristics of participants (participants with no intervention are not included in baseline comparison).

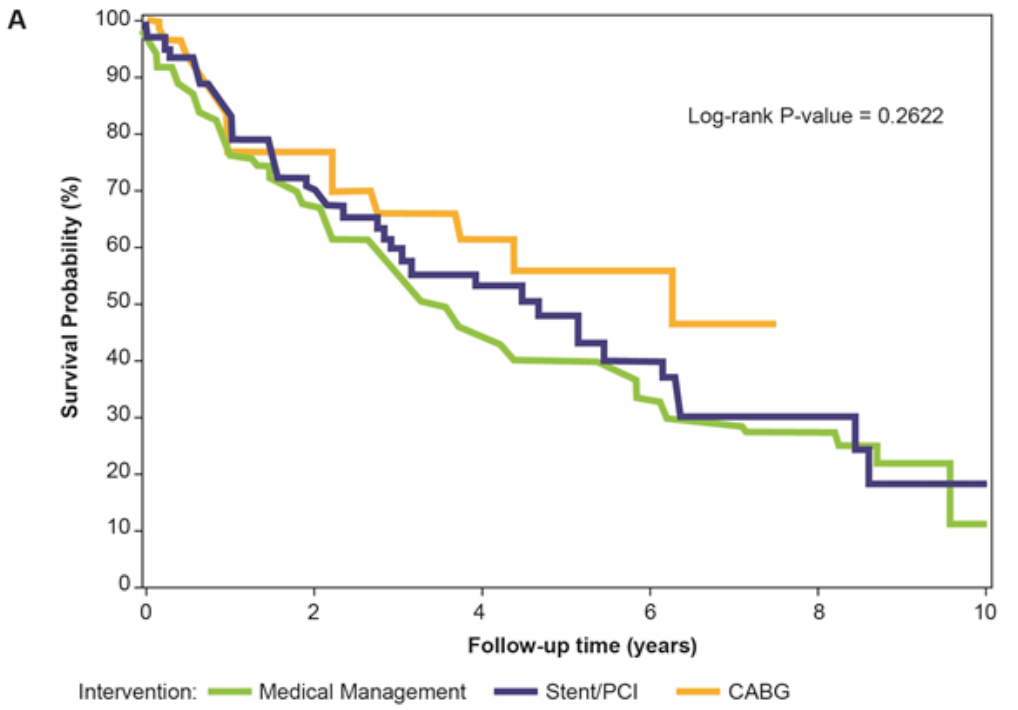
Intervention	CABG	Stent	Medical management	Total	Chi Squared P
Age [years], mean ± SD	58.4±8.4	61.2±12.2	60.6±10.2	59.3±11.3	
Gender					
Male, n (%)	22 (73)	41 (67)	105 (70)	193 (67)	0.8364
Ethnicity					
European, n (%)	8 (27)	24 (39)	48 (32)	100 (35)	0.6831
Māori, n (%)	8 (27)	18 (30)	49 (32)	92 (32)	
Pacific, n (%)	12 (40)	14 (23)	40 (26)	71 (25)	
Other, n (%)	2 (7)	5 (8)	14 (9)	25 (9)	
Diabetes, n (%)	19 (63)	34 (56)	100 (66)	169 (59)	0.3578
Cause of renal failure					
DM, n (%)	14 (47)	30 (49)	87 (58)	143 (50)	0.2495
GN, n (%)	9 (30)	12 (20)	37 (25)	78 (27)	
Other, n (%)	7 (23)	19 (31)	27 (18)	67 (23)	
Duration of dialysis [days], median	760	926	983	912	
Smoking status					
Never, n (%)	5 (17)	5 (8)	23 (15)	39 (13)	0.3401
Previous, n (%)	11 (37)	15 (25)	52 (34)	96 (33)	
Current, n (%)	8 (27)	26 (43)	42 (28)	89 (31)	
Unknown, n (%)	6 (20)	15 (25)	34 (23)	64 (22)	
Indication					
Transplant, n (%)	5 (17)	9 (15)	18 (12)	60 (21)	0.5827
MI, n (%)	13 (43)	28 (46)	64 (43)	106 (37)	
Chest pain, n (%)	5 (17)	18 (30)	43 (28)	74 (26)	
Other, n (%)	7 (23)	6 (10)	26 (17)	48 (17)	
Number of vessels with >50% stenosis					
0, n (%)	0	0	41 (27)	86 (30)	<0.0001
1, n (%)	1 (3)	17 (28)	22 (15)	41 (14)	
2, n (%)	7 (23)	21 (34)	25 (17)	53 (18)	
3, n (%)	22 (73)	23 (38)	63 (42)	108 (37)	

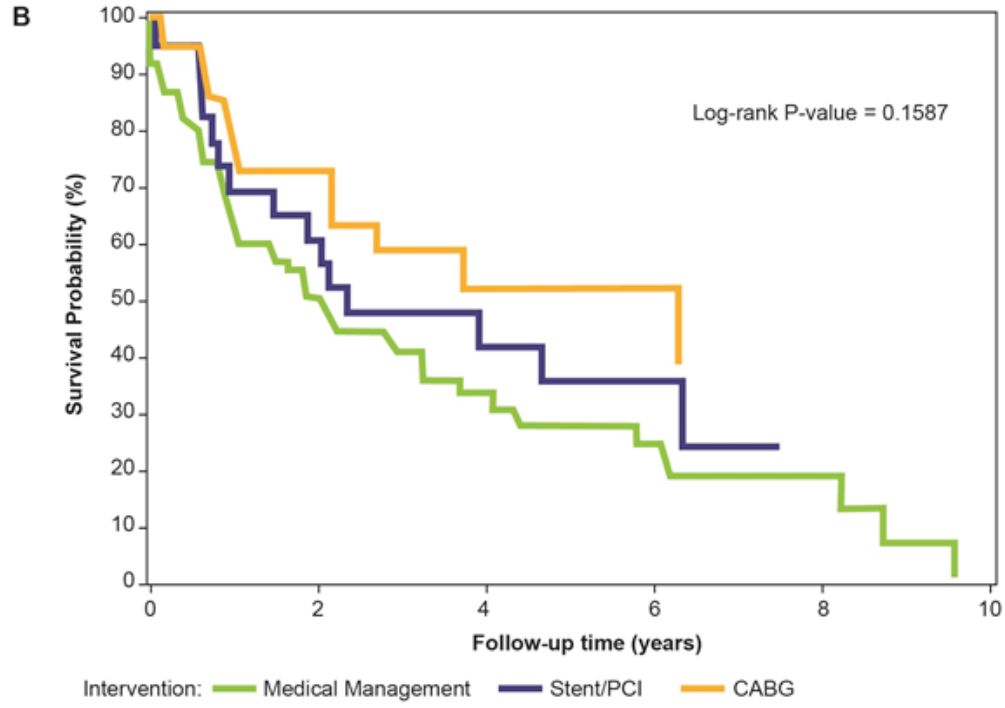
Mortality

One hundred and seventy (59%) patients died during the follow-up period. Eighty-two (48%) patients had a cardiovascular cause of death, 31 (18%) patients died due to infection, 22 (13%) patients due to withdrawal of dialysis, four (2%) patients due to malignancy, 11 (6%) patients due to other causes and 20 (12%) patients with an unknown cause of death.

The median survival was 3.3 (IQR 2.1–5.3) years after the initial angiogram in patients undergoing CABG, 2.9 (IQR 1.5–5.4) years in patients who were treated with PCI and 2.9 (IQR 1.3–5.5) years in patients managed medically. There was no difference in survival between the treatment modalities for the entire cohort (Figure 2A), nor in those patients with triple vessel disease (Figure 2B).

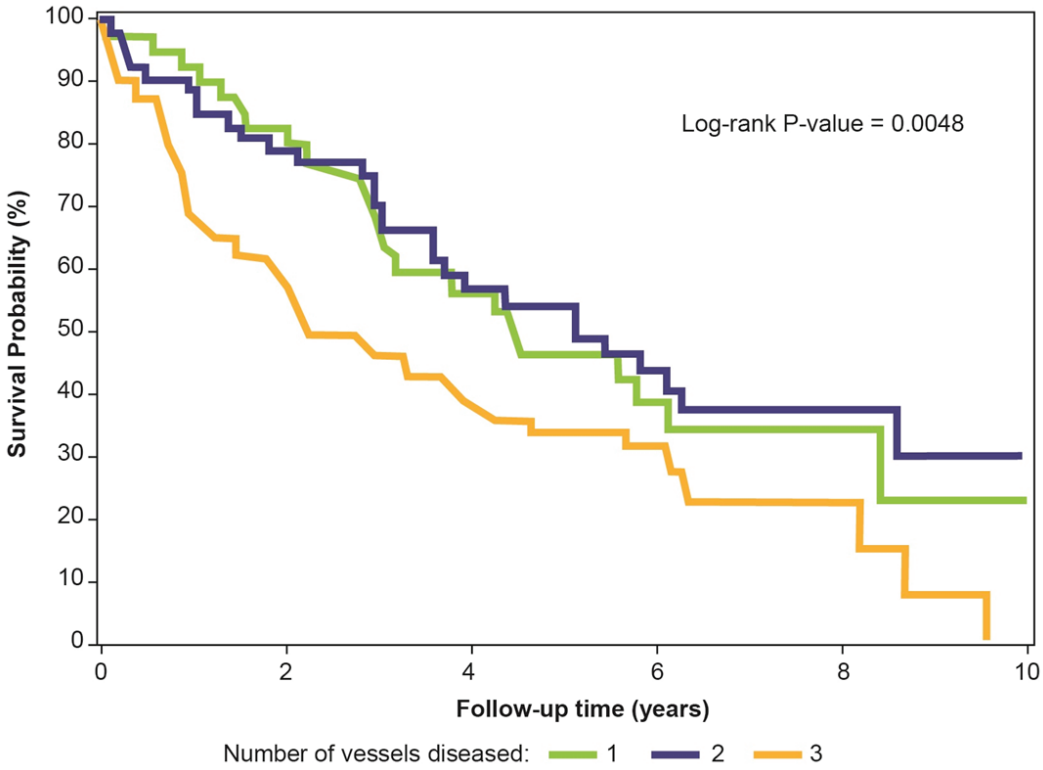
Figure 2: Kaplan-Meier (KM) curves for overall survival for all vessels by intervention (A). KM curves for overall survival in triple vessel disease by intervention (B).





When comparing survival according to the number of coronary vessels with a greater than 50% stenosis, there was a lower survival rate for patients with three vessel disease, compared with those having no significant coronary artery disease. Survival was not reduced in those with one or two diseased vessels (Figure 3).

Figure 3: Kaplan-Meier (KM) curves for overall survival in all patients by number of vessels.



Predictors of all-cause mortality

All-cause mortality was higher with increasing age, the presence of diabetes mellitus and the presence of triple vessel disease (Table 2). Those listed for transplantation after angiography and undergoing kidney transplantation had a lower subsequent risk of death.

On a multivariable analysis the only factor associated with survival was transplantation status (Table 3).

Major adverse cardiac events

Factors predicting MACE were increasing age, diabetes and triple vessel disease, while undergoing angiography as a part of transplantation assessment and being transplanted or listed for transplantation were associated with improved survival (Table 2). There was no difference in the rate of MACE between patients who underwent a revascularisation procedure and those who were medically managed (HR 0.928; 95% CI 0.694–1.242; p=0.6163). There was also no difference in the rate of MACE comparing patients treated with medical management and PCI (HR 0.971; 95% CI 0.687–1.373; p=0.869), or medical management and CABG (HR 0.677; 95% CI 0.395–1.163; p=0.159) (Figure 4).

Medication

Medications were recorded in 286 (99%) patients at discharge after their first angiogram. Seventy-three percent of patients were prescribed beta blockers, while 88% were given aspirin and 82% prescribed a statin (Table 4). There was no significant difference in the use of medications in patients treated medically compared to those treated with PCI or CABG, except for an increased use of dual antiplatelet therapy in patients undergoing PCI.

Repeat angiography

Sixty patients underwent more than one coronary angiogram (mean 2.5 procedures). In those patients who had a normal coronary angiography, 9% required a second angiogram. In comparison, 34% of those undergoing PCI as primary treatment after the first angiogram required subsequent coronary angiography, compared with 17% and 23%, respectively, of those treated initially with medical management or with CABG.

Table 2: Independent factors associated with all-cause mortality (grey) and major adverse cardiac events (white).

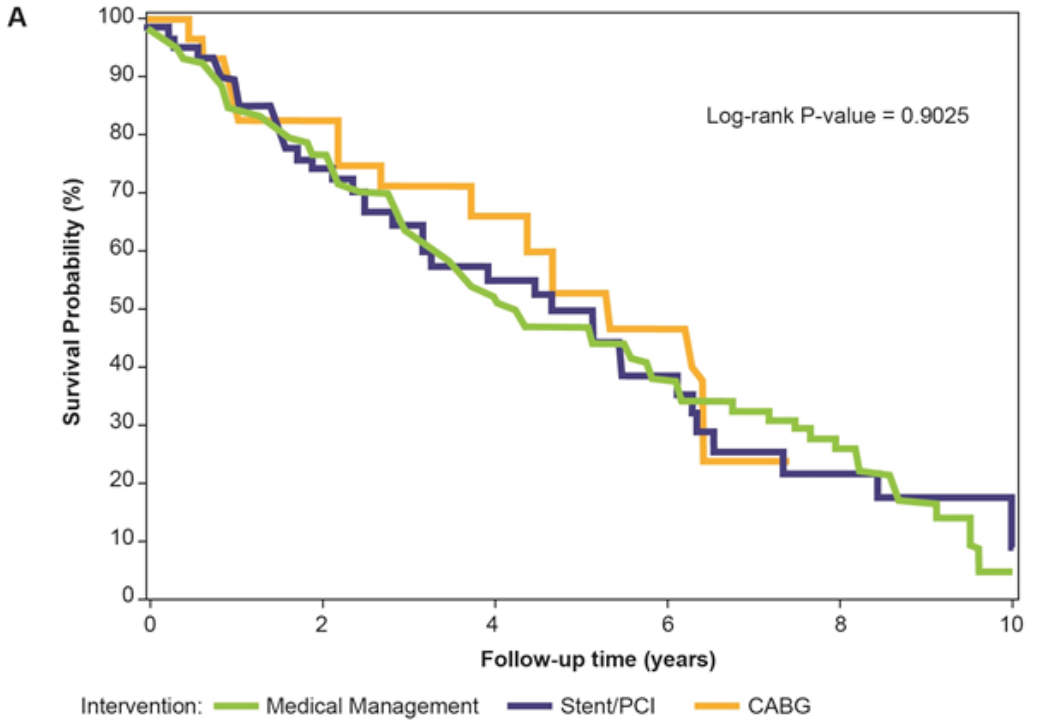
		Hazard ratio Mortality	95% CL	p-value	Hazard ratio MACE	95% CL	p-value
Age		1.034	1.019–1.049	<0.0001	1.032	1.018–1.045	<0.0001
Indication for angiography	transplantation assessment	1			1		
	myocardial infarction	2.889	1.823–4.58	<0.0001	2.992	1.955–4.581	<0.0001
	chest pain	1.592	0.963–2.633	0.0699	1.661	1.052–2.623	0.0295
	other*	2.484	1.474–4.188	0.0006	2.271	1.391–3.709	0.001
Diabetes mellitus		1.436	1.05–1.964	0.0236	1.469	1.097–1.967	0.0099
Cause of end stage renal disease	diabetes mellitus	1			1		
	glomerulonephritis	0.688	0.475–0.997	0.0481	0.68	0.483–0.959	0.028
	other	0.870	0.598–1.264	0.4638	0.828	0.581–1.181	0.2975
Dialysis modality	haemodialysis vs peritoneal dialysis	1.073	0.761–1.513	0.6880	1.102	0.8–1.517	0.5528
Smoking status	never	1			1		
	versus previous smoker	1.308	0.867–1.973	0.2014	1.452	1.001–2.107	0.0493
	versus current smoker	1.382	0.823–2.32	0.2212	1.486	0.924–2.389	0.1023
Number of coronary artery stenoses	none	1			1		
	versus one and two vessel disease	1.164	0.776–1.746	0.4617	1.226	0.843–1.783	0.2857
	versus three vessel disease	2.075	1.419–3.035	0.0002	2.183	1.525–3.126	<0.0001
Listed for kidney transplantation		0.192	0.125–0.295	<0.0001	0.213	0.146–0.31	<0.0001
Kidney transplantation		0.15	0.066–0.340	<0.0001	0.2	0.106–0.380	<0.0001
Revascularisation post-angiography		0.791	0.576–1.088	0.1496	0.928	0.694–1.242	0.6163
Coronary artery intervention	medical management	1			1		
	versus PCI	0.878	0.602–1.280	0.4981	0.971	0.687–1.373	0.8688
	versus CABG	0.626	0.351–1.117	0.1128	0.677	0.395–1.163	0.1578

*Other indications for angiography include arrhythmia, valvular heart disease, syncope and unknown indications.

Table 3: Multivariable analysis of factors associated with mortality (grey) and major adverse cardiac events (white).

	Hazard ratio Mortality	95% CL	p-value	Hazard ratio MACE	95% CL	p-value
Age	1.013	0.996–1.029	0.1375	1.009	0.993–1.024	0.2755
Diabetes						
Yes vs no	1.419	0.815–2.47	0.2163	1.267	0.752–2.137	0.374
Number of diseased vessels						
1&2 vs 0	0.7	0.455–1.075	0.1033	0.87	0.588–1.287	0.4854
3 vs 0	0.976	0.638–1.493	0.9104	1.137	0.763–1.693	0.5289
Cause of renal failure						
GN vs DM	1.048	0.577–1.904	0.8772	0.877	0.507–1.517	0.6382
Other vs DM	1.081	0.61–1.917	0.7889	1.182	0.671–2.082	0.5619
Indication						
MI vs transplant	1.244	0.751–2.058	0.3966	1.556	0.975–2.483	0.0635
Chest pain vs transplant	0.848	0.5–1.438	0.5396	1.001	0.616–1.626	0.9977
Other vs transplant	1.696	0.977–2.942	0.0604	2.096	1.257–3.497	0.0046
Listed for kidney transplant	0.285	0.172–0.474	<0.0001	0.558	0.387–0.803	0.0017
Transplant after angiography	0.423	0.167–1.072	0.0697	0.313	0.155–0.632	0.0012

Figure 4: Kaplan-Meier (KM) curves for MACE in all vessels by intervention (A). KM curves for MACE in triple vessel disease by intervention (B).



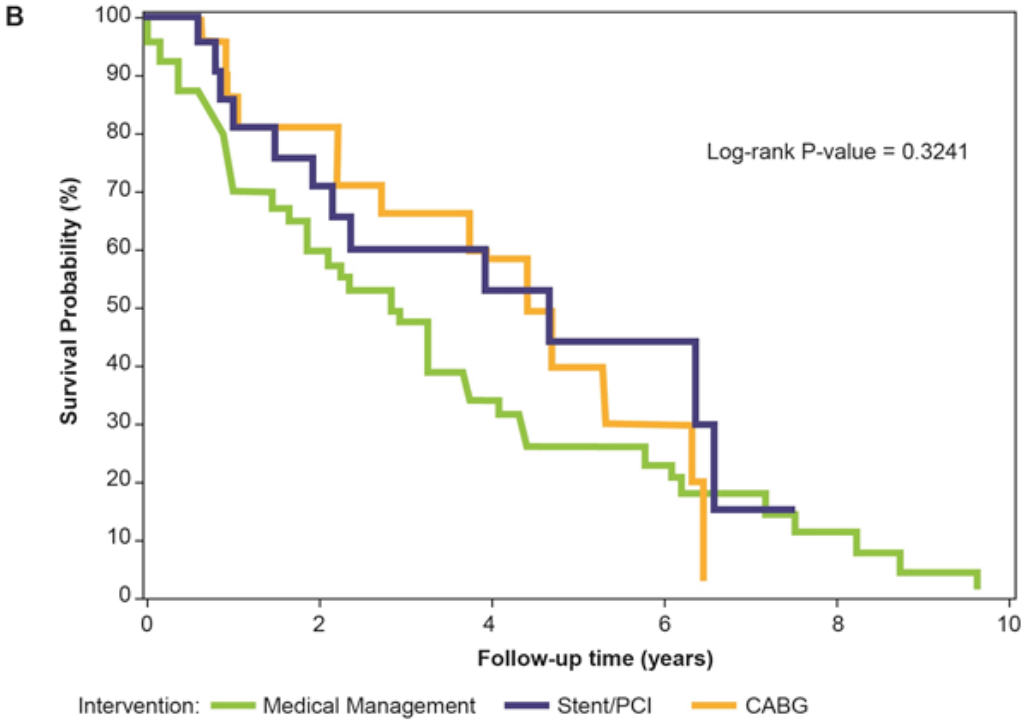


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Table 4: Use of medications at discharge following first angiogram, %.

	Overall	Medical management	PCI	CABG	p-value
Beta blockers	73	71	80	70	0.4319
Aspirin	88	84	97	90	0.0395
Statin	82	82	80	83	0.8942
ACE inhibitor	53	57	54	33	0.0549
Other antiplatelet	39	21	95	17	<0.0001

Discussion

This study, evaluating an all-comers population of patients with ESRF undergoing coronary angiography, found no significant difference in outcomes between the one-third of patients revascularised by either PCI or CABG, and the two-thirds who were managed medically. A full spectrum of patients were enrolled, including those with chest pain, those presenting with an acute coronary syndrome and those being evaluated for possible renal transplantation.

The results contrast with findings suggesting improved survival with revascularisation. The only randomised, controlled trial comparing revascularisation and medical management in patients with renal failure and coronary artery disease was undertaken over two decades ago. Only 26 patients with asymptomatic coronary disease and diabetes being assessed for renal transplant were enrolled; 10 of 13 patients treated medically reached a cardiovascular endpoint after 8.4 months of follow-up, compared with just two of 13 revascularised patients. The trial was limited by the use of short-acting calcium channel blockers, sub-optimal aspirin use, the very small study population and short follow-up.[5] An analysis from the APPROACH study[6] evaluated 662 dialysis patients undergoing cardiac catheterisation, comparing survival in patients having CABG, PCI and no revascularisation. Adjusted eight-year survival rates in those having CABG (45%) or PCI (41%) were better than in those not revascularised (30%). Reddan et al found that, in a small cohort of 69 dialysis patients, CABG but not PCI was associated with a survival benefit, compared with medical management.[7]

In contrast, other authors have reported similar findings to our study. A single-centre, prospective observational study found no difference between patients with ESRF being assessed for kidney transplant who underwent PCI or CABG, versus those who were medically managed.[8] Another study by De Lima et al[9] showed that, in patients with chronic kidney disease and significant coronary artery disease, survival for patients on medical treatment at one, three and four years was 91%, 71% and 59%, which was similar to survival in those who underwent revascularisation (PCI or CABG) at 93%, 67% and 57%, respectively.

In the general population of patients with stable coronary disease, CABG has been shown to have a survival benefit over medical treatment in those with left main stenosis and those with three vessel disease and left ventricular dysfunction. Outcomes following CABG and PCI are similar, except in patients with extensive coronary disease and diabetes, in whom CABG is associated with better longer-term outcomes.[10] It is difficult extrapolating the results to patients with ESRF because they were almost invariably excluded from these trials. In addition, there are specific challenges to both CABG and PCI in ESRF. Heavy and extensive coronary artery calcification is common in ESRF, and may make surgical graft anastomosis technically difficult, and may cause difficulties with stent delivery and achieving full stent expansion.

In patients presenting with a non-ST elevation acute coronary syndrome, a strategy of early angiography and revascularisation is associated with better clinical outcomes than a conservative approach reserving angiography to those with ongoing symptoms. Further, the absolute gain with early angiography is greater in higher-risk than lower-risk patients. In those with ST elevation myocardial infarction, revascular-

istion by primary percutaneous coronary intervention improves survival, compared with thrombolysis. It remains uncertain whether these findings are applicable to those with ESRF, because they were excluded from most of the trials.[11]

The guidelines for coronary revascularisation in dialysis patients recommend adherence to the guidelines for the general population, although decisions made regarding revascularisation should take into account the perioperative mortality risk, which is higher than the general population.[12]

Our study confirms that there is a poor survival in all dialysis patients compared to the general population. The two-year survival for all patients following initial angiography was 69%, and five-year survival was 29%. Data from the ERA-EDTA registry[13] shows that overall survival in dialysis patients following initiation of dialysis is poor with a two-year survival of 68% and five-year survival of 40%. For patients in the general population with triple vessel disease, the five-year survival is 89% following CABG and 85% following PCI.[14] This is much higher than survival in dialysis patients undergoing revascularisation with a five-year survival after CABG of 28% and after PCI of 24%.[15]

Compared to those with no coronary disease, there was significantly worse survival for patients with three vessel disease. In the general population of patients with coronary artery disease, survival is much lower in those with triple vessel disease. The four-year survival for medically treated patients with no disease is around 97%, whereas survival in those with one and two vessel disease is 92% and 84%, respectively, and only 68% in those with three vessel disease.[16]

We found that the use of cardioprotective medications was high with over 80% of patients treated with medical management or revascularisation receiving aspirin and statins, in addition to a high use of beta blockers. There was no difference between groups, except for dual antiplatelet therapy being higher in the PCI group, as expected. Over a third of patients treated initially with PCI required repeat angiography with fewer in both the CABG and medically managed groups. This is consistent with previous reports demonstrating a high requirement for repeat target vessel revascularisation in patients with ESRF treated.[17]

Kidney transplantation was associated with improved survival and reduced MACE. This has previously been demonstrated in multiple studies, highlighting the benefits of transplantation even in those with coronary artery disease.[18] Others have demonstrated that kidney transplantation confers a survival benefit in patients with significant CAD.[19] Despite the improved survival with transplantation, it remains unclear whether revascularisation prior to kidney transplantation provides an additional benefit. Additionally, it must be noted that in general the superior survival in transplant recipients is, at least in part, due to patient selection.

A strength of our study is the inclusion of all patients undergoing angiography, reflecting the real-world patient population. The study included not only patients with ESRF without evidence of CAD evaluated for transplant but also patients requiring clinical management for myocardial infarction, angina or other indications. There was a long period of follow-up, which was complete, with medication data available in over 99% of patients. All patients were from a single centre.

The major study limitation is that the treatment groups were not randomly allocated, and it is not possible to adjust for all potential confounders. The small size of subgroups limits the ability to draw conclusions from these patient cohorts. Some patients had multiple angiograms and further revascularisation procedures, including cross-over from PCI to CABG and vice versa, which may cause confounding.

Conclusion

Our study found no difference in survival between patients with ESRF undergoing revascularisation and those managed medically in a group where the use of cardioprotective medication was high. Only kidney transplantation was associated with a reduction in death and cardiac events.

The high mortality rate in patients with ESRF and coronary disease and the modest evidence base for the optimal treatment of coronary disease lead to clear equipoise for a randomised trial randomly comparing different treatment strategies.

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Morbidity from intentional self-harm among Pacific peoples in New Zealand 1996–2015

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ABSTRACT

AIM: The aim of this study was to describe trends in intentional self-harm for Pacific peoples in New Zealand by reviewing official data over the period 1996–2015.

METHOD: Publicly funded hospitalisations where the external cause was intentional self-harm were examined and areas of interest were identified and are presented.

RESULTS: Over a 19-year period (1996–2015), there were 1,608 intentional self-harm events for Pacific peoples (2.8%) out of 58,643 intentional self-harm events nationally for New Zealand's total population.

CONCLUSION: This study has been able to delineate Pacific ethnic-specific information not previously available for a prolonged period of 19 years. There are differences in Pacific peoples' experiences between ethnic groups. Furthermore, disparities persist between Pacific and non-Pacific. This study exposes priority areas for more targeted interventions according to ethnic, socioeconomic status, gender and age variations.

The link between intentional self-harm and suicide is complex and not fully understood.[1] However, it is well known that there is a significant and assiduous suicide risk for those who engage in intentional self-harm.[2–4] In fact, the suicide rate for this group is believed to escalate to between 50 and 100 times the rate of suicide in the general population.[4] Intentional self-harm for the purposes of this discussion is defined as any form of self-destructive behaviour where an individual purposefully hurts or mutilates their body regardless of their intentions to die.[5]

The main sources of statistical information are usually databases that collect self-inflicted injury hospital presentations developed more for administrative purposes rather than surveillance, thus missing the opportunity to measure intent.[6,7] Motives for intentional self-harm are multifaceted, for instance, hospitalisation data for intentional self-harm cannot be entirely a measure of suicide attempts.[8] Therefore there can be no clear distinction between incidents of suicide attempt and intentional self-harm without suicidal intent.[9] Ministry of Health data only report those events of intentional self-harm through hospital emergency departments (ED) that resulted in hospital admission to an inpatient ward or a mental health unit for more than two days or longer.[8] Evidently, it appears that intentional self-harm may be subject to underreporting.

The number of intentional self-harm hospitalisations for 2013 includes events where admitted patients were discharged under an ED domain after a short stay. District health boards (DHBs) started reporting these types of ED admissions from 1 July 2012 onwards. In order to provide comparable data with previous years, 2013 data presented in time trends and DHB aggregated data exclude short-stay ED hospitalisations.[8]

There were a total of 7,267 intentional self-harm hospitalisations in New Zealand in 2013, equating to a rate of 176.7 per 100,000

population.[8] The New Zealand European and Other ethnic group followed by Māori, showed the highest rates of intentional self-harm hospitalisations.[8] Furthermore, hospitalisation rates were greater in more deprived locations where the highest rate was for those residing in deprivation quintile 4 (226.3 per 100,000) as opposed to the lowest in quintile 1 (128.0 per 100,000).[8]

In 2013, there were 297 Pacific peoples hospitalised for intentional self-harm, which equates to an age-standardised rate of 100.9 per 100,000 Pacific population.[8] Additionally, the 2012 New Zealand Adolescent Youth Health Survey found that more than one in four Pacific students (27.3%) reported 'deliberate self-harm' in the previous 12 months, and 71% of Pacific students who attempted suicide (*n*=159) also experienced both suicide ideation and had previously intentionally self-harmed (*n*=114).[10]

More Pacific-focused research around intentional self-harm is needed to grow an evidence base to help inform future preventative initiatives and to cater to an increasing and evolving Pacific population in New Zealand.

There is currently no investigation of the statistical trends in Pacific intentional self-harm for all ages and outcomes over time. An analysis of Ministry of Health morbidity data for intentional self-harm will highlight specific areas for intervention, training, campaigning and further Pacific-centred research. This study is the first Pacific statistical analysis of trends in hospitalisation data for intentional self-harm for Pacific peoples and a companion paper to *Suicide mortality among Pacific peoples in New Zealand, 1996-2013.*[11]

Method

Design

Patterns among Pacific peoples of morbidity due to intentional self-harm over the period 1996 to 2015 were examined from a review of routinely collected public hospitalisation records.

Data collection

Morbidity data relating to Pacific peoples over a period of 19 years—from June 1996 to June 2015—were obtained from the New Zealand Ministry of Health's National Minimum Dataset, comprising publicly funded hospital discharges with any reported external cause code of intentional self-harm excluding sequelae (ICD-9-CMA-II E codes 950-958, ICD-10-AM codes X60-X84). Day-stay and inpatient events were included (short stay ED events were excluded), resulting in a total of 63,062 data records available for analysis.

Analysis

Descriptive tables of selected outcomes are presented, ie, intentional self-harm broken down by Pacific ethnicities: Samoan, Cook Islands, Tongan and Other, as well as Total Pacific and Total New Zealand (NZ).

Annual rates of intentional self-harm (per 100,000) for 1996, 2001, 2006 and 2013 were approximated by using our hospitalisation data (in year ending June 30) as the numerators, and the census usually resident population (in year ending December 31)—with total responses for ethnic group—as the denominator.[12,13] Note that these are the only years within our data range (1996 to 2015) for which Pacific ethnic breakdowns were available from Statistics New Zealand. In view of the small numbers of events, particularly when broken down by Pacific ethnicities, all further tables refer to events aggregated across the period 1996 to 2015. Additionally, we assessed patterns by age group and gender, deprivation quintile, event type, admission type, discharge type, primary diagnosis, length of stay, district health board area and health specialty. For each substantive variable, we show the numbers of admissions/discharges (and the percentages) in various categories. Note that tables exclude missing data from the calculation of percentages.

Results

Annual rates of intentional self-harm by ethnicity are shown for 1996, 2001, 2006 and 2013 (Table 1). Results should be interpreted with caution because of the small number of events by Pacific ethnic group. However, what is evident is that there appears to be an increasing rate for Cook Islands which then has the highest rate among the three Pacific ethnicities by 2013; and overall, Total Pacific has around 40–50% of the rate for Total NZ consistently across the years.

Table 1: Annual rates per 100,000 of intentional self-harm events by ethnicity: 1996, 2001, 2006 and 2013.

Year	Samoan		Cook Islands		Tongan		Other Pacific		Total Pacific		Total NZ	
	Events	Rate*	Events	Rate*	Events	Rate*	Events	Rate*	Events	Rate*	Events	Rate*
1996	37	36.4	12	26.0	3	9.6	19	82.6	71	35.1	3,116	86.1
2001	48	41.7	17	33.0	6	14.7	33	134.3	104	44.9	3,339	89.3
2006	35	26.7	19	33.4	14	27.7	20	72.7	88	33.1	3,212	79.7
2013	50	34.7	31	50.8	13	21.6	26	85.6	120	40.6	3,991	94.1

*The numerator is the number of self-harm events for the year ending June 30; the denominator is the census usually resident population—ethnic group total responses—for the year ending December 31.[12,13]

Table 2: Intentional self-harm events by ethnicity: patient characteristics (gender-age group, deprivation), June 1996–June 2015.[14]

	Samoan			Cook Islands			Tongan			Other Pacific			Total Pacific			Total NZ		
	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All
Age group																		
<15	8	39	47 (6.7%)	2	12	14 (4.3%)	1	7	8 (5.1%)	1	7	8 (1.9%)	12	65	77 (4.8%)	367	1,737	2,104 (3.6%)
15–24	139	156	295 (42.0%)	56	59	115 (35.7%)	40	42	82 (51.9%)	70	105	175 (41.1%)	305	362	667 (41.5%)	5,488	11,744	17,232 (29.4%)
25–39	121	116	237 (33.8%)	58	79	137 (42.5%)	32	21	53 (33.5%)	69	81	150 (35.2%)	280	297	577 (35.9%)	7,408	12,046	19,454 (33.2%)
40+	63	60	123 (17.5%)	30	26	56 (17.4%)	9	6	15 (9.5%)	33	60	93 (21.8%)	135	152	287 (17.8%)	7,686	12,158	19,844 (33.8%)
Total	**331 (47.2%)**	**371 (52.3%)**	**702 (100%)***	**146 (45.3%)**	**176 (54.7%)**	**322 (100%)**	**82 (51.9%)**	**76 (48.1%)**	**158 (100%)**	**173 (40.6%)**	**253 (59.4%)**	**426 (100%)**	**732 (45.5%)**	**876 (54.5%)**	**1,608 (100%)**	**20,949 (35.7%)**	**37,685 (64.3%)**	**58,634 (100%)**
Missing**			57			20			20			30			127			4,428
Deprivation* **	**All**			**All**			**All**			**All**			**All**			**All**		
1 Least	35 (4.6%)			17 (5.1%)			14 (8.0%)			32 (7.1%)			98 (5.7%)			7,137 (11.4%)		
2	51 (6.7%)			26 (7.8%)			16 (9.1%)			43 (9.6%)			136 (7.9%)			9,226 (14.7%)		
3	104 (13.7%)			38 (11.4%)			28 (16.0%)			74 (16.4%)			244 (14.2%)			11,977 (19.1%)		
4	178 (23.5%)			81 (24.4%)			46 (26.3%)			119 (26.4%)			424 (24.7%)			17,267 (27.6%)		
5 Most	389 (51.4%)			170 (51.2%)			71 (40.6%)			182 (40.4%)			812 (47.4%)			16,952 (27.1%)		
Total	**757 (100%)**			**332 (100%)**			**175 (100%)**			**450 (100%)**			**1,714 (100%)**			**62,559 (100%)**		
Missing	2			10			3			6			21			503		

*Percentages may not sum to 100% due to rounding.
**Missing data have been excluded from calculation of percentages.
***NZDep is an area-based measure of deprivation.[14]

Ethnicity

There were 1,608 intentional self-harm events (2.8%) among Total Pacific out of 58,364 for Total NZ (Table 2). The largest Pacific ethnic group was Samoan at 702 or 43.7% of Total Pacific (1,608).

Gender

Intentional self-harm is more prevalent in females than males across all Pacific ethnic groups, except Tongan (48.1%) ranging up to 59.4% (Other Pacific) (Table 2). In Total Pacific, females comprised 54.5% compared to 64.3% in Total NZ, showing a similar pattern by gender.

Age group

Across Pacific ethnic groups, intentional self-harm events were more prevalent in the 15–24 age group followed by the 25–39 group, except for Cook Islands where the order was reversed (Table 2). Thus, in Total Pacific, the percentages in each age group in order of magnitude were: 15–24 (41.5%),

25–39 (35.9%), 40+ (17.8%), <15 (4.8%). These compared to Total NZ as follows: 40+ (33.8%), 25–39 (33.2%), 15–24 (29.4%), <15 (3.6%); here it can be seen that prevalence increases with age group, thus the highest percentage is in the 40+ age group.

Gender and age group

In Total Pacific, the largest group were females aged 15–24 (22.5% of all events) compared to females aged 40+ (20.7% of all events) in Total NZ (Table 2).

Deprivation

Prevalence increased with deprivation across all Pacific ethnic groups so that 47.4% were in the worst deprivation quintile for Total Pacific; this percentage was highest in Samoan (51.4%) (Table 2). Although prevalence also increased with deprivation in Total NZ, the distribution was much more even with a gradual rise to 27.6% (deprivation quintile 4) before dropping slightly to 27.1% in the worst deprivation quintile.

Admissions and discharge type

The majority of events were inpatient admissions in both Total Pacific (85.9%) and Total NZ (85.0%), increasing to as high as 87.0% in Samoan (Table 3). Overwhelmingly, events were acute admissions in both Total Pacific (95.7%) and Total NZ (95.0%), rising as high as 96.5% in Cook Islanders. Most discharges were Routine followed by Further Care, and Community Care: Total Pacific (77.5%, 12.7% and 6.6% respectively), Total NZ (74.9%, 16.7% and 4.8% respectively). A small percentage of events ended in death at discharge: 1.2% for Total Pacific and 1.0% for Total NZ, while among Pacific ethnic groups, the highest percentage was 3.4% in Tongan.

Table 3: Intentional self-harm events by ethnicity: admission and discharge characteristics, June 1996–June 2015.

	Samoan		**Cook Islands**		**Tongan**		**Other Pacific**		**Total Pacific**		**Total NZ**	
	n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Event type												
Day stay	99	13.0	51	14.8	27	15.2	68	14.9	245	14.1	9,460	15.0
Inpatient admission*	660	87.0	291	85.1	151	84.8	388	85.1	1,490	85.9	53,602	85.0
Total	**759**	**100****	**342**	**100**	**178**	**100**	**456**	**100**	**1,735**	**100**	**63,062**	**100**
Admission type												
Arranged admission**	30	4.0	9	2.6	13	7.3	18	3.9	70	4.0	2,961	4.7
Acute admission***	728	96.0	330	96.5	165	92.7	437	95.8	1,660	95.7	59,926	95.0
Waiting list	1		3	0.9	-		1	0.2	5	0.3	154	0.2
Psychiatric readmission	-		-		-		-		-		21	0.0
Total	**759**	**100**	**342**	**100**	**178**	**100**	**456**	**100**	**1,735**	**100**	**63,062**	**100**
Discharge type												
Further care	88	11.6	39	11.4	22	12.4	71	15.6	220	12.7	10,525	16.7
Community care	46	6.1	18	5.3	20	11.2	30	6.6	114	6.6	3,015	4.8
Deceased	7	0.9	1	0.3	6	3.4	6	1.3	20	1.2	601	1.0
Self-discharge	17	2.2	10	2.9	3	1.7	7	1.5	37	2.1	1,677	2.7
Routine discharge	601	79.2	274	80.1	127	71.3	342	75.0	1,344	77.5	47,244	74.9
Total	**759**	**100**	**342**	**100**	**178**	**100**	**456**	**100**	**1,735**	**100**	**63,062**	**100**

*Occupying a hospital bed for at least one night.
**Planned.
***Unplanned.
****Percentages may not sum to 100% due to rounding.

Table 4: Intentional self-harm events by ethnicity: primary diagnosis and health specialty, June 1996–June 2015.

	Samoan		Cook Islands		Tongan		Other Pacific		Total Pacific		Total NZ	
	n	%	n	%	n	%	n	%	n	%	n	%
Primary diagnosis												
Injury/poisoning	597	78.6	280	81.9	140	78.7	380	83.3	1,397	80.5	49,308	78.2
Mental disorder	111	14.6	39	11.4	28	15.7	58	12.7	236	13.6	11,405	18.1
Other	51	6.7	23	6.7	10	5.6	18	3.9	102	5.9	2,379	3.8
Total	**759**	**100***	**342**	**100**	**178**	**100**	**456**	**100**	**1,735**	**100**	**63,062**	**100**
Health specialty												
Medicine	423	55.7	195	57.0	95	53.4	287	62.9	1,000	57.6	41,128	65.2
Surgery	169	22.3	73	21.3	35	19.7	78	17.1	355	20.5	5,884	9.3
Mental health	160	21.1	66	19.3	44	24.7	89	19.5	359	20.7	15,175	24.1
Other	7	0.9	8	2.3	4	2.2	2	0.4	21	1.2	875	1.4
Total	**759**	**100**	**342**	**100**	**178**	**100**	**456**	**100**	**1,735**	**100**	**63,062**	**100**

*Percentages may not sum to 100% due to rounding.

Primary diagnosis

Injury-poisoning and mental disorder were the largest primary diagnoses: Total Pacific (80.5% and 13.6% respectively) and Total NZ (78.2% and 18.1% respectively) (Table 3). Similarly, this pattern applied across all the Pacific ethnic groups.

Health specialty

While Medicine was the largest health specialty treating intentional self-harm events, Mental Health was the second largest: Total Pacific (57.6% and 20.7% respectively) and Total NZ (65.2% and 24.1% respectively) (Table 4). Again this pattern applied across all the Pacific ethnic groups.

Table 5: Intentional self-harm events by ethnicity, gender and age group: mean days of stay, June 1996–June 2015.

	Samoan		Cook Islands		Tongan		Other Pacific		Total Pacific		Total NZ	
Age group	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
<15	1.8	2.7	21.0	1.6	1.0	2.0	1.5	1.8	5.5	2.4	4.8	3.2
15–24	9.0	3.7	9.2	3.7	7.3	8.5	11.0	4.6	9.3	4.5	6.5	5.3
25–39	8.6	5.3	7.7	5.0	5.2	15.3	12.6	5.4	9.1	6.1	6.9	6.1
40+	5.2	6.7	16.0	6.1	6.8	15.3	7.6	5.9	8.2	6.7	8.6	6.9
Overall	**8.0**	**4.6**	**10.2**	**4.5**	**6.5**	**10.7**	**10.9**	**5.1**	**8.9**	**5.3**	**7.4**	**6.0**
N	660		291		151		388		1,490		53,602	
Missing*	99		51		27		68		245		9,460	

*Missing data have been excluded from calculations.

Length of stay

Males stayed in hospital longer than females for both Total Pacific (8.9 vs 5.3 days) and Total NZ (7.4 days vs 6.0 days) (Table 5). Among Pacific ethnic groups, this pattern was reversed for Tongan males 6.5 days vs female 10.7 days. Pacific males stayed longer than NZ males (8.9 vs 7.4 days), while Pacific females stayed shorter than New Zealand females (5.3 vs 6.0 days). Length of stay tended to increase with age group for both Total NZ and Total Pacific (less so), though across Pacific groups the pattern among males was inconsistent.

Table 6: Intentional self-harm events by ethnicity: DHB area, June 1996–June 2015.

	Samoan	**Cook Islands**	**Tongan**	**Other Pacific**	**Total Pacific**		**Total NZ**	
DHB	**n**	**n**	**n**	**n**	**n**	**%**	**n**	**%**
Northland	5	6	3	12	26	1.5	2,528	4.0
Waitemata	109	43	25	63	240	13.8	6,749	10.8
Auckland	158	54	41	75	328	18.9	3,954	6.3
Counties Manukau	188	86	44	76	394	22.7	3,536	5.6
Waikato	19	30	2	28	79	4.6	6,008	9.6
Lakes	3	2	-	17	22	1.3	1,631	2.6
Bay of Plenty	25	7	3	15	50	2.9	3,476	5.5
Tairawhiti	1	1	1	-	3	0.2	784	1.3
Hawke's Bay	11	6	-	1	18	1.0	1,628	2.6
Taranaki	5	1	1	4	11	0.6	1,898	3.0
Midcentral	6	4	1	11	22	1.3	2,736	4.4
Whanganui	7	-	1	1	9	0.5	858	1.4
Capital and Coast	99	38	32	65	234	13.5	5,058	8.1
Hutt	45	17	3	21	86	5.0	2,953	4.7
Wairarapa	8	2	-	4	14	0.8	1,067	1.7
Nelson- Marlborough	6	6	1	4	17	1.0	2,540	4.1
West Coast	2	2	-	-	4	0.2	822	1.3
Canterbury	36	17	8	36	97	5.6	8,168	13.0
South Canterbury	3	-	1	2	6	0.3	903	1.4
Southern	22	12	9	15	58	3.3	5,389	8.6
Total	**758**	**334**	**178**	**450**	**1,735**	**100***	**62,686**	**100**
Missing**	1	-	-	6	-		376	

*Percentages may not sum to 100% due to rounding.
**Missing data have been excluded from calculation of percentages.

DHB

Examination by district health board region demonstrates that most of the intentional self-harm events for Total Pacific occurred in Counties-Manukau (22.7%), Auckland (18.9%), Waitematā (13.8%) and Capital-Coast (13.5%) (Table 5). By comparison, most of these events for Total NZ occurred in Canterbury (13.0%), Waitematā (10.8%), Waikato (9.6%), Southern (8.6%), Capital-Coast (8.1%), Auckland (6.3%) and Counties-Manukau (5.6%).

Discussion

Annual rates of intentional self-harm by ethnicity across the years 1996, 2001 and 2013 show that Pacific ethnic-specific focused investigations should continue to be supported. The increasing rate for the Cook Islands population affirms this. It is important to take into account Pacific heterogeneity in analyses of this kind.

Overall, Pacific peoples experienced a proportionately low level of intentional self-harm hospitalisations. Our findings indicate that intentional self-harm among Pacific peoples in New Zealand is predominantly among youth, particularly young Pacific females, except for the Cook Islands population where intentional self-harm was more prevalent in the adult group 25–39 years. Generally, the higher prevalence rate among Pacific females is comparable to the rates of intentional self-harm and suicide attempts for all other non-Pacific investigations.[3,15–17]

Length of hospital stay for Pacific males was longer when compared to all Pacific females, except Tongan females, and for all New Zealand males. These results highlight the significance of gender analyses, as well as the disparities that exist between Pacific and non-Pacific males and longer hospital stays for Tongan females.

Evidently, low socioeconomic areas are still underserved. Findings reinforce the importance of deprivation as a risk factor, not only for Pacific peoples but for Total NZ.

In relation to admissions and discharges, results highlight that more focused ethnic-specific efforts are needed, in particular with the Cook Islands population who experience more acute admissions, and Tongans who demonstrate the highest percentage (although small) of events ending in death.

For all Pacific ethnic groups, injury-poisoning and mental disorder formed the largest proportion of primary diagnoses. On this premise, more targeted initiatives are needed in these areas as the association between intentional self-harm and mental health is unequivocally interlinked.

Limitations

A major strength of the study is the focus on the Pacific population in New Zealand over an extended period of 19 years. A limitation however is that for those reporting multiple ethnic affiliations, according to Statistics New Zealand's protocol, information is prioritised. For instance, Māori ethnicity takes precedence over Pacific.[18]

Another limitation is the use of the term 'Pacific peoples' which assumes homogeneity of this population group. While this study provided Pacific ethnic breakdowns for Samoan, Cook Islands and Tongan populations, there were restrictions for 'Other' Pacific groups because of small numbers. The category 'Other' poses a challenge for Pacific ethnic-specific intentional self-harm for the unspecified Pacific groups.

Gender identification is restricted to the binary male and female categorisation and excludes those who do not identify with these (eg, transgender, intersex, gender fluid, gender neutral, etc.).

Conclusion

This study has been able to delineate Pacific ethnic-specific information not previously available, for a prolonged period of 19 years. It appears that one cannot homogenise Pacific peoples' experiences as there are clear distinctions. There continues to be inequalities between Pacific and non-Pacific sub-populations. This study exposes priority areas for more targeted interventions according to ethnic, socioeconomic status, gender and age variations.

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Nil.
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Outcome of acute hospital admission for non-specific low back pain: what is the role of MRI?

Eric TA Lim, Jean-Claude Theis

ABSTRACT

BACKGROUND: Low back pain is a common worldwide condition, affecting most people during their lifetime. Various imaging modalities are being used to assist clinicians in diagnosing and thus, aid in formulating a suitable management plan. Extensive research has been carried out in assessing this condition due to its high prevalence, with many guidelines published internationally.

AIM: To determine whether MRI imaging influences the management of patients admitted with acute, non-specific low back pain between 1 January 2013 and 31 December 2015.

METHOD: A total of 209 patients who met the inclusion criteria were included in the study. Suitable patients were initially identified from the ward admission book. Subsequently, relevant data regarding patient admission and management within the two-year period were obtained from the hospital patient management system, including radiology reports.

RESULTS: Out of the 209 patients included in this study, 131 patients (63%) had an MRI as part of the diagnostic process. Most patients were managed non-operatively with only 41 (20%) out of the 209 patients having undergone acute surgery while an inpatient. In this subgroup, 38 had an MRI done prior to surgery. Among the 168 patients who were treated non-operatively, including epidural steroid injection, 13 patients (8%) had elective surgery within one year from their initial presentation.

CONCLUSION: Use of MRI can aid in the early diagnosis and facilitate faster rehabilitation for patients. It can also potentially reduce patient stay in hospital and result in significant cost savings for the healthcare system. Imaging guidelines should be developed in the assessment of patients with low back pain in an acute hospital setting.

Low back pain is a very common condition affecting people worldwide. It can be defined as pain or stiffness affecting the region between the costal angles and gluteal folds and associated with or without leg pain.[1] An acute presentation is defined as low back pain for a duration between 6–12 weeks.[1] The back pain reported is considered to be non-specific when it is not associated with any known pathology such as infection, fracture or sinister causes like cauda equina syndrome or a tumour.[2]

Patients presenting acutely to the emergency department of a secondary or tertiary hospital often require inpatient admission for diagnostic and pain management reasons. The usefulness of MRI imaging in the diagnostic process as well as its influence on the management of the patient has been well documented in the literature.[2–7] However, there are no guidelines for clinicians to use in the assessment and management of acute low back pain in the context of an emergency department or acute hospital ward.

Chou et al in 2009 carried out a systematic review and meta-analysis on the effects of immediate lumbar imaging versus routine clinical care for patients with low back pain on their outcomes of pain and function.[3] They concluded that there was no statistically significant difference between immediate lumbar imaging and routine clinical care at short-term as well as at

long-term follow-up.[3] They added that the use of imaging itself can lead to unnecessary radiation exposure as well as additional invasive procedures.[3] This was further confirmed from a more recent article published by Chou et al in 2011, which showed that patients who had MRI were twice as likely to undergo spinal surgery.[4]

In terms of current available guidelines, Koes et al looked into guidelines published from 13 countries including two European guidelines.[5] All the guidelines were reported to have the same consensus that imaging is not recommended on initial presentation with low back pain unless there is a strong suspicion of serious pathology or red flags.[2,5–7] Imaging is recommended in cases of patients' reporting no improvement in symptoms after 4–7 weeks.[2,5–7] This guideline also includes the current guideline used in New Zealand, which is based on the ACC New Zealand Acute Low Back Pain Guide.[8] The New Zealand guideline further added that MRI is not recommended as a diagnostic test in patients presenting with non-specific low back pain.[8]

In this study, we have focused our attention to patients presenting to the emergency department with an acute episode of low back pain with or without leg symptoms, who subsequently require inpatient admission to an orthopaedic ward. In this context, although most patients will have no serious underlying pathology, it is often difficult to exclude pathology such as infection, fracture, cauda equina compression or tumour.[1–3,5,6,8] These patients often require orthopaedic admission for further investigation and pain management. The aim of this study was to determine how MRI would influence the management of these patients and how the cost of MRI would fit in with the overall cost of hospital expenditure in this patient group.

Method

In this study, we recruited patients presenting to the emergency department of Dunedin Hospital with acute back pain and who were subsequently admitted to the orthopaedic ward.

Figure 1:

INCLUSION CRITERIA OF THE STUDY	
1	Patients admitted acutely with non-specific low back pain from fracture clinic, outpatient clinic or the emergency department.
2	Patients with an acute presentation with a background of chronic back pain.
3	Patients who presented with a possible discitis.
4	Patients referred from within as well as outside of the Southern DHB region.
5	Patients who presented with back pain and thigh/hip/groin pain.
6	Patients who presented with back pain and fever.
7	Patients who presented with back pain associated with radiculopathy or sciatica.

Figure 2:

EXCLUSION CRITERIA OF THE STUDY	
1	Patients admitted to the orthopaedic ward with a confirmed fracture on imaging.
2	Patients referred following a trauma or motor vehicle accident (MVA).
3	Patients with known cancer or spinal metastases.
4	Patients with back pain post-removal of metal ware.
5	Patients admitted as an elective case to the ward.
6	Patients with a history of post-operative spinal infection.
7	Patients admitted with no formal imaging reports.

Patients admitted to the ward were firstly identified from the ward admission book. A total of 358 patients were selected between 1 January 2013 to 31 December 2015. Further details regarding the patient's admission were then obtained from iSOFT (computerised patient management system), which included notes from the emergency department, relevant outpatient clinic notes, imaging reports, operation notes and previous ward discharge summary if applicable. All imaging findings were obtained directly from the formal radiology report via PACS (computerised patient imaging system) that has been checked and reported by a radiologist in Dunedin Hospital.

Data obtained for analysis included age, gender, length of stay, number of previous admissions, main presenting complaint, imaging modality performed and its resulting findings, type of management, type of surgery performed, if applicable, and any elective surgery performed within one year from the patient's initial presentation. A total of 209 patients who satisfied all the inclusion criteria were included in the final analysis.

Results

From this study, we have included 209 patients into our analysis. The data has been stratified and summarised in Table 1A and 1B.

From Table 1A, we identified that there were 96 male patients and 113 female patients admitted to the orthopaedic ward with acute low back pain over the two-year study period. After stratifying the patients into age groups, male patients tended to be more in the older group with the peak seen in the 41–60 age group (48%) followed by the over 60 age group.

For female patients, admissions for low back pain were generally quite evenly distributed among the age groups. However, the peak age group for admission was in the 20–40 age group (35%). This was followed by those over 60 years old, similar to that seen in the male population of this study. In the over 60-years old group, both male and female patients accounted for about one-third of the patients in this cohort.

In terms of the length of stay, more than half of the study population (58%) were admitted for 3–10 days before being discharged. The mean length of stay was 5.4 (SD=4.6) and the median length of stay was four days. One-third of the study population (31%) was admitted for a much shorter course of less than three days. In assessing the number of admissions, majority of the patients were only admitted to the ward once (92%). Only 16 patients (8%) were admitted twice over the two-year admission period and one patient was admitted more than three times.

Table 1A:

Male	Subject	Female
96	Gender count	113
	Age group	
1	<20	4
19	20–40	39
46	41–60	34
30	>60	36

Table 1B:

Length of stay (days)	
<3	64
3–10	122
>10	23
Number of admissions	
1	192
2	16
3 or more	1
Number who had MRI on admission	
Yes	131
No	78
Management	
Acute surgery	41
Non-operative management	156
CT-guided steroid injection	12
Number who had elective surgery within one year	
Yes	13
No	155
N/A	41

Table 2:

Pathology on imaging		Number of patients
Normal		13
Disc prolapse		81
Degenerative disc disease and facet joint	Spondylosis	28
	Disc dehydration	4
	Disc/osteophyte complex	7
Spinal column abnormalities	Scoliosis	16
	Spondylolisthesis	8
	Spondylolysis	2
Spinal stenosis	Present	36
	Absent	95
Nerve root compression	Present	42
	Absent	89
Cauda equina syndrome		4
Vertebral infection/discitis		11
Cancer/metastases		5
Fracture		2

In terms of imaging, a total of 131 patients had an MRI done during admission. The pathology found on MRI imaging is shown in Table 2.

For the purpose of this study, a disc prolapse is defined as all pathology described on the radiology report as disc prolapse, disc herniation, disc bulge, disc protrusion, disc extrusion and disc sequestration. Degenerative disc disease and facet joints also included spondylosis, disc/osteophyte complex and disc dehydration. Spinal stenosis included all cases reported as having spinal stenosis, foraminal stenosis and thecal sac stenosis.

The most common pathology found on MRI was disc prolapse with 81 patients, which accounted for 62% of all patients who had MRI. The second most common pathology was nerve root compression with a total of 42 patients (32%) followed by degenerative disc disease and facet joints with a total of 39 patients (30%). Discitis and vertebral infection were found in 11 patients (8%) and cancer including spinal metastases in five (4%). Only four patients (3%) were found to have a cauda equina compression on MRI.

In terms of patient management, the majority (156 patients) were managed non-operatively (75%). Non-operative management included analgesia, spinal orthoses and physiotherapy. Forty-one patients (20%) out of the 209 study population underwent acute surgery during the admission while 12 patients (5%) received a CT-guided steroid injection. Among the 41 patients who had acute surgery, 38 of them had an MRI while the remaining had other imaging modalities done. This would mean that approximately one-third of the 131 patients in this study who had an MRI subsequently underwent acute surgery. Looking at the data over the two-year study period for patients who were managed non-operatively or had a CT-guided steroid injection, a total of 13 patients out of 168 (8%) underwent elective surgery within one year from their initial presentation.

Figure 3:

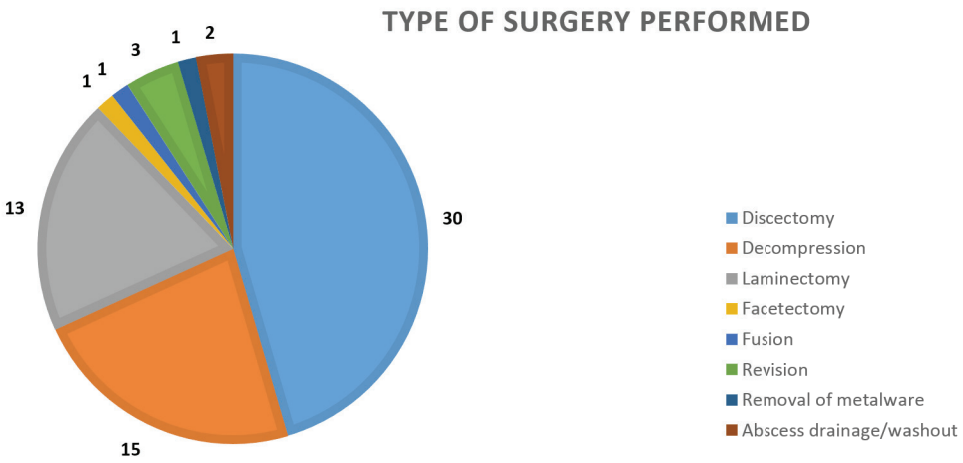
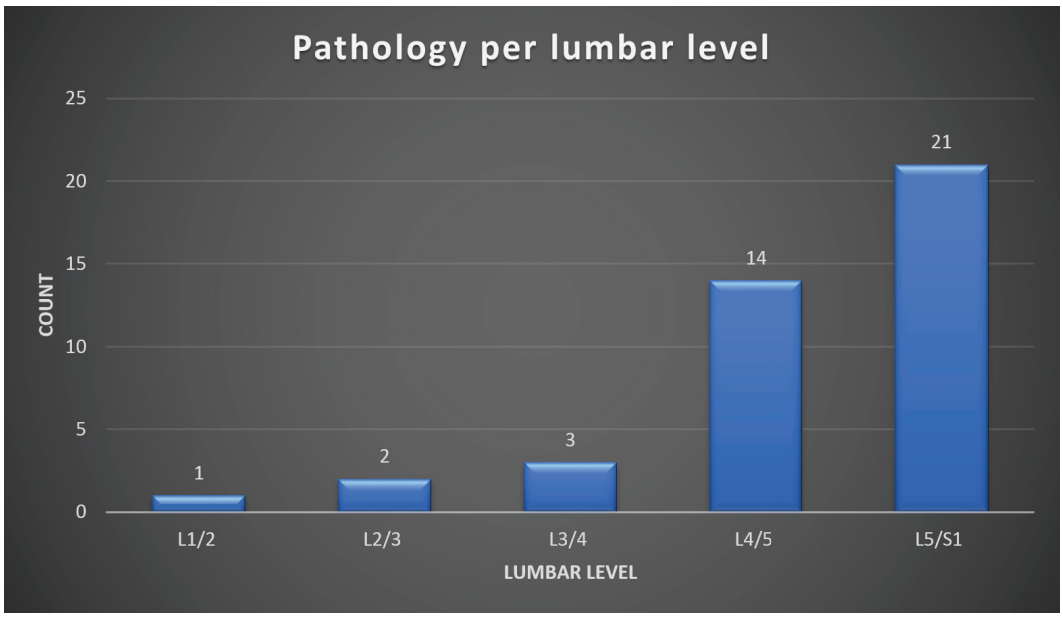


Figure 3 lists the type of surgery performed on the 41 patients who had surgery while an inpatient. The most common operation was a discectomy which accounted for almost 70% of the surgical cases. This was followed by a decompression and laminectomy. Most of the surgery performed involved pathology found in the L5/S1 level accounting for 21 patients and L4/5 level in 14 patients as listed in Figure 4 below.

Discussion

Our study has shown that more than half of patients (63%) admitted to Dunedin Hospital for acute back pain had an MRI to determine the cause of their low back pain. In this subgroup, 38 of them underwent acute surgery while inpatient. A total of 41 patients in this study underwent acute surgery with three of them having a non-MRI imaging modality performed

Figure 4:



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prior to surgery. This makes up about 20% of the 209 study population who underwent surgical management while an inpatient with the majority being treated non-operatively. Of those patients, only 8% underwent elective surgery within one year from their initial presentation. One of the drawbacks of this study is that we were unable to ascertain if some patients might have had surgery done privately or outside the Southern DHB catchment region.

Imaging guidelines for the management of patients with low back pain in an acute hospital inpatient setting have to be different from those developed for general practitioners in the community. The aim of MRI imaging, even in the absence of clinical signs suggesting serious pathology, is to help in the management of the patient and in particular to determine whether there is an underlying surgically treatable pathology including infection and tumour. Being able to reassure the patient that the MRI has not shown any serious pathology will facilitate the rehabilitation, recovery and discharge of the patient.

A study carried out in Scotland and England has shown that patients who underwent early imaging reported an improvement in their symptoms.[9] This was reflected by a significantly lower Aberdeen Low Back Pain score reported in this group.[9] Furthermore, the study also assessed the diagnostic impact of early imaging compared to delayed imaging.[9] It was found that early imaging itself increased the diagnostic confidence of treating physicians significantly, a difference of almost 30%, which was statistically significant.[9]

When taking into account the cost of MRI versus hospital bed stay, it appears that the cost of an MRI is the equivalent of one day in hospital on an acute ward at around NZD$1,300 (Southern DHB Personal Communication, April 2016). If an MRI gets the patient out of hospital quicker, then it has to be seen as a cost-effective investigation. So, looking at the 131 patients in this study who had an MRI scan, the cost can be estimated at around NZD$170,000. If the MRI can save one day of hospital stay, then the cost to the healthcare system would be neutral. However, any additional hospital day saved would have led to a saving of NZD$170,000 in this study or multiples of that amount. Unfortunately, there is often a waiting time of days before the MRI scan is carried out on inpatients with back pain in our institution, which will negate the potential cost saving.

Current evidence has stressed that the most important principle in the assessment of patients with acute low back pain is to provide a thorough history and physical examination.[2,4,6] This is the most cost-efficient tool to assist the clinician in deciding the best approach in terms of investigation and management for the patient.

In the acute hospital setting, early MRI scanning helps identify or confirm the diagnosis and allow a prompt management plan to be put in place, which will be either surgery or non-operative. This has the potential to save hospital costs by reducing the length of stay. Further research is required to identify how early MRI should be performed to produce the best outcomes. Studies are also needed to assess the cost efficiency in performing MRI compared to other diagnostic interventions.

Conclusion

From our study, we have shown that 62% of patients (131 out of 209) admitted with acute low back pain had an MRI scan and that the majority (75%) were treated non-operatively. It is possible that early MRI scanning in all patients admitted with acute low back pain could possibly result in significant cost savings in terms of length of hospital stay, patient recovery and diagnostic confidence.

There is a need to adapt the current acute low back pain guidelines to the hospital setting. Through comprehensive clinical assessment and early MRI imaging, patient outcomes, length of stay and financial efficiency of the healthcare system will be optimised.

Competing interests:
Nil.

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Office design and health: a systematic review

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ABSTRACT

AIM: To carry out a systematic review of recent research into the effects of workplace design, comparing individual with shared workspaces, on the health of employees.

METHODS: The research question was "Does workplace design (specifically individual offices compared with shared workspaces) affect the health of workers?" A literature search limited to articles published between 2000 and 2017 was undertaken. A systematic review was carried out, and the findings of the reviewed studies grouped into themes according to the primary outcomes measured in the studies.

RESULTS: The literature search identified 15 relevant studies addressing health effects of shared or open-plan offices compared with individual offices. Our systematic review found that, compared with individual offices, shared or open-plan office space is not beneficial to employees' health, with consistent findings of deleterious effects on staff health, wellbeing and productivity. Our findings are also consistent with those of earlier reviews.

CONCLUSION: These findings have public health implications for the New Zealand workforce. Decisions about workplace design should include weighing the short-term financial benefits of open-plan or shared workspaces against the significant harms, including increased sickness absence, lower job satisfaction and productivity, and possible threats to recruitment and retention of staff.

In the government, health, and tertiary education sectors of many countries including New Zealand, workplace design is changing from the provision of individual offices for employees, to shared or open-plan workspaces. Open-plan offices can range from large areas with desks arranged in rows, sometimes called "bull pens", to desks separated by dividers of varying heights.[1] Previous reviews of the literature have suggested that open-plan workspaces have deleterious effects on employees,[2,3] so the increasing use of shared workspaces may have public health implications for the New Zealand workforce.

The increasing use of open-plan offices in the public sector reflects earlier changes in corporate workplace design, where open-plan offices were introduced from the 1920s, becoming common by the 1970s.[1,4] Cost-saving is a major driver for open-plan offices, because this design is cheaper to construct, and makes it possible to accommodate more employees in a given area.[5,6] For example, it has been reported that 10–20% of a university's total expenditure can be taken up in space provision, and that cost savings can be made by re-evaluating the amount of space provided for academic and research work.[4] It has been argued that the focus on cost containment and efficiency gains is an example of 'new managerialism'.[4,7] Essentially, this can be understood as the imposition of "managerial techniques, more usually associated with medium and large 'for profit' businesses, onto public sector and voluntary organisations".[7] Beyond considerations of cost, Nikolaeva and Russo note that "power and politics are communicated through the physical space",[8] by which they mean that the design of space gives physical expression to a dominance hierarchy in the workplace.

Arguments that open-plan offices provide flexible and collaborative work spaces are frequently put forward to justify their implementation,[9–11] but employees are seldom consulted,[8] and empirical research

has found that improved accessibility can be outweighed by increased noise and distraction.[12,13] Roderick argues that open-plan workspaces give expression to neo-liberal ideologies that normalise deregulation and 'flexibilisation' of labour.[14] This approach to office design, it is argued, is ideological, not based on empirical findings, and may be not only inimical to the work required but also detrimental to physical and social well-being.[8] Thus, it is important to determine whether the increasing use of shared workspace has health implications for the New Zealand workforce. We provide here a systematic review of recent research into the effects of shared workspace on the health of employees.

Method

We reviewed the literature on the effects of workplace design on health, using the broad WHO definition of health; "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"[15] so that the effects of workplace design on psychological wellbeing and job satisfaction would be included, as well as outcomes such as sickness absence. The research question was "Does workplace design (specifically individual offices compared with shared workspaces) affect the health of workers?"

The search was conducted using Medline, Embase, PsychInfo, Sociological Abstracts, Web of Science, Scopus, Education Source, EBSCO and Google Scholar. Keywords included: interior design and furnishings; facility design and construction; open-plan; office or workplace; design or layout or space; hot-desk; sick leave; noise occupational; psychology, industrial; absenteeism; efficiency; job satisfaction; presenteeism; task performance and analysis; time and motion studies; work simplification; time management; workplace productivity or performance or privacy; efficiency. The search was limited to publications in English, published between 2000 and 2017. Reference lists of the publications meeting our inclusion criteria (please see Results section below) were also searched.

Because most of the published research on workplace design and health, job satisfaction and productivity is observational, and some studies generated qualitative findings, this is a systematic review rather than a meta-analysis, although we used the PRISMA framework[16] as a guide. The findings of the reviewed studies have been grouped into themes according to the primary outcomes measured in the studies.

Results

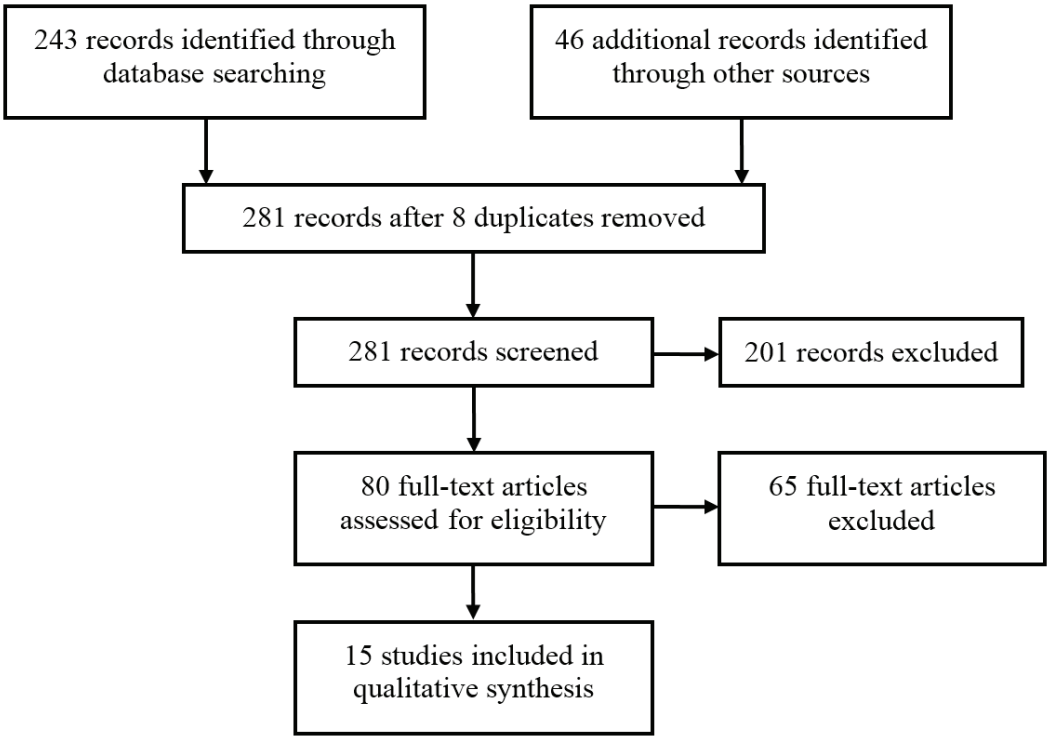
The literature search identified 15 relevant studies (Figure 1) addressing the health effects of shared or open-plan offices compared with individual offices, published between 2000 and 2017. The 15 relevant studies were observational rather than interventional studies, and differed in primary outcomes, so we were unable to carry out a meta-analysis. We used a consistent approach to determining study quality by assessing threats to internal validity (chance, bias and confounding) and external validity (generalisability); summarised in the comments column in Table 1.

Studies were excluded if they (i) did not address the research question about whether workplace design (specifically individual offices compared with shared workspaces) affects the health of employees (studies on co-working spaces, aspects of open-plan office design such as cubicle size, partition height, lighting, indoor air quality, thermal control, noise masking techniques and ergonomics were excluded), (ii) were not published in peer-reviewed journals, (iii) were opinion pieces or case studies, (iv) were review articles rather than reports from individual studies. The findings of the 15 studies are reported below grouped into themes according to the primary outcomes measured in the studies (sickness absence; health and wellbeing; job satisfaction; concentration), and summarised in Table 1.

Sickness absence

A national cross-sectional survey of 14,969 Danish employees aged 18–59 years, working in a variety of office environments (response proportion 62%), found that sickness absence was higher in open-plan than in cellular (individual) offices. Sickness absence was statistically significantly related to having a greater number of occupants in the office after adjusting for confounding by age, sex, socioeconomic status, body mass index, alcohol consumption, smoking habits and physical activity during leisure time. Compared to cellular offices, occupants in

Figure 1: Identification of relevant research.



two-person offices had 50% more days of sickness absence; relative risk (RR) 1.50, 95% confidence interval (95% CI) 1.13–1.98; occupants in three- to six-person offices had 36% more days of sickness absence (RR 1.36, 95% CI 1.08–1.73); and occupants in open-plan offices (>6 persons) had 62% more days of sickness absence (RR 1.62, 95% CI 1.30–2.02).[17]

A Swedish longitudinal study of 1,852 employees aged 16–64 (response proportion 57%) found similar results, adjusted for sex, age, labour market sector and job rank.[18] Elevated risks of short sickness absence (a week or less) were found among employees in open-plan offices compared with individual offices. Odds ratios (OR) were reported, with employees in small open-plan offices (OR 1.9, 95% CI 1.16–3.1) medium-sized open-plan offices (OR 1.92, 95% CI 1.08–3.4) and large open-plan offices (OR 1.82, 95% CI 1.14–2.88) statistically significantly more likely to have sick leave than those in individual offices. The only statistically significant result for long sickness absence (more than a week) was for women in large open-plan offices (OR 2.14, 95% CI 1.08–4.26).

Health and wellbeing

A 12-month longitudinal study of 71 employees in Sweden (response proportion 70%) who moved from individual offices to open-plan offices found a statistically significant deterioration in perceived health ($p=0.002$) and performance ($p=0.026$) 12 months after the employees had moved from individual offices to an open-plan office space.[19]

A cross-sectional study of 207 German insurance workers with similar jobs, in offices with different workspace density (from individual offices up to open-plan with 30 occupants), was undertaken to determine whether workspace density was associated with physical and mental health.[20] The response proportion to an online survey was 83%, with respondents asked to state the number of people working in their enclosed office space. Logistic regression analysis, adjusted for age, showed that higher workspace density was associated with higher psychosocial work stressors and environmental dissatisfaction, which, in turn, were associated with poorer physical health ($p<0.05$), emotional and cognitive irritation ($p<0.05$), and lower mental work ability ($p<0.001$).

In an Australian cross-sectional study, 1,000 office workers who had volunteered to participate in research completed an online questionnaire that was designed to collect data on the socioemotional effects of shared workspaces.[21] The questionnaire sought information on the extent of sharing in the workspace, 'demands' such as distractions, uncooperative behaviours, distrust and negative relationships, and 'resources' (positive aspects of sharing) such as co-worker friendships and supervisor support. The study found that shared work environments, particularly hot-desking, were associated with higher demands ($p=0.009$) and lower friendship opportunities ($p=0.013$). Shared work environments were associated with perceptions of less supportive supervision ($p=0.001$).

Job satisfaction

A post-occupancy survey compared two newly-designed academic environments in the UK. The first (environment A) was a design where 32 academics had access to shared resources and their own workspaces in an open-plan area. The second (environment B) was a design where 28 academics had access to shared resources and their own designated individual offices. Self-administered questionnaires were used (response proportions were not provided). Occupant satisfaction was reported as statistically significantly higher for environment B than for environment A; however, some measures used to assess satisfaction differed between the two environments, and p values were not provided.[22]

The University of California at Berkeley Center for the Built Environment carried out an analysis of their database of responses to surveys of 42,764 office workers in a variety of workplaces.[23] The surveys used a validated, standardised instrument; the Post-Occupancy Evaluation questionnaire, one of the most widely-used instruments to survey workers about their satisfaction with the indoor environmental quality (IEQ) of their work places, including overall satisfaction, temperature, sound privacy, visual privacy, noise level, ease of interaction, cleanliness and building maintenance. Enclosed private offices outperformed open-plan offices on all aspects of IEQ ($p<0.05$), except cleanliness and building maintenance. Benefits of enhanced ease of interaction were reported to be "smaller than the penalties of increased noise level and decreased privacy resulting from open-plan office configuration" and the authors concluded that "our results categorically contradict the industry-accepted wisdom that open-plan layout enhances communication between colleagues and improves occupants' overall work environmental satisfaction".[23]

A longitudinal study of 80 individuals who were relocated from traditional to open-plan offices was undertaken in Canada. This study had been requested by the organisation in which the relocation took place, to assess the long-term effect of the office redesign on employee satisfaction and productivity and to determine whether the change to open-plan offices should be implemented across the whole organisation. Three questionnaires were distributed to 80 employees, and 21 participants returned all the questionnaires at all three time intervals, prior to the move, four weeks after the move and five months after the move (26% response proportion). Open-plan working was associated with decreased employee satisfaction ($p<0.01$), including a decline in team-member relations ($p=0.001$) and perceived job performance ($p<0.01$), and increased stress ($p<0.01$). This did not abate after a six-month adjustment period. The primary concerns of participants were increased noise and lack of privacy and confidentiality.[1]

A cross-sectional study of 93 full-time white-collar workers (sampling method and response proportion not reported) in a variety of jobs at a university in the US found that the association between workspace density and employee reactions could not be "fully understood unless one also accounts for additional organisational variables, namely job characteristics and tenure".[24] Overall, workspace density was negatively correlated with job satisfaction ($p\leq0.05$) and organisational commitment ($p\leq0.05$). High workspace density was inversely associated with job satisfaction for people with high job-complexity and high organisational tenure ($p\leq0.05$). Job satisfaction was not associated with workspace density for those with high job-complexity and low tenure, or those with low job-complexity irrespective of tenure.

A longitudinal study involving 73 workers in three departments was carried out in the Netherlands. Although this was reported as a case study, it can also be described as a small longitudinal study of workers who made the transition from a traditional work environment, where each department had its own workspace, to a new flexible office layout. The new layout comprised a single shared area with a variety of workspaces (such as meeting rooms and silent open workspaces) and the ability to work from home or other remote locations, with flexible work hours (called "New Ways of Working" or NWW). All 73 workers received an online questionnaire during the transition (response proportion 79%) and 60 (the reduced number of participants is not explained in the paper) received a second online questionnaire six months later (response proportion 87%), with 39 workers completing both questionnaires. NWW was associated with increased ability to work flexibly in time and location, with 60% of work time spent at the office building and the remaining time at home, travelling or working elsewhere. Compared with the traditional environment, now when they were at the office, employees worked in the open area (61% of the time), meeting rooms and team rooms (38% of the time) or phone booths (1% of the time). There was no change in collaboration, employees' satisfaction or perceived suitability of the environment to perform work tasks. Knowledge sharing decreased but this was not a statistically significant change. Suggested reasons that the change to a flexible office layout did not deliver the anticipated benefits were that the NWW had not been fully implemented or that, contrary to expectations, the NWW was not beneficial.[25]

Also in the Netherlands, a post-occupancy survey was carried out when the Faculty of Architecture at Delft University of Technology relocated from a building with individual offices (after a fire destroyed the building) to "New Ways of Working" including 'non-territorial' office space. In the new space, administrative staff were assigned personal desks but there was desk sharing and a 'clear desk' policy for all other staff. Personal storage space was limited, but there was shared storage space in communal areas. An online survey was completed by 266 employees (26% response proportion), and 83 employees also completed a three-day diary describing their daily activities. Overall, when comparing their new work situation with their previous individual offices, employees were less satisfied with their own work situation ($p<0.001$) and the accommodation for their department ($p<0.005$), but there was no change in satisfaction with the accommodation for their faculty. Perceived advantages of the new space were the opportunities to meet other people, and to have informal conversations. Perceived disadvantages were lack of suitable spaces for confidential (telephone) conversations, insufficient visual and auditory privacy, and lack of secure storage. It was reported to be more difficult to find staff after the relocation. Respondents were more likely to work at home after the relocation; working at home for 26.6% of their time, compared with 15.6% in the former situation ($p<0.001$). The occupancy level in the new environment was 27%.[26]

Preliminary results of a Swedish longitudinal study of 1,852 employees aged 16–64 (response proportion 57%) of office type on job satisfaction showed that hot-desking was associated with statistically significantly lower scores ($p<0.05$) on factors important for job satisfaction, such as decision authority and social support.[27] The results of this study in relation to sickness absence are reported above.[18]

Concentration

A Swedish cross-sectional study of 1,445 individuals (69.5% of the 2,078 approached to take part) in five organisations, examined the impact of office type on concentration. The study found that concentration was better in individual offices than in open-plan. Individual offices were associated with the lowest levels of distraction ($p<0.001$) and cognitive stress ($p<0.001$), particularly for employees who rated their work as requiring a high need for concentration. There were no statistically significant associations reported between office type and emotional exhaustion, depersonalisation, personal efficacy or self-reported health, but the authors stated their study may have lacked power to find significant associations.[28] Memory performance of the workers was assessed using an immediate free recall test, once in quiet

conditions (with telephones, computer sounds and email alerts switched off, the doors of individual offices closed and no talking with other workers in open-plan areas until the test had been completed) and later repeated in normal working conditions. There was a statistically significant ($p<0.001$) decline in memory performance at the second test in individual offices and large open-plan offices, but not in small open-plan offices.[29] An advantage of this study was that the outcome measures were independently assessed rather than self-reported, but the order of the quiet and noisy conditions was not randomly allocated, and the investigators acknowledged this as a limitation. Another limitation was possible selection bias if workers with poor inhibition abilities avoided employment in open-plan offices.[29] A subsequent analysis of data from 1,205 participants (those who had changed workstations, had been on parental leave or other long periods of leave, or who failed to answer more than two of the personality trait questions, were excluded) investigated the combined effects of office type and personality traits on self-reported distraction, job satisfaction and job performance.[30] There was a positive association between agreeableness and distraction, which was stronger in occupants of open-plan than individual offices ($p=0.018$). Interactions between personality and office type did not appear to affect job satisfaction or performance, apart from more conscientious people in cellular offices reporting greater job satisfaction than more conscientious people in open-plan offices.[30]

Table 1: Summary of studies included in the systematic review.

Source	Study type	Sample size	Response proportion	Comparison	Outcome measure	Results	Comments, and risk of bias
Pejtersen et al 2011[17]	National cross-sectional	14,969	62%	Open-plan compared with individual offices	Sickness absence	Relative risk 1.62 (1.30–2.02)	National population sample with moderate response proportion reduces selection bias. Self-reported sickness absence; possible recall bias (but self-report validated in other published research). RR adjusted for confounding by age, sex, socioeconomic status, BMI, alcohol, smoking and physical activity.
Bodin Danielsson et al 2014[18] Danielsson 2016[27]	Longitudinal	1,852	57%	Open-plan compared with individual offices	Sickness absence Job satisfaction	Odds ratio 1.82 (1.14–2.88) Hot-desking was associated with statistically significantly lower scores ($p<0.05$) than individual offices.	Nationally representative sample with moderate response proportion. Self-reported sickness absence, but prospective study (two survey waves, two years apart). OR adjusted for confounding by sex, age, labour market sector and job rank.
Bergstrom et al 2015[19]	Longitudinal	71	70%	Move from individual to open-plan offices	Perceived health Performance	Deteriorated ($p=0.002$) Deteriorated ($p=0.026$)	High response proportion. Self-assessment of health and performance. Self-administered confidential questionnaires, one month prior, then three months and six months after move.
Herbig et al 2016[20]	Cross-sectional	207	83%	Workspace density (Higher compared with lower workspace density)	Physical health Emotional and cognitive irritation Mental work ability	Poorer ($p<0.05$) Increased ($p<0.05$) Lower ($p<0.001$)	High response proportion. Online survey of workers with similar jobs, in offices with different workspace density (but all employed by one company). Logistic regression analysis, adjusted for age.
Morrison and Macky 2017[21]	Cross-sectional	1,000	100%	Open-plan compared with individual offices (Extent of sharing)	Workplace demands Friendship opportunities	Higher ($p=0.009$) Lower ($p=0.013$)	Volunteer sample may reduce external validity. Confidential online questionnaire.

Table 1: Summary of studies included in the systematic review (continued).

Haynes et al 2011[22]	Post-occupancy survey	60	Not reported	Open-plan compared with individual offices	Satisfaction	Statistically significantly higher for individual offices.	Small sample. Response proportion not reported. Some measures used to assess satisfaction differed between the two environments, and p values were not provided.
Kim and de Dear 2013[23]	Analysis of database of post-occupancy surveys	42,764 (303 office build-ings)	Not reported	Open-plan compared with enclosed, private offices	Overall satisfaction Amount of space Noise level Visual privacy	Mean satisfaction scores statistically significantly lower for open-plan offices.	Response proportion not reported. Standardised, validated post-occupancy survey. Regression model showed ease of interaction did not offset the negative impacts of noise and lack of privacy on open-plan occupants' workspace satisfaction.
Brennan et al 2002[1]	Longitudinal field study	80	26% (to all 3 surveys)	Move from individual to open-plan offices	Satisfaction Team member relations Perceived job performance Physical stress	Declined (p<0.01) Declined (p=0.001) Declined (p<0.01) Increased (p<0.01)	Low response proportion; selection bias likely. Self-administered confidential questionnaires, prior, four weeks, and five months after move.
Fried et al 2001[24]	Cross-sectional	93	Not reported	Workspace density in a US university	Job satisfaction	Inversely associated with workspace density for those with high job complexity and high tenure (p<0.05). No association for high job complexity and low tenure, or low job complexity irrespective of tenure.	Small sample. Sampling method and response proportion not reported. Selection bias may affect findings. Workspace density was measured by the researchers. Job complexity and job satisfaction were self-assessed by respondents, using validated instruments.
Blok et al 2012[25]	Longitudinal	73	79% of 73 (survey 1) 87% of 60 (survey 2) 53% of 73 (both)	Move from traditional offices to a shared workspace including a variety of spaces and ability to work remotely.	Satisfaction Collaboration Knowledge sharing Flexibility in time and location of work	No change No change Decreased (but not statistically significant) Increased (greater variety of locations available)	Only 53% responded to both surveys—possible selection bias. All 73 employees of three departments moving to a new shared workspace were sent an online survey during the transition and 60 were sent the survey six months later.
Gorgievski et al 2010[26]	Post-occupancy survey	266	26%	Move from individual offices to 'non-territorial' shared office space.	Satisfaction with own work situation. Working from home. Opportunities for informal conversations	Decreased (p<0.001) Increased (p<0.001) Improved (p value not provided)	Low response proportion—likely selection bias. Online survey—secure website, independent research organisation. Occupancy level in the new environment was 27%.
Seddigh et al 2014[28] Seddigh et al 2015[29] Seddigh et al 2016[30]	Cross-sectional	1,445 (Five organi-sations)	66%	Open-plan compared with individual offices.	Concentration, distraction, and cognitive stress Memory test (initially in quiet conditions, then repeated in normal working conditions)	Individual offices associated with lower distraction (p<0.001) and cognitive stress (p<0.001). Performance declined (p<0.001) at repeated memory test in individual offices and large open-plan offices, but not small open-plan offices.	Moderate response proportion. Online survey (excluded employees who had recently changed workstation, spent <50% of working time in the office, or <25% at their designated workstation). Order of the memory tests not randomly allocated. Possible selection bias if workers with poor inhibition abilities avoid open-plan offices.

Discussion

Our systematic review found that, compared with individual offices, the introduction of shared or open-plan office space is remarkably consistent in its consequences, with every study reporting deleterious effects on employees' health.[1,17–30] One of these studies reported that moving to a shared workspace increased flexibility in time and location of work,[25] and one reported improved opportunities for informal conversations.[26] These were the only positive outcomes reported and neither reported statistical significance, whereas other studies reported that open-plan offices were associated with a statistically significant decline in team-member relations,[1] statistically significantly lower friendship opportunities than individual offices[21] and one reported that any benefits of increased interaction were outweighed by the penalties of increased noise levels and lack of privacy.[23] Although the studies included in this systematic review were observational, so causation cannot be demonstrated, and some studies had small samples and/or low response proportions, the consistency of the deleterious findings is impressive. If there were no negative consequences of open-plan offices on health, such consistency in findings would be highly unlikely.

Our findings are also consistent with those of earlier reviews.[2,3,31] In their systematic review, De Croon et al found "strong evidence that working in open workplaces reduces privacy and job satisfaction, and limited evidence that working in open workplaces intensifies cognitive workload and worsens interpersonal relations".[2] The authors of that systematic review also cautioned that open-plan offices may adversely affect an organisation's cost-efficiency as well as the work conditions and wellbeing of office workers.[2] Oommen et al found that "research evidence shows that employees face a multitude of problems such as the loss of privacy, loss of identity, low work productivity, various health issues, overstimulation and low job satisfaction when working in an open-plan work environment."[3] In their recent review, Al Horr et al found that office layout is one of the most important factors affecting productivity, through distraction (negative effect on productivity) or interaction (positive effect on productivity).[31] Avoiding distraction is more important than opportunities for interaction for workers performing complex tasks, with reported distraction frequency highest among open-plan office occupants and lowest in single-room occupants.[31]

Surveys of staff working in open-plan offices have found that, although most believe that open-plan work environments encourage teamwork, respondents do not prefer to work in open-plan offices. Reasons for not preferring open-plan work environments include distraction, difficulty concentrating and loss of privacy in open-plan offices[32] and, in a university environment, lack of privacy, lack of security of personal items and information in a shared space, reduced access for students, difficulties in providing counselling to students and negative effects of noise and distraction on the mental concentration required for preparing lectures and research applications.[4,33] One of the findings illustrated in the quote below was that allocation of only some staff to individual offices may send unwelcome signals about the social order of the organisation:

"And the thing that sticks in most people's gullets is that the people who advocate open plan don't work in them themselves. To me that's double standards".[4]

Given the consistent findings that shared and open-plan work environments adversely affect the health and productivity of their occupants, the short-term financial benefits of open-plan or shared workspaces should be balanced against the harms of these types of workplace, including increased sickness absence (which may be associated with the easier transmission of infectious agents in open-plan spaces as well as impacts on psychological wellbeing), lower job satisfaction and productivity, and possible threats to recruitment and retention of staff. Employers and managers will need to consider this imbalance of benefits and harms when making decisions about workplace design, and should recognise that workplace design affects people differently according to their personal characteristics and the type of work they do, with open-plan offices particularly detrimental where work requires high levels of concentration.[9,21,34,35] A "one size fits all" approach does not suffice.

Where the decision to introduce shared or open-plan work environments is made, it should be acknowledged that this is a cost-based decision rather than an initiative to improve working conditions or productivity.[6,8,14] Employers and managers should be honest about this, and should not claim that there will be benefits to workers from changing to shared office space, because, as this and earlier reviews show, little evidence for such benefits exists. In open-plan workplaces where staff handle confidential documents; such as health records, research data with identifiable personal information, or identifiable patient data, ways to avoid contravening ethics committee requirements and relevant health and privacy legislation are required.

The findings of this systematic review have public health implications for the New Zealand workforce. Decisions about workplace design should include weighing the short-term financial benefits of open-plan or shared workspaces against the significant harms, including increased sickness absence, lower job satisfaction and productivity, and possible threats to recruitment and retention of staff.

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Characteristics of and differences between Pasifika women and New Zealand European women diagnosed with breast cancer in New Zealand

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ABSTRACT

AIM: Breast cancer in New Zealand-based Pasifika women is a significant issue. Although Pasifika women have a lower incidence of breast cancer compared to New Zealand European women, they have higher breast cancer mortality and lower five-year survival. The aim of this study was to describe the characteristics and tumour biology of Pasifika women and to compare New Zealand European women to identify what factors impact on early (Stage 1 and 2) vs advanced stage (Stage 3 and 4) at diagnosis.

METHOD: Data on all Pasifika and New Zealand European women diagnosed with breast cancer (C50) during the period 1 June 2000 to 31 May 2013 was extracted from the Auckland and Waikato Breast Cancer Registries. Descriptive tables and Chi-square test were used to examine differences in characteristics and tumour biology between Pasifika and New Zealand European women. Logistic regression was used to identify factors that contributed to an increased risk of advanced stage at diagnosis.

RESULTS: A significantly higher proportion of Pasifika women had advanced disease at diagnosis compared to New Zealand European women (33.3% and 18.3%, respectively). Cancer biology in Pasifika women was more likely to be: 1) HER2+, 2) ER/PR negative and 3) have a tumour size of ≥50mm. Pasifika women live in higher deprivation areas of 9–10 compared to New Zealand European women (55% vs 14%, respectively) and were less likely to have their cancer identified through screening. Logistic regression showed that if Pasifika women were on the screen-detected pathway they had similar odds (not sig.) of having advanced disease at diagnosis to New Zealand European women.

CONCLUSION: Mode of detection, deprivation, age and some biological factors contributed to the difference in odds ratio between Pasifika and New Zealand European women. For those of screening age, adherence to the screening programme and improvements in access to earlier diagnosis for Pasifika women under the current screening age have the potential to make a substantial difference in the number of Pasifika women presenting with late-stage disease.

Breast cancer is a significant health issue for women in New Zealand. There are approximately 3,000 registrations and around 600 deaths during 2012.[1] One hundred and twenty Pasifika women were registered during the calendar year 2012, with 31 deaths of Pasifika women with breast cancer during the same period.[1] Differences for indigenous and ethnic minority populations around the world are well documented.[2–5] Within New Zealand there are many examples of inequitable outcomes that disadvantage minority populations.[6–13] Māori and Pasifika women with breast can-

cer have been shown to have much poorer outcomes than their New Zealand European counterpart. This is often characterised by the frequency of late-stage disease at diagnosis.[14–16]

'Pasifika' is a broad name for a heterogeneous group with a long history of migration to New Zealand from an array of island nations. Pasifika people are currently the fourth largest ethnic group in New Zealand, accounting for 7.4% of the New Zealand population.[17] The primary Pasifika population groups in New Zealand are Samoan, Cook Island, Tongan, Niuean, Fijian and Tokelauan. The average age of the Pasifika population is younger than other groups at 21.1 years, compared to 41.0 years for New Zealand European. Approximately two-thirds of the current New Zealand Pasifika population are New Zealand born.[17]

Pasifika women have been found to have a lower breast cancer incidence compared with other ethnic groups[9,18] but have an increased risk of breast cancer-specific mortality compared to New Zealand European women (Hazard ratio (HR) 1.25 (Confidence Interval (CI) 0.94, 1.68)).[12,19] Pasifika women are predominantly younger at diagnosis, come from more deprived areas and have larger tumour size with more ductal histology.[19] Sarfati et al (2005) found that during the 1980s to end of 1990s Pasifika women had a three-fold increase in breast-cancer mortality, from 11 to 96 deaths during the period.[12] Some of the major causes of disparity between the ethnic groups in New Zealand have been attributed to higher levels of deprivation and in particular, inadequate access to healthcare.[20–22]

The aim of this study was to describe the characteristics and tumour biology of Pasifika women and compare to New Zealand European women registered on the Waikato and Auckland Breast Cancer Registers during 1 June 2000 and 31 May 2013. The purpose was to consider which factors, including ethnicity, deprivation and mode of detection, impact on early (Stage 1 and 2) vs advanced stage (Stage 3 and 4) at diagnosis and to determine differences in cancer biology between all women recorded as 'Pasifika' and compare to New Zealand European women. Understanding the factors that contribute to poorer outcomes are important in addressing where to improve service provision.

Methods

Data sources

Data on all Pasifika and New Zealand European women diagnosed with breast cancer (C50) during the period 1 June 2000 to 31 May 2013 was extracted from the Auckland and Waikato Breast Cancer Registries (referred to as the combined register). Both registries are computer-based databases that confidentially capture all women diagnosed with breast cancer within their region. All women are placed on the register but can opt out if desired. The Waikato Breast Cancer Register began collecting data in November 2004, but undertook a back-dating project to complete records back to 1999. The Auckland Breast Cancer Register began in June 2000. Data collected and recorded on the register databases included: demographic details, mode of and characteristics at presentation, comorbidities (also from the National Minimum Data Set (NMDS)), investigations and information on the management of the disease, follow-up and outcomes.

The combined register was linked to National Ministry of Health (MOH) datamart via patient National Health Index number (NHI). The NHI is a unique identifier assigned to all individuals that are New Zealand residents. National MOH datamart included the New Zealand Cancer Register (NZCR), NMDS (or hospital discharge data), Mortality Collection (MORT) and Death Certificates.

Study population

All Pasifika and New Zealand European women with an invasive breast cancer registration in the Auckland and Waikato Regions during the period 1 June 2000 to 31 May 2013 were included in the study.

Study covariates

Ethnicity

Ethnicity was collated from all datasets using Statistics New Zealand Ethnicity Classification. This classification system is a hierarchical structure with four levels. For this study, ethnicity has been coded to level two.[23] Pasifika ethnicity was assigned to a patient if they had any of the level one

or two ethnicity codes of 30 to 37, on any dataset.[23] Pasifika ethnicity was assigned from the datasets as follows: the combined registers: 832 women, and the MOH databases: 109 women. From the NZCR, it was identified 20 women on the combined register had dual Māori and Pasifika ethnicities assigned and were included in the analysis as Pasifika.

Deprivation

Deprivation is derived by domicile at diagnosis. The New Zealand Deprivation Index (Dep Index) is a measure of nine factors (transport access, benefit, employment, income, communication access, single parent family, education, living space and home ownership) collected in the national census.[24] The Dep Index is a scale of 1 to 10, least deprived to most deprived.

Stage

Cancer stage at diagnosis is classified from clinical notes within the respective breast cancer registers. Tumours are categorised into four cancer stages based on the size of the tumour and the extent of spread. Stage 1 is small and confined within the organ. Stage 2 usually means the cancer has not spread onto surrounding tissue but may have spread to the lymph nodes close to the tumour. Stage 3 is a larger cancer with some spread to the surrounding tissue and lymph nodes. Stage 4 is the spread of the cancer to other organ/s. Advanced disease is defined as Stage 3 and 4.[25]

Comorbidity—Cancer, Care and Comorbidity Index (C3)

Comorbidities were identified from the National Minimum Data Set (NMDS) or hospital discharge data—those that had a hospital stay. Comorbidities were scored using the C3 score, a validated alternative to the Charlson and NCI indices in cancer populations.[26] The index collects up to 50 conditions to achieve a score. C3 only considers conditions that require hospital admission and overnight stay. Each registered comorbidity is coded on to the NMDS, which is a collection of all patient presentations (overnight) to hospital and if the comorbidity is recorded during the visit by a healthcare practitioner on the clinical note.

Mode of detection

Mode of detection has been categorised into two groups: screen-detected and non-screen detected. 1) Screen-detected: in New Zealand Breast Screen Aotearoa (BSA), a publicly funded national screening programme that facilitates the access of women that fit eligibility criteria to attend and participate in the breast screen programme was introduced in December 1998. The screening programme was originally targeting women in the 50- to 64-year age bracket. The age range was extended during 2004 to include the following criteria: aged between 45 and 69 years; no symptoms of breast cancer; no mammogram in the previous 12 months; not pregnant/breastfeeding; New Zealand resident. Mammograms are available two-yearly for eligible women.[27] Breast screening can still be undertaken in private facilities at patient expense. 2) Non-screen detected: are all those cancers not detected through screening and include those identified symptomatically.

Statistical analyses

Statistical analysis was performed in SPSS (IBM Corporation, New York, NY, USA. Characteristics of women diagnosed with breast cancer are presented in descriptive tables. Chi-square testing for the difference between Pasifika and New Zealand European women was undertaken. Incidence-rates were calculated per 1,000 cases in two age categories: <45 years (pre-screening age) and 45–69 years (screening age). Binary logistic regression was used to identify factors that contribute to the risk of being diagnosed with advanced stage disease (Stage 3 and 4) compared to early stage breast cancer (Stage 1 and 2) in Pasifika compared to New Zealand European women. Factors that were included were: ethnicity, age, year of diagnosis, mode of detection, deprivation, location (Auckland/Waikato), comorbidity score, oestrogen receptor status (ER), progestogen receptor status (PR) and human epidermal growth factor receptor 2 status (HER2). Stage of disease at diagnosis was examined as not-advanced (Stage 1 and 2) and advanced (Stage 3 and 4).

Ethical approval for the use of retrospective patient health data was granted for the study through the Northern A Health and Disability Ethics Committee, reference: 12/NTA/42/AM01.

Results

There were 14,456 breast cancers registered on the combined register. A total of 11,267 were identified as Pasifika or New Zealand European, 941 and 10,326, respectively. Māori and other ethnic groups (n=3,189) were excluded. In-situ (Stage 0) cancers were excluded, leaving 9,780 invasive primary breast cancers; 853 Pasifika women and 8,927 New Zealand European women (Table 1). Two-thirds of Pasifika women were under 60 years old at the time of their diagnosis, compared to half of New Zealand European women. The average age for Pasifika and New Zealand European women was 54 years and 60 years, respectively. Pasifika women were more likely than New Zealand European women to be pre-menopausal at the time of their diagnosis (40.9% vs 26.7%, respectively).

Table 1: Distribution of patient and tumour characteristics comparing Pasifika and New Zealand European women registered in the Auckland and Waikato Breast Cancer Registers (2000–2013).

	Pasifika women		**NZ European women**			
	All stage	**Advanced**	**All stage**	**Advanced**		
	n (%)	**n (% of all stage)**	**n (%)**	**n (% of all stage)**	**Odds ratio (OR)**	**P value**
Age at diagnosis						
<45 years	208 (24.4)	91 (43.8)	1,128 (12.60	314 (27.8)	2.02	<0.001
45–69 years	541 (63.4)	157 (29.0)	5,524 (61.9)	859 (15.6)	2.22	<0.001
70+ years	104 (12.2)	36 (34.6)	2,275 (25.5)	459 (20.2)	2.09	<0.001
Total	853 (100)	284 (33.3)	8,927 (100)	1,632 (18.3)	2.23	<0.001
Stage at diagnosis						
Stage 1	240 (28.1)		4,000 (44.8)			
Stage 2	329 (38.6)		3,291 (36.9)			
Stage 3	196 (23)		1,283 (14.4)			
Stage 4	88 (10.3)		349 (3.9)			
Unknown	0 (0)		4 (0.04)			
Menopausal status						
Pre	349 (40.9)	139 (39.8)	2,383 (26.7)	541 (22.7)	2.25	<0.001
Peri	33 (3.9)	8 (24.2)	449 (5)	74 (16.5)	1.62	0.3653
Post	443 (51.9)	130 (29.3)	5,937 (66.5)	998 (16.8)	2.06	<0.001
Unknown	28 (3.3)	7 (25)	158 (1.8)	19 (12)		
C3 score						
0	631 (74.0)	212 (33.6)	6,969 (78.1)	1,248 (17.9)	2.32	<0.001
1	69 (8.1)	24 (34.8)	724 (8.1)	141 (19.5)	2.21	0.0045
2	61 (7.2)	18 (29.5)	511 (5.7)	100 (19.6)	1.72	0.0998
3	92 (10.8)	30 (32.6)	723 (8.1)	143 (19.8)	1.96	0.007
Year of diagnosis						
2000–2003	168 (19.7)	56 (33.3)	2,249 (25.2)	386 (17.2)	2.41	<0.001
2004–2006	192 (22.5)	64 (33.3)	1,944 (21.8)	379 (19.5)	2.06	<0.001
2007–2009	220 (25.8)	76 (34.5)	2,132 (23.9)	423 (19.8)	2.13	<0.001
2010–2013	273 (32.0)	88 (32.2)	2,602 (29.1)	444 (17.1)	2.31	<0.001

Table 1: Distribution of patient and tumour characteristics comparing Pasifika and New Zealand European women registered in the Auckland and Waikato Breast Cancer Registers (2000–2013) (continued).

Region						
Auckland	801 (93.9)	264 (33)	6,717 (75.2)	1,191 (17.7)	2.28	<0.001
Waikato	52 (6.1)	20 (38.5)	2,210 (24.8)	441 (20)	2.51	0.0019
Deprivation						
1–2	42 (4.9)	14 (33.3)	2,183 (24.5)	372 (17)	2.43	0.0106
3–4	47 (5.5)	19 (40.4)	1,612 (18.1)	265 (16.4)	3.45	<0.001
5–6	99 (11.6)	25 (25.3)	2,027 (22.7)	357 (17.6)	1.58	0.0720
7–8	188 (22)	60 (31.9)	1,765 (19.8)	377 (21.4)	1.73	0.0013
9–10	466 (54.6)	160 (34.3)	1,264 (14.2)	251 (19.9)	2.11	<0.001
Missing	11 (1.3)	6 (54.5)	76 (0.9)	10 (13.2)		
Mode of detection						
Not screen detected	593 (69.5)	258 (43.5)	5,405 (60.5)	1,381 (25.6)	2.24	<0.001
Screen detected	260 (30.5)	26 (10)	3,522 (39.5)	251 (7.1)	1.45	0.1112
Grade						
1	140 (16.4)	17 (12.1)	2,151 (24.1)	111 (5.2)	2.54	0.0010
2	361 (42.3)	110 (30.5)	3,937 (44.1)	678 (17.2)	2.11	<0.001
3	297 (34.8)	130 (43.8)	2,340 (26.2)	633 (27.1)	2.10	<0.001
Unknown	55 (6.4)	27 (49.1)	499 (5.6)	210 (42.1)		
ER/PR status						
ER and PR -	181 (21.2)	66 (36.5)	1,602 (17.9)	408 (25.5)	1.68	0.0020
ER and/or PR +	639 (74.9)	211 (33)	7,108 (79.6)	1,173 (16.5)	2.49	<0.001
Unknown	33 (3.9)	7	217 (2.4)	51		
HER2 status						
Positive	180 (21.1)	86 (47.8)	1,037 (11.6)	324 (31.2)	2.01	<0.001
Negative/Equivocal	477 (55.9)	150 (31.4)	5,738 (64.3)	996 (17.4)	2.18	<0.001
Not done	196 (23)	48 (24.5)	2,152 (24.1)	312 (14.5)	1.91	0.0003
Histology						
Ductal	714 (83.7)	241 (33.8)	7,020 (78.6)	1,206 (17.2)	2.46	<0.001
Lobular	61 (7.2)	22 (36.1)	1,128 (12.6)	278 (24.6)	1.72	0.0645
Others incl. mixed	67 (7.9)	15 (22.4)	621 (7)	85 (13.7)	1.82	0.0823
Unknown	11 (1.3)	6 (54.5)	158 (1.8)	63 (39.9)		
Tumour size						
0–9	99 (11.6)	6 (6.1)	1393 (15.6)	37 (2.7)	2.36	0.0999
10–19	175 (20.5)	10 (5.7)	3,069 (34.4)	207 (6.7)	0.84	0.7075
20–29	157 (18.4)	26 (16.6)	2,007 (22.5)	285 (14.2)	1.20	0.4878
30–49	196 (23)	72 (36.7)	1,360 (15.2)	384 (28.2)	1.48	0.0183
50+	152 (17.8)	120 (78.9)	600 (6.7)	437 (72.8)	1.40	0.1519
Unknown	74 (8.7)	50 (67.6)	498 (5.6)	282 (56.6)		

Over time, the number of breast cancers diagnosed increased over the period 2000 to 2013, however the proportion of advanced cancers changed very little. Overall, breast cancers were more likely to be identified symptomatically, eg, palpable breast lump, nipple discharge. This was reflected in the stage at diagnosis with Pasifika women 2.6 times more likely to be diagnosed with Stage 4 breast cancers than New Zealand European women who are over one and a half times more likely than Pasifika women to have Stage 1 disease at diagnosis.

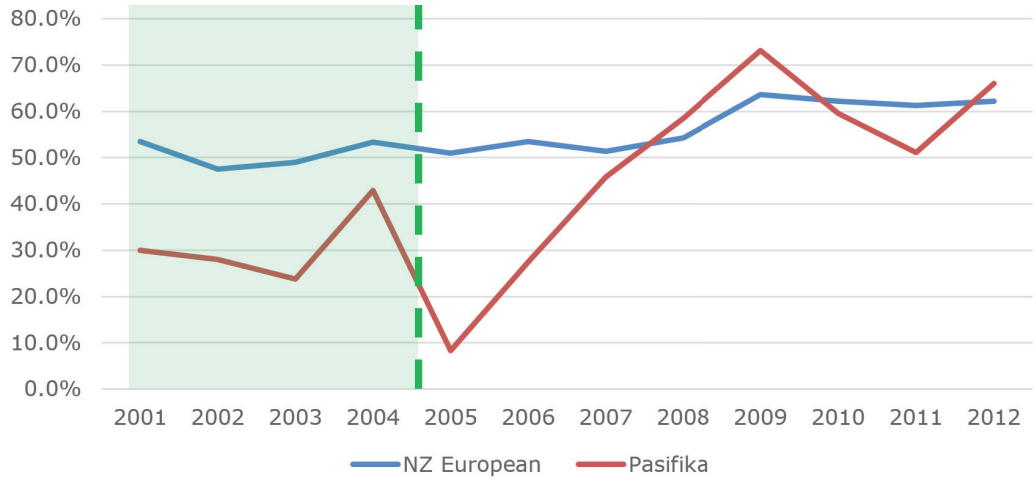
The characteristics of the breast cancer tumour differ between the two groups. Pasifika women were less likely than New Zealand European women to be PR negative (30.6% and 34.1%, respectively) and more likely to be ER negative (23.4% and 18.4%, respectively). Pasifika women were significantly more likely to be ER/PR negative (p value 0.002), be 1.8 times more likely to have a HER2 positive cancer (p value <0.0001) and have an increased likelihood of ductal cancer. The difference in size of tumour was substantial with Pasifika women over 2.5 times more likely to have a tumour 50mm or greater (p value <0.0001). Although nearly a quarter of women did not have a HER2 status recorded in the register, the vast majority (70%) of missing HER2 status data was from 2000–2003 when HER2 status was not routinely tested for and recorded. The proportion of missing HER2 data was similar between Pasifika and New Zealand European women (23.0% and 24.1%, respectively).

Pasifika women were significantly more likely to live in Auckland and be urban-based. They were also significantly more likely to live in a higher deprivation area than New Zealand European women with 54.6% of Pasifika women in the highest deprived area (9–10) compared to 14.2% of New Zealand European women. Conversely, New Zealand European women with breast cancer were significantly more likely to live in the lowest deprivation areas compared to Pasifika women (24.5% and 4.9%, respectively).

The C3 or comorbidity score was calculated from hospital discharge data, gathered from the National Minimum Data Set (NMDS). However, the majority of patients (78%) had no evidence of comorbidities. Pasifika women tended to be more likely to have one or more comorbidities.

Across the period 2001–2012, a lower proportion of Pasifika women were identified through screening compared to New Zealand European women (46.4% and 55.4%, respectively). Figure 1 shows the screening rates of women aged 45–69 years old at diagnosis. Over time the trend has changed with the proportion of women diagnosed by screening increasing (Figure 1).

Figure 1: Proportion of women aged 45 to 69 years diagnosed by screening annually (2001–2012).*



*Screening programme was initially 50 to 64 year olds during 2001–2004, then was extended to 45–69 year olds.

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Advanced stage of disease by ethnic group

Nearly half of the Pasifika women diagnosed with advanced stage at diagnosis were younger than 45 years old (43.8%), ie, younger than the screening age. This compares to less than one-third of New Zealand European women (27.8%). Within the older age categories 70 years plus, Pasifika women were significantly less likely to be diagnosed than New Zealand European women (12.2% and 25.5%, respectively).

Disparities in socio-economic factors and deprivation have been found to be associated with poorer outcomes, including late stage of disease at diagnosis and worse mortality outcomes.[28] Of those women with advanced stage disease at diagnosis, Pasifika women were significantly more likely to live in high deprivation of 9–10 compared to New Zealand European women (34.3% and 19.9%, respectively (OR 2.11; p <0.001)).

The proportion of Pasifika women diagnosed with advanced disease at diagnosis changed very little over time: from 33.3% during 2000–2003 to 32.2% during 2010–2013. The proportion of New Zealand European women with advanced disease at diagnosis remained below 20% during 2000–2013. The mode of detection for advanced disease was primarily through non-screened methods. However, 10.0% and 7.1% of Pasifika and New Zealand European women respectively with advanced stage breast cancer were diagnosed through screening.

Factors associated with risk of Stage 3 and 4 diagnosis in Pasifika women compared to New Zealand European women

To understand the differences in outcomes for Pasifika vs New Zealand European women we undertook separate age-stratified multivariate analyses to investigate the contribution of factors that were considered clinically or theoretically important to advanced stage disease at diagnosis (Tables 2 and 3). For the screening age group 45–69 years old, with an odds ratio (OR) of 2.22 (1.819–2.710), we can account for 0.295 of the contribution to increased odds for factors; demographic, disease, residential area, comorbidity and screening status. Both deprivation and the mode of detection (screening status) were the largest contributing significant factors within the model.

Table 2: Adjusted OR and 95% CI for factors associated with advanced stage breast cancer at diagnosis in 45–69 year old Pasifika women compared to New Zealand European women.

Screening age 45–69			**95% CI**		
		OR	**Lower**	**Upper**	**P value**
	Unadjusted	2.220	1.819	2.710	<0.001
	Adjusted for:				
Demographics	+ Age	2.176	1.781	2.658	<0.001
	+Year of diagnosis	2.185	1.788	2.670	<0.001
Disease factors	+ ER/PR status	2.277	1.857	2.793	<0.001
Area of residence	+ Auckland/Waikato	2.341	1.904	2.878	<0.001
	+ Deprivation	2.109	1.676	2.655	<0.001
Comorbidity	+ C3 score	2.073	1.645	2.612	<0.001
Healthcare access	+ Screening status	1.925	1.513	2.449	<0.001

Table 3: Adjusted OR and 95% CI for factors associated with advanced stage breast cancer at diagnosis in Pasifika women compared to New Zealand European women younger than the screening age.

Younger than screening age <45yrs			**95% CI**		
		OR	**Lower**	**Upper**	**P value**
	Unadjusted	2.016	1.489	2.731	<0.001
	Adjusted for:				
Demographics	+ Age	2.018	1.489	2.734	<0.001
	+Year of diagnosis	1.999	1.469	2.720	<0.001
Disease factors	+ ER/PR status	1.973	1.445	2.694	<0.001
Area of residence	+ Auckland/Waikato	2.027	1.479	2.777	<0.001
	+ Deprivation	1.546	1.078	2.216	0.018
Comorbidity	+ C3 score	1.543	1.076	2.211	0.018

Although nearly a quarter of the HER2 status information was missing, it was modelled in a second (not included) model to ascertain the contribution that HER2 made. The contribution of HER2 to the disease factors of women in the screening age reduced the model from 1.925 to 1.864 (1.421–2.433; p<0.001).

For women diagnosed with breast cancer when they were younger than the screening age, ie, under 45 years old, the biggest contributing factor was deprivation (not sig.). HER2 status did not contribute to decreasing the OR (1.543; CI 1.044–2.280; p 0.029) for this younger group. For this age group it is likely that factors outside of those presented contribute to the increased OR.

Contribution of mode of detection

To further understand the contribution of mode of presentation to advanced stage at diagnosis, we used forward stepwise logistic regression to analyse factors that contributed to the OR by screened vs non-screened detection pathways (Table 4). For those cases that were not-screened detected, we found that very few of the variables used in the modelling process (as outlined within the method section) accounted for the increased OR between the ethnic groups. HER2 status and age were the only two factors that were significant to outcomes for those women diagnosed on the symptomatic (non-screen detected) pathway. However, these decreased OR marginally, from 2.242 to 2.133.

Table 4: Adjusted OR and 95% CI derived from forward stepwise multivariate analyses for factors associated with advanced stage breast cancer at diagnosis in Pasifika women compared to New Zealand European women by mode of presentation (not stratified by age).

		95% CI		
Not screen detected	**OR**	**Lower**	**Upper**	**P value**
A. Ethnicity	2.242	1.885	2.667	<0.001
B. Ethnicity + HER2	2.231	1.825	2.729	<0.001
C. Ethnicity + HER2 + Age	2.133	1.740	2.614	<0.001
Screen detected cases				
A. Ethnicity	1.495	0.967	2.313	0.071
B. Ethnicity + HER2	1.390	0.859	2.249	0.180
C. Ethnicity + HER2 + ER/PR status	1.368	0.843	2.220	0.205
D. Ethnicity + HER2 + ER/PR status + deprivation	1.174	0.706	1.952	0.537

In contrast, nearly all the difference in OR for women who were diagnosed on a screen detected pathway was accounted for. Despite not reaching significance, HER2 status, ER/PR status and deprivation accounted for much of the increased OR for advanced stage at diagnosis, highlighting that if we can ensure that Pasifika women are on a screened pathway their risk of being diagnosed with advanced stage at presentation decreased substantially, with an adjusted OR of 1.174.

Discussion

Early stage breast cancer at diagnosis typically has a better prognosis than for those with more advanced disease. Pasifika women within our study population were more likely to be younger at diagnosis, nearly twice as likely to be diagnosed at an advanced stage (Stage 3 and 4) and over two and a half times more likely to be diagnosed with metastatic disease than New Zealand European women. The higher odds of having advanced disease at diagnosis contributes negatively to outcomes from breast cancer for this population group.[29]

Factors that contributed to increased risk were aligned to what other researchers have found, that deprivation and mode of detection have a significant impact on advanced stage disease at diagnosis.[12–15] Biological factors, HER2 status and ER/PR status contributed in a small way to increased risk of being diagnosed with more advanced disease. Pasifika women were more likely to have a tumour equal to or greater than 50mm at diagnosis, more than twice as likely than for a New Zealand European woman. For Pasifika women who were post-menopausal this was 2.2 times greater than New Zealand European women. Adjusting for factors such as comorbidities and biological status made little difference to the risk of advanced disease.

The year 2005 was a significant year for Pasifika women. This was the year that Pasifika women had the lowest proportion of cancers diagnosed through screening (8.3%) and this was also the year that the screening age was extended to include women aged 45–49 years and 65–69 years.[30] The drop from over 40% detected by screening in 2004 to 8% in 2005 highlighted the significant disparity between the ethnicities during that period. Since 2008, over 50% of all breast cancers diagnosed were identified through screening.

Regular two-yearly breast screening has been shown to reduce the population risk of dying from breast cancer by about 30%.[31] Breast Screen Aotearoa (BSA) has focused on improving the participation of Pasifika women in mammography screening across New Zealand. This has resulted in participation rates of 72% for Pasifika women, exceeding the targeted coverage of 70% in the two years ending 31 March 2016.[32] Trends within BSA data highlight that participation of Pasifika women has steadily increased, and this has been linked to the decreased mortality rate in 'ever-screened' Pasifika women.[30]

Despite increased participation rates of Pasifika women in the national screening programme, we found that Pasifika women were less likely than New Zealand European women to be diagnosed through screening and more likely to be diagnosed at an advanced stage. There was also very little stage-shift in advanced disease at diagnosis for Pasifika women and no change to the gap between Pasifika and New Zealand European women. This could be due to an array of factors, including the younger age of the Pasifika population. However, the expected rate of reduction of advanced stage at diagnosis can differ from the actual proportion of late stage presentation for other reasons, including diagnostic improvements resulting in stage migration.[33]

Pasifika women are inequitably represented in areas of high deprivation. This may have some impact on access to timely and high-quality healthcare, including delays in diagnosis and treatment timeliness. High deprivation may also contribute to decreased accessibility to other facilities, for example private care. TinTin et al (2016) identified that outcomes were better for those able to access healthcare from a private institution compared to the public system.[34]

Conclusion

Mode of detection, deprivation, age and tumour biology contribute to the risk of having advanced disease for Pasifika compared to New Zealand European women diagnosed with breast cancer. Proportionately, more Pasifika women are diagnosed with breast cancer younger than the screening age. Access to diagnostics from a younger age could facilitate diagnosis at an earlier stage for this group.

Pasifika women with breast cancer are much more likely to live with high deprivation. This disproportionately inhibits access to care. Addressing how women are diagnosed and improving access to earlier diagnosis has the potential to make a difference in numbers of Pasifika women who present with late stage disease. If screened regularly, Pasifika women have a similar proportion of advanced disease as New Zealand European women.

Further investigation into barriers to early presentation and early access to diagnostics is necessary to identify improved routes to diagnosis for the younger Pasifika population, and those that are outside of the screening age, to improve outcomes for this group.

Competing interests:
Dr Brown, Dr Tin Tin and Dr Campbell report grants from Health Research Council of New Zealand during the conduct of the study.

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A retrospective audit of the characteristics and treatment outcomes in patients with diabetes-related charcot neuropathic osteoarthropathy

Joanne Dixon, Joshua Coulter, Michele Garrett, Rick Cutfield

ABSTRACT

AIMS: To review the characteristics, management and outcomes one year after diagnosis in patients with diabetes related charcot neuropathic osteoarthropathy (CN) treated at the Diabetes Podiatry service, Waitemata District Health Board (WDHB) between 2000–2014.

METHODS: Patients with diabetes and recorded diagnosis of CN were identified from the podiatry service records. Clinical details were retrospectively obtained from WDHB databases and patient medical records.

RESULTS: Forty-one patients were included, 31 had type 2 diabetes, 10 had type 1 diabetes. At presentation, the median duration of all-type diabetes was 15 years. The median time from symptom onset to diagnosis was 17 weeks. Symptoms at presentation were: oedema (49%), warmth (73%), erythema (17%), swelling (90%) and pain (60%). Concomitant ulcers were present in 32%, deformities 83%, osteomyelitis 2% and septic arthritis 2%. Mean time to ambulation in modified shoes was 21.3 weeks (±11.5). Complication rates one year from diagnosis for ulcers, osteomyelitis, amputations and all-cause mortality were 34%, 2%, 2% and 5% respectively.

CONCLUSION: Time to diagnosis of CN was shorter than previously reported, though the high rate of deformities still suggests a significant delay in diagnosis. Increased education of healthcare professionals and people with diabetes-related neuropathy is important to ensure early diagnosis and appropriate management to reduce deformities and complications.

Charcot neuropathic osteoarthropathy (CN) is a degenerative arthropathy affecting single or multiple joints resulting from significant peripheral neuropathy. This leads to fractures or dislocations of the bones and joints of the foot. It can result in minimal structural damage or lead to longstanding deformities, ulcerations, osteomyelitis and lower-limb amputations. The most common etiology for CN is diabetes mellitus and it is universally associated with peripheral neuropathy.[2] It tends to affect males more than females in their fifth and sixth decade of life, and the duration of diabetes prior to developing CN is at least 10 years.[1] CN has a low prevalence of 0.08% in the general diabetic population but up to 13% in high-risk populations,[1] however the true incidence is unknown and is partly related to the high rate of misdiagnosis. The pathogenesis of CN is unknown, however repetitive trauma is thought to cause an increase in proinflammatory cytokines, leading to persistent local osteolysis and bony destruction.[3]

Active CN presents as warmth, swelling, erythema and pain in the foot. Patients may have no recollection of trauma to the

foot or they may recall only minor trauma such as a sprain or a twisting injury.[2] Early active CN is a clinical diagnosis and often misdiagnosed as infection, gout or deep vein thrombosis. The average delay in diagnosis has been reported to be around 29 weeks.[2] Al-Busaidi et al recently described two cases in Christchurch who received a late diagnosis of CN and who both experienced residual bony deformities. The diagnostic delay in these cases was four and 12 months. Their patients were initially treated as a sprain, DVT, cellulitis and arthritis prior to receiving the diagnosis of CN.[4]

In early active CN, x-ray shows no or minimal abnormalities. However in established CN, x-ray features include capsular distention, osseous fragmentation, peri-articular debris formation, subluxations/dislocations and fractures. Delay in diagnosis and treatment leads to an increased risk of complications and long-term deformities.[2] More recently, magnetic resonance imaging (MRI) has been recommended in early CN to confirm the diagnosis and initiate early treatment.[5] MRI has been shown to detect stress injuries, micro fractures and soft tissue oedema in patients with normal x-rays.[6]

The mainstay of treatment for CN is offloading and immobilisation of the foot with the goal of treatment being a stable, plantigrade foot that can be easily shod.[2] Immobilisation can be with a total contact cast or removable cast walker and duration depends on the clinical assessment of healing. One retrospective study by Armstrong et al found that the mean duration of immobilisation was 18.5 weeks while duration to return to shoe gear was 28.3 weeks.[7] Protective weight bearing is required after the acute episode and lifetime surveillance is required.[5] Surgical intervention is reserved for severe deformities or concurrent osteomyelitis. Pharmacological measures such as bisphosphonates have been studied, however there is no strong evidence to support routine use.[3]

The aim of our audit was to review the characteristics of patients with diabetes-related CN treated at the Waitemata District Health Board (WDHB) Diabetes Podiatry service between 2000 and 2014. We also reviewed time to diagnosis, management and outcomes one year from the time of diagnosis.

Methods

Study design and data sources

This was a retrospective audit conducted by the Diabetes Service at WDHB whose podiatry service has maintained a list of patients treated for CN since 2000. Those who presented with an active CN between the years 2000 and 2014 were included in our study. We reviewed the electronic hospital database for demographic data and documentation of clinical encounters. If the CN diagnosis pre-dated electronic records, paper documentation was then reviewed. Clinical data such as HbA1c, diabetes management and complications were taken from a clinical encounter, usually within weeks of the date of diagnosis of CN. The presence of peripheral neuropathy was taken from documentation of this during a clinical encounter. Referral letters to the service were not archived and we therefore did not have the ability to review primary care or community records. The data were cross-referenced between different sources to ensure accuracy and completeness. As this was a retrospective review, some clinical data could not be obtained, though it was not felt that this affected the integrity of the study. Ethics approval was not required.

Definitions

Cases of active CN were identified by the presence of warmth, erythema, acute swelling or pain with or without deformities in the affected foot in the absence of infection as the primary diagnosis. Date of diagnosis was taken as the earliest point a clinical or radiological diagnosis of CN was made. Time to diagnosis was calculated based on duration of reported symptoms at first presentation to the time of review and confirmation of diagnosis by secondary services as documented in the patient records.

Statistical analysis

Descriptive statistics, including frequencies and proportions, were used to summarise baselines variables and the findings of our study. This was done using SPSS version 23 (SPSS, Chicago, IL, USA).

Results

A total of 41 active CN cases were included and the patient characteristics are summarised in Table 1. Five patients were recorded twice as they also developed CN in the contralateral foot. No patient presented with bilateral acute CN. A disproportionate number were male and identified with Pacific Island ethnicity. Eighty-three percent required insulin therapy for diabetes management.

Table 1: Patient characteristics.

	(N=41)
Mean age, yrs (range)	54 (34–73)
Gender, n (%) Male	 28 (68%)
Diabetes type, n (%) Type 2 Type 1	 31 (76%) 10 (24%)
Diabetes treatment, n (%) Insulin therapy Oral therapy Diet control	 34 (83%) 6 (15%) 1 (2.5%)
Ethnicity, n (%) NZ European Pacific Island Asian NZ Māori Other	 18 (44%) 9 (22%) 7 (17%) 3 (7%) 4 (10%)
Median duration of diabetes, yrs (range)	15 (1–47)
Median HBA1c, mmol/mol (range)	70 (36–178)

The majority of our referrals (46%) were from within the Diabetes Service, which included physicians, nurse specialists and podiatrists. Nineteen percent were from the orthopaedic service, 10% from community podiatrists, 5% from inpatient services, 5% from rheumatologists and the remainder were from uncertain sources. We were unable to ascertain how many were referred from primary care direct to the Diabetes Service.

The time from symptom onset to diagnosis was variable as shown in Figure 1. The median time to diagnosis was 17 weeks (1–70 weeks). Twenty (41%) patients recalled an episode of trauma preceding the development of CN. Swelling was the most common symptom at presentation in 90%; followed by warmth, pain, oedema and erythema in 73%, 60%, 49% and 17% respectively. Eighty-three percent of patients had deformities of the foot at the time of presentation. Thirty-two percent had concurrent ulcers on the ipsilateral foot. One patient presented with osteomyelitis complicating an acute CN requiring amputation and one patient required washout of a septic joint complicating a heel ulcer at presentation.

All patients underwent plain x-ray of the affected foot and 22% also had an MRI performed to confirm the diagnosis or to rule out coexisting osteomyelitis. Ninety-three percent (38/41) had abnormal x-ray findings at the time of diagnosis, with bony destruction and subluxation being the most common findings at 50% (19/38) and 37% (14/38) respectively. A number of different joints in the foot can be affected as shown in Figure 2. In our cohort, 62 joints in our 41 patients were radiologically confirmed as being affected by CN. The tarsometatarsal

Figure 1: Diagnostic delay.

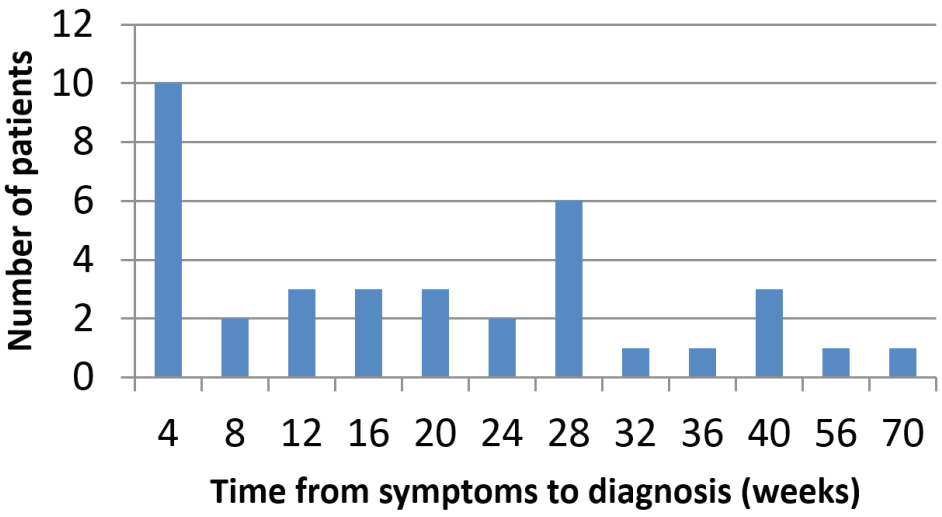
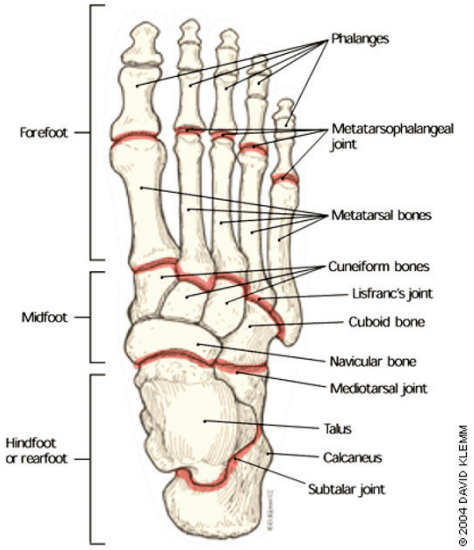


Figure 2: Anatomy of the foot.



joint was the most commonly affected at 35% (22/62), followed by the tarsal and metatarsophalangeal joints at 15% (9/62) each. The ankle joint showed active involvement in 13% (8/62), with the remainder involving the metatarsals and tarsal-ankle joint equally.

Twenty-three (56%) patients were treated in a total contact cast while removable casts were used in the majority of the remaining patients. The mean time till patients were ambulatory in modified shoes was 21.3 weeks (±11.5 weeks). Within one year from diagnosis of CN, 17 (34%) patients had developed a foot ulcer, two patients suffered a further fracture, one developed osteomyelitis and one required an amputation. There was an all-cause mortality of 5%.

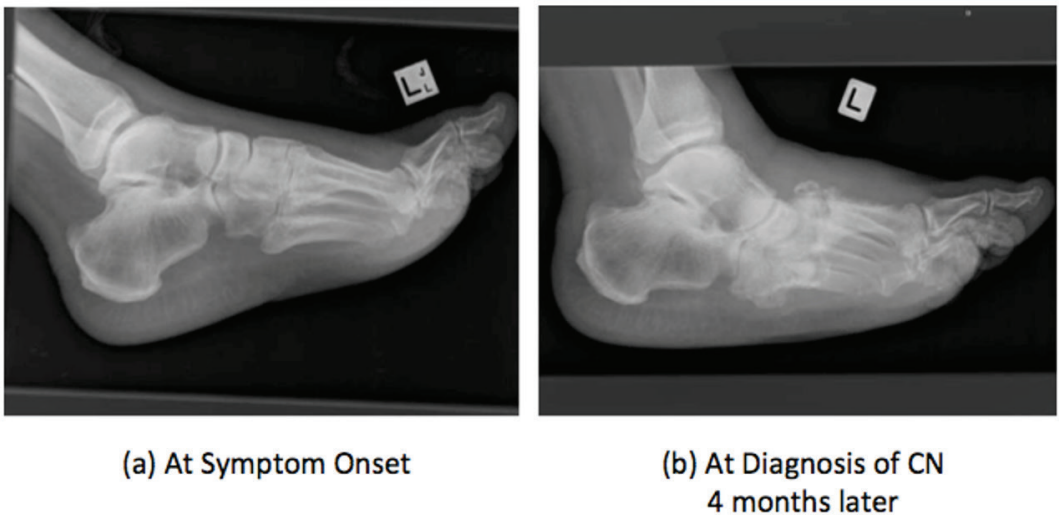
Discussion

This audit of CN presentation and management at WDHB is the largest series published in New Zealand. While acknowledging that it does not reflect the true incidence, partly due to patient relocation, misdiagnosis and that some patients may have been treated privately, we feel that we have captured most, if not all, new cases in our DHB especially over recent years. All patients with CN and diabetes should be referred to a secondary podiatry service without delay and our service works closely with the orthopaedic and vascular service to optimise outcomes.

Our audit found that the characteristics and demographics of our patients presenting with active CN generally align with international studies. The time to diagnosis of 17 weeks is shorter than described in previous studies.[2] The early symptoms of CN are often attributed to minor trauma or possible infection and disregarded by patients, which can delay true diagnosis. We were unable to ascertain all the direct causes of delay in our retrospective audit.

The early stages of active CN requires a high index of suspicion and if treated early, long-term deformities and complications may be prevented.[2] Figure 3 shows the joint destruction that can occur with CN particularly when there is a delay in diagnosis. Figure 3a shows the normal appearances of the foot with soft tissue swelling only at the time of symptom onset in one of the patients in our study cohort. When the CN

Figure 3: Midfoot destruction due to CN.



was diagnosed four months later, the x-ray showed the typical destructive CN changes with collapse of the midfoot, destruction of the tarsometatarsal and ankle joints, and periosteal new bone at the bases of the first to fourth metatarsal. Once joint destruction has occurred, it is irreversible; therefore it is critical that offloading of the foot occurs early. Most of our patients presented with established deformities suggesting a significant delay to diagnosis and appropriate treatment.

MRI was underutilised as a diagnostic tool in our cohort. WDHB had limited access to MRI imaging from 2003 up until 2007. This likely impacted on the low numbers of MRIs performed in our patients in the early years. When performed, this was to rule out coexisting infection in cases when the diagnosis of CN was evident on x-ray.[5]

There was an underrepresentation of general practitioner (GP) referrals in our patient group suggesting GPs may refer these patients to a number of secondary services such as emergency departments, general physicians or orthopaedics, particularly since infection is a common misdiagnosis. If there is a high suspicion of CN without coexisting infection, we recommend a direct referral to the Diabetes Podiatry service.

While patients had a low risk of developing amputations and were ambulatory in modified footwear within five months, a significant number nevertheless developed foot ulcers. CN leads to collapse of the midfoot and results in bony prominences that lead to overlying ulceration. Ulcers predispose patients to infection and potentially amputation. Treatment of CN and ulcers requires casting and intensive, often weekly, review and input from a specialist diabetes podiatry service and long-term follow-up.

Conclusion

While CN has a low prevalence among patients with diabetes even in those with peripheral neuropathy,[1] it is a very significant complication and has important implications for the individual. By diagnosing CN in the early stages, deformities and subsequent complications may be prevented. Our study and the cases reported by Al-Busaidi et al[4] highlight that there are still significant delays in diagnosis in these patients.

It is important that not only health professionals but also patients are aware of the presenting symptoms of CN and the need to present for early treatment. An opportune time for this education could be during their annual diabetic foot check with their GPs or diabetes teams. A high level of clinical suspicion is needed to suspect the diagnosis in patients with long-standing diabetes and peripheral neuropathy.

As stated in the BPAC New Zealand guidelines, a suspected acute presentation of CN is considered an emergency and warrants prompt referral directly to a specialist diabetes podiatry service. An MRI scan should now be considered an essential part of the work up of a swollen, erythematous foot in a patient with diabetes-related peripheral neuropathy.[5] Timely offloading of the foot is crucial to preserve the architecture of the foot and prevent complications such as deformities, ulcers and amputation. Once joint destruction occurs, this is irreversible, therefore early diagnosis is critical.

Any medical professional presented with a patient with diabetic peripheral neuropathy and an acutely red, swollen and warm foot needs to consider Charcot neuropathic osteoarthropathy as a diagnosis and refer urgently to a specialist diabetes foot service.

Competing interests:
Nil.

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Paediatric testicular tumours in a New Zealand centre

Timothy Little, Shareena Lala, Vipul Upadhyay

ABSTRACT

AIM: This is a 12-year, single-centre retrospective review of paediatric testicular tumours and review of the world literature on paediatric testicular tumours. The aim was to identify presenting features, the range of pathology and management of such tumours in comparison with other published series.

METHODS: The hospital's pathology database was searched for all testicular and paratesticular tissue submitted for patients younger than 16 years of age during the 12-year study period January 2000 to December 2011, and patients with testicular tumours identified. A detailed review of clinical records was then completed and summary statistics calculated.

RESULTS: There were 33 tumours and 22 (66.7%) were malignant. The most common tumour was mature teratoma. No tumours presented with a twisted gonad. The mean incidence per year was 2.75 cases. This is comparable to other reported series worldwide (median 1.92, range 1.7–6.3).

CONCLUSION: Testicular tumours in children are rare. In our centre, mature teratoma was the most common tumour, and malignant testicular tumours did not present with torsion. Our experience in managing gonadal tumours is similar to that published by major centres for paediatric surgery across the world. There is scope to develop the practice of testis-sparing surgery.

Cribb et al[1] published a series of paediatric ovarian masses at our institution in 2014, finding a relatively large number of patients vis-à-vis international comparisons. We now analyse our experience of paediatric testicular tumours to ascertain if the prevalence is similarly higher than that of other published series and to compare the patterns of presentation, the types of tumour found and how they are managed.

The total male New Zealand population for the age range studied (0<16 years of age) grew steadily over the study period from 479,470 boys (2000) to 498,650 boys (2011). Estimates by region were only available for age 0<15 years. The catchment area of our institution grew from 223,700 boys (2000) to 239,800 (2011)—source: statistics New Zealand (stats.govt.nz).

Several series of paediatric testicular tumours have been published from major centres around the world,[2–14] all demonstrating testicular tumours to be less common than ovarian tumours. Single-centre figures range from a mean of 1.7 to 6.3 cases per year and a reported incidence of 0.5–2/100,000 children. The series differ between including all tumours or just germ cell tumours.

Methods

The hospital's pathology database was searched for all patients 0–15 years old with testis, testicle, testicular remnant and streak gonad submitted for analysis during a 12-year period (January 2000–December 2011). Only testicular tumours were then included and clinical records of these cases reviewed in detail with relevant aspects of each recorded in an Excel® spreadsheet. Demographic details were recorded, as well as presenting complaint, alpha-fetoprotein (aFP), beta human chorionic gonadotropin (bhCG) and lactate dehydrogenase (LDH), operation type and findings, histological analysis and follow-up.

Other world series were identified using MEDLINE and EMBASE.

Results

There were 33 children with testicular tumours, including five paratesticular tumours. There was no pattern to the ethnicity of children with particular tumours; the commonest two groups were New Zealand European and Māori.

Presentation

By far the commonest presentation (26 of 33) of these cases was of a unilateral intrascrotal swelling. In one case the swelling was thought to be acute (teratoma in a seven-month-old) and in another the increase in size was noted to be rapid, occurring over the few days prior to an acute presentation (yolk sac tumour in another infant). One 14-year-old presented with haemoptysis. It was only when metastases were seen on a plain chest film that the patient was further examined and investigated to find the testicular yolk sac tumour. Finally, the two patients with Leydig cell tumours presented with precocious puberty, in keeping with the diagnosis.

Histopathology

The breakdown of this 33 according to histological appearances is illustrated in Table 1. Of the 28 testicular tumours, 15 were malignant and 13 benign. The commonest tumour was mature teratoma, making up approximately a third (n=10) of the tumours over the study period. As expected, median aFP was higher in malignant tumours than in benign tumours (4,000 and 1.8 units respectively).

Follow-up

There were three deaths among the cohort. The first was a six-year-old patient with lymphoma who died four years after presentation and treatment with chemotherapy and palliative radiotherapy, having previously been treated for acute lymphoblastic leukaemia. The second died aged 17 years with lymphoblastic leukaemia, having presented six years prior, undergoing orchidectomy, chemotherapy and radiotherapy. The third was a 12-year-old with rhabdomyosarcoma who had presented a year prior and had undergone orchidectomy and radiotherapy.

The follow-up of the other patients was highly variable. However, in general, malignancies were followed by oncologists rather than surgeons and for longer than benign tumours (median follow-up five years and two years respectively).

Table 1: Testicular and paratesticular tumours.

Tumour	Subtype	Number	%	aFP (IU/ml)	bhCG (mIU/ml)	LDH (IU/L)
Germ cell tumours	Mature teratoma	10	36	3	NA	289.5
	Immature teratoma	1	4	44.1	NA	NA
	Yolk sac tumour	6	21	9,453	1,165	NA
	Embryonal carcinoma	1	4	1	3	NA
	Mixed embryonal carcinoma/teratoma	1	4	8,087	1,165	NA
	Seminoma	1	4	NA	NA	NA
Sex cord stromal tumours	Granulosa cell tumour	3	11	4,064.5	NA	NA
	Leydig cell tumour	2	7	0.85	NA	NA
Others	Lymphoma	2	7	NA	NA	NA
	Lymphoblastic leukaemia	1	4	NA	NA	NA
Paratesticular tumours	Lipoblastoma	1	20	2.5	NA	262
	Rhabdomyosarcoma	4	80	1.4	NA	307

Table 2: Comparison with international experience.

Centre	Max age	Length of study (years)	No. of cases	Cases per year
Auckland, New Zealand	16	12	33	2.75
Melbourne, Australia (Sugita et al[2])	18	30	68	2.27
Turkey (Cifti et al[3])	17	30	51	1.7
France—multiple (Valla et al[4])	15	15	273	n/a
USA—multiple (Ross et al[5])	12	Not stated	395	n/a
Toronto, Canada (Metcalfe et al[6])	18	18	51	2.83
Washington DC, Philadelphia, Boston, Toronto, USA/Canada (Pohl et al[7])	12	Various	98	n/a
USA—multiple: SEER program (Walsh et al[8])*	14	28	131	n/a
Leipzig, Germany (Troebs et al[9])	18	25	24	0.96
Taipei, Taiwan (Chen et al[10])*	12	25	34	1.36
Helsinki, Finland (Taskinen et al[11])	18	25	34	1.36
Belgaum, India (Nerli et al[12])	12	10	22	2.2
Hangzhou, China (Wang et al[13])	13	10	63	6.3
Seoul, Korea (Baik et al[14])	15	25	48	1.92

*germ cell tumours only.

International comparisons

We found 13 case series, including benign and malignant tumours. It must be noted that two series[8,10] include only germ cell tumours. The age range also varies between studies, some considering paediatric to include up to the age of 18 years whereas others only up to 12 years so as to describe the series as pre-pubertal. The most common tumour varied between mature teratoma (as in our series) and yolk sac tumour.

Discussion

Our results show that the numbers of patients with testicular patients is similar to those published by other centres worldwide. The most common subtype was mature teratoma, also in line with other published series. During the work-up of patients presenting with a unilateral testicular mass, we found any elevation in tumour markers to be—as expected—predictive of a malignant lesion. Pre-operative aFP must, however, be interpreted with caution, both for the fact that elevated levels are physiological in the neonatal period and that yolk sac tumours do not always secrete aFP. Nevertheless, elevation in those aged older than six months warrants suspicion of malignancy.

Ultrasound has been used to assist in pre-operative planning, with some characteristics suggestive of a benign tumour, namely the findings of a well-circumscribed lesion, anechoic with a unilocular process,[16] indeed one series found pre-operative ultrasound discriminated between benign and malignant tumours correctly in all cases.[17] It is also helpful in indicating the volume and position of normal parenchyma remaining, thereby demonstrating the feasibility of testis-sparing surgery.

None of the patients in our series underwent testis-sparing surgery, but worldwide at least 10 centres advocate this approach where possible.[2–12] The possibility of testis-sparing surgery was first raised in 1984 by Weissbach and colleagues,[15] and Valla's group in France[4] advised on specific pre-operative and intra-operative criteria.

The disadvantages of testis-sparing surgery may be overstated. One argument is that the remaining tissue is not worth preserving and may even atrophy, but Shukla et al[18] report no post-operative size alterations in their experience, and another group[19] even reported compensatory growth of the remaining tissue.

Pain is not a significant feature reported in any of the series, even those with long-term follow-up. Perhaps more important than any other considerations is the fact that there were no recurrences or malignant transformations of incompletely resected tissue reported.

Of course, in practical terms, the practice relies on frozen section and therefore a well-resourced laboratory and local histopathological expertise in testicular tumours. Frozen section for testicular biopsies is, at least, highly accurate, with the literature reporting complete ability to discriminate malignant from benign pathology on frozen section.[20, 21]

In summary, Starship Children's Hospital in Auckland treats children with testicular tumours as frequently as other major centres worldwide. It is useful to know that our most common lesion was mature teratoma. Many centres are moving to testis-sparing surgery and suitable candidates could be identified using tumour markers, pre-operative ultrasound and intra-operative frozen section.

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Potential for public health success in tackling the hepatitis C virus epidemic

Ian Sheerin

ABSTRACT

New Zealand and Australia both now have the potential for a major public health success in controlling the hepatitis C virus epidemic. The burden of advanced liver disease and drug-related harm is increasing. However, a new range of anti-viral therapies have become available which offer a potential cure for most people with few side-effects. The epidemic is potentially preventable and hepatitis C is now curable. Although public health strategies for blood-borne viruses have been updated, they fall short of what is needed and should be upgraded with more emphasis on prevention, in order to achieve control of this epidemic.

New Zealand and Australia have a major hepatitis C virus (HCV) epidemic which is receiving inadequate public health policy attention. Currently there is a mix of factors that offer the potential for a major public health success in terms of controlling and even possibly eliminating the epidemic, however health policies would need significant ongoing improvement to achieve this. HCV imposes a substantial burden on the population and the health system. Evidence indicates that approximately 54,000 New Zealanders and 230,000 Australians have chronic HCV and many will develop liver cirrhosis and hepatocellular carcinoma (HCC).[1,2] This epidemic has spanned decades and is international with estimates of up to 170 million people worldwide having HCV infection.

Current situation

HCV infection is potentially preventable and also in 2016 new direct acting anti-viral medicines (DAAs) were publicly funded in both New Zealand and Australia. These DAAs are potentially a game-changing improvement as they offer cure rates of 95% with few side-effects, with only 12 weeks of treatment, much of which can be provided in primary care.[3,4] This contrasts with previous interferon-based treatments that had poorer outcomes, major side-effects which led to adherence problems, an HCV community view that the "treatment was worse than the disease" and consequent low uptake. Hence the new DAAs offer a major step forward and they are rapidly gaining a good reputation among people infected with HCV who are now hearing good news stories from their peers who have experienced the new treatments. But until 2016, treatment uptake was low. In Australia, 1 to 2% of the chronically infected initiated specific HCV treatments each year, while in New Zealand fewer than 10% had accessed treatment by 2014.[2,5] Treatment uptake has improved following the public funding of DAAs in 2016 in both countries. Pharmac reported that by July 2017, 2,000 people in New Zealand had been treated with the new DAAs.[6] Australia has made more progress, as from March to December 2016 more than 32,500 people had initiated treatment with DAAs.[7]

There is some opinion that a reduction in stigmatisation is now enabling more people to present for treatment.

New treatments

Recommended treatments are genotype specific. In both countries the prevalent genotypes (Gt) are Gt1 (50–55% of cases) and Gt3 (35–40%).[3] Access to the new DAA medicines is better in Australia where DAAs were approved and publicly funded

in 2016 for both Gt1 and Gt3. New Zealand is currently behind as DAAs were publicly funded in 2016 for Gt1, while DAAs for Gt3 are not yet publicly funded unless a special case is made on an individual patient basis.[4] Importing a DAA privately directly from the drug company would cost approximately $NZ75,000, so some people have been accessing a buyers club to obtain the medicine at a more affordable private cost of between $NZ1,600–4,000.[8] The high prices proposed by the drug companies for government funding for the new DAAs has been a barrier to their being adopted sooner.

For most people the new DAA medicines can be prescribed and managed in primary care, by a GP in consultation with a specialist. However, if the infection has progressed to liver cirrhosis, treatment requires specialist consultation and management, so there has been considerable effort to develop treatment guidelines and coordination between primary- and secondary-care services.[3,4] Recent trends to encourage more treatment in the primary care sector are creating more potential for widespread early intervention and prevention of complications and costs of advanced liver disease.[3,9] Although there is some evidence of possible recent declines in HCV incidence and prevalence in some countries[10] the overall burden of liver disease is increasing, which is placing increased pressure on specialist hospital care, liver transplants and public health resources.[5,11] Specific strategies are required to control and reduce this disease burden.

Causes and prevention

In recent decades, 95% of new HCV infections in western countries have been caused by injecting drug use and sharing of injecting equipment.[11,12,13] Other risk factors include previous blood transfusion, history of imprisonment, tattoos, body piercing, contact with blood and blood products. Studies suggest that in Australia and New Zealand, immigration and mother-to-child transmission account for relatively few cases.[10] Sexual transmission is not significant for HCV, except where there is HIV coinfection. The epidemic varies in different parts of the world, particularly in less developed countries with less resourced health systems and where safe blood supplies may not be available.

Both voluntary and health sector agencies have invested considerably in harm reduction strategies, generating blood safety awareness, the importance of safe injection practices, needle exchanges and avoiding sharing of needles. However, there are recent reports of increases in injecting drug use and associated harms. In the US, studies indicate from 2006–12 there was a nationwide increase in HCV infections and injecting drug use.[14] This has occurred in the context of a nationwide epidemic of opioid use and drug overdose deaths.[15,16] In Australia, New Zealand and the US, there is concern over the increasing injecting of oxycodone, other prescription opioids and methamphetamine.[17–22] In Australia, studies indicate there has been an increase in opioid prescribing and in opioid poisoning since at least 2002.[17,19,21] Similar trends have been reported for the UK, US and Canada.[18] Hence, the evidence of any possible reduction of HCV incidence is at best uncertain and in fact it indicates that drug-related harm is increasing. Therefore, continuing investment should be made in policies and services aimed at reducing such harm, including HCV infections.

People with a history of injecting drug use (PWID) are generally on lower incomes, are often difficult to engage in general primary care services, tend to be marginalised and stigmatised. Similarly, surveys of prisoners and ex-prisoners in both Australia and New Zealand have found HCV prevalence ranging upwards from approximately 25% with higher prevalence in those with a history of injecting drug use.[10,23] Prevention of drug-related harm and blood-borne viruses (BBV) requires multi-faceted harm reduction policies, including alcohol and drug services, needle exchanges and creating much greater awareness of BBVs and how to prevent them. This includes a collaborative partnership with voluntary agencies who are able to engage and communicate with marginalised people such as PWID, prisoners and ex-prisoners.[15,24] Regrettably, in New Zealand voluntary agencies with these aims have been operating with very limited government funding. As those infected with HCV tend to have lower incomes, widening

access to treatment needs to include reducing financial barriers to access such as patient copayments, currently around an average $40 per consultation.

Discussion and conclusion

The outlook for people with chronic HCV infection has improved dramatically in 2016, with improved access to effective medicines that offer every likelihood of a cure for most. However, in both Australia and New Zealand, many infections remain undiagnosed, the majority have not yet been treated and the burden of chronic liver disease is growing. This will place increasing strain on health services. An estimated 5–10% of cases of chronic HCV develop to cirrhosis within 20 years from the time of infection,[25] and approximately 3–5% per annum of those develop HCC. More rapid rate of progression to advanced liver disease is associated with other factors such as co-infection with hepatitis B virus and/or heavy alcohol use. Cirrhosis involves complications that necessitate hospital admissions, and a portion will require liver transplants. This disease burden is potentially preventable and with specific public health policies the HCV epidemic could be contained and reduced. The key elements that are needed include:

- Recognition and willingness at higher levels of government and the health sector;
- Collaborative harm reduction policies to reduce drug-related harms;
- Expanding access to diagnosis and treatment, including drug and alcohol services and primary care. Education of primary care professionals is important. Nurse-led HCV clinics and ways of paying for them should be promoted. Treatment for prisoners and ex-prisoners should be provided. Cirrhosis necessitates regional networks with capacity for specialist management;
- Investment and public funding of DAAs for all HCV genotypes, with copayments affordable for lower income people;
- Greater investment in prevention and communication strategies to address key populations and including awareness programmes through needle exchanges, alcohol and drug services, prisons and rehabilitation services;
- Management of the overall strategy at national and regional government levels, including regular review of key indicators.

Both Australia and New Zealand have published HCV strategies,[11,26] with much emphasis on improving the coordination of treatment. Shorter courses of treatment, fewer side-effects and options for general practitioners to be involved with treatment all offer the potential to increase capacity and numbers treated.[27,28] Australia is making more progress in-so-far that it has achieved a higher diagnosis rate, with an estimated 80% of infections having been diagnosed.[11] In contrast, only approximately half of infected New Zealanders have been diagnosed.[2] Australia has also funded access to new DAA treatments for all HCV genotypes, whereas in New Zealand access to DAAs is currently limited to patients with genotype 1. Progress in Australia has prompted discussion that it could potentially be the first country in the world to attain the World Health Organization's goal of eliminating viral hepatitis as a public health threat by 2030 (defined as a 65% reduction in mortality and a 90% reduction in new infections compared with the 2015 baseline).[13,28]

However, improved control of the HCV epidemic requires preventive strategies which engage with higher risk populations. Regrettably, government strategies in both New Zealand and Australia fall short on prevention. It would be a significant advance to get more people through treatment, but unless new infections can also be prevented, the HCV epidemic will continue to impose an increasing burden on the health system. A key to prevention is to reduce infections associated with injecting drug use, while also addressing other risk factors such as tattooing, body piercing and barriers to access. There is good evidence that needle exchanges have been effective in helping to control both HIV and HCV[11,29] and that they are perceived as engaging successfully with PWID, who tend to be marginalised and often do not engage with conventional health services. Government

strategies need to emphasise greater collaboration with such community agencies who can effectively engage higher risk populations, convey preventive measures and assist with accessing heathcare. In Australia, advocacy by non-government agencies has resulted in more funding and emphasis on public awareness and case detection.

Gane and colleagues[2] have modelled the potential for HCV infection to be eliminated from New Zealand within our lifetime. Access to the new DAAs is a key ingredient but they also noted the requirement for ongoing measures to prevent new infections, improve community awareness, increase detection and to provide programmes for people at high risk of infection such as PWID and prisoners. Australian experts have also recommended similar requirements.[24] Agencies working with these populations are not currently able to access sufficient funding to provide adequate ongoing preventive services.

There is potential for a major public health success in controlling the HCV epidemic, but this will require investment in an improved, coordinated, collaborative strategy, including renewed emphasis on prevention as well as the above key ingredients.

Competing interests:
Dr Sheerin is Chairman of the Hepatitis C resource Centre Trust (Te Waipounamu) Inc, which has previously received New Zealand government funding to undertake educational activities to increase awareness about the causes and prevention of blood borne virus transmission.

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An osteoarthritis model of care should be a national priority for New Zealand

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ABSTRACT

Osteoarthritis is highly prevalent, disabling and costly to the person and the community. The burden of this chronic condition is predicted to increase dramatically over the coming decades. Healthcare spending on osteoarthritis is unsustainable and action is needed to improve care delivery. At present, there is an over-emphasis on surgical and pharmacological interventions, despite evidence supporting conservative treatments such as exercise, weight loss and education. While clinical guidelines provide recommendations regarding best practice (ie, *what* to do), they fail to address *how* to operationalise these recommendations into clinical practice. Models of care (MoCs) can help bridge the evidence-practice gap by outlining evidence-informed interventions as well as how to implement them within a local system. However, New Zealand has no osteoarthritis MoC. The Mobility Action Programme, funded by the Ministry of Health, is delivering evidence-informed, multi-disciplinary care for osteoarthritis through local initiatives. Although the programme remains under evaluation it presents an opportunity to inform development of a national osteoarthritis MoC for New Zealand. A policy framework, such as a MoC, is needed to scale up successful programs and deliver best practice care nationwide. Ultimately, addressing the burden of osteoarthritis will require system-wide approaches involving public policy responses to target primary prevention.

The burden of osteoarthritis

Osteoarthritis is a highly prevalent and disabling condition. Persistent pain, physical disability, depression, impaired work and social participation are common sequelae, which have major implications for healthy ageing and human capital in New Zealand.[1–4] Osteoarthritis is ranked as the 12th highest contributor to disability globally, and the 16th highest in New Zealand.[5] One in 10 New Zealand adults (10%; 370,000) live with the condition,[6] and the prevalence of arthritis (of which osteoarthritis is the most common form) has been projected to reach 17% by 2020.[7] By comparison, diabetes affects an estimated 257,700 (6%) New Zealanders.[8] Recent data from the US suggests that one in two adult Americans live with a musculoskeletal condition—a prevalence comparable to that of cardiovascular and chronic respiratory disease combined, costing $USD 213 billion in 2011 (or 1.4% GDP).[9] Older adults are most commonly affected, reported by 28% and 35% of New Zealanders aged 56–74 and 75+ years, respectively, although younger adults also experience considerable impacts on work ability and quality of life.[10]

Osteoarthritis is also costly. In New Zealand, the total cost of arthritis in 2010 was estimated at $3.2 billion.[7] Lost productivity was the greatest cost ($1.5 billion), as over 25,000 New Zealanders did not work due to arthritis. Health sector costs are also substantial, estimated at $695 million annually in 2010.[7] As a point of comparison, healthcare costs of diabetes were estimated at $686 million in 2008.[11] Joint replacements dominate hospital costs ($182.3 million), with over 8,000 hip and 7,000 knee replacements performed in 2015.[12] By 2026 the number of hip and knee replacements is projected to increase by 84% and 183%, respectively, equating to a further 6,000 operations at an additional cost of over $90 million annually.[13]

Reforming osteoarthritis care

A 'paradigm shift' in osteoarthritis management is required to delay or avoid the need for surgery by providing appropriate interventions to people with early disease.[14] Calls have also been made to optimise non-surgical and non-pharmacological management (for which supporting evidence abounds) for people with established disease, particularly in light of substantial evidence-practice gaps in this area.[15] In Australia the recent release of the Clinical Care Standard for Knee Osteoarthritis signifies a focus on improving quality and standardisation of care for osteoarthritis at a national level,[16] while at a jurisdictional level several Australian states including Western Australia, Victoria and New South Wales have developed local models of care (MoCs) to guide service delivery.[17–19] Similar initiatives in other nations have been reviewed recently.[20] In New Zealand the Ministry of Health's Long-Term Conditions Programme is supporting a systematic approach to the management of chronic conditions encompassing patient-centred coordinated care and the promotion of equitable health outcomes. Through this programme, knowledge sharing between healthcare professionals is being facilitated through workshops and clinical leadership, and best practice care is being promoted through patient co-design and self-management. Earlier, effective conservative management of osteoarthritis could alleviate the strain on the New Zealand hospital system and is likely to reduce indirect costs (such as lost productivity) by addressing the disability burden. Recently, modelling data from Australia highlight the financial benefits of emphasising early and appropriate care for osteoarthritis.[21] In this article we describe current osteoarthritis management in New Zealand, outline the need for change and present the development of a model of care as one possible solution. We present two hypothetical case studies illustrating both current management and projected management under an osteoarthritis model of care to highlight important differences in care delivery and patient outcomes.

Lower limb osteoarthritis management: the current state of play and lost opportunities

There is, as yet, no cure for osteoarthritis. Management is directed towards relieving pain and improving function and quality of life. Although medication (which is frequently offered as first-line treatment) can alleviate pain, this 'palliative' intervention is often recommended before conservative interventions.[14] This represents a lost opportunity to intervene. Joint replacement surgery, performed when pain is intolerable or function is significantly impaired, is expensive and not without risk, and could be avoided or delayed by earlier conservative interventions.[12] Conservative interventions for which strong evidence is available, such as exercise and weight loss,[22] are inadequately discussed by primary care physicians.[23] For example, weight loss strategies targeting females over the age of 50 years could prevent up to 48% of knee osteoarthritis in females.[24] As evidence of the link between overweight/obesity and lower limb osteoarthritis, the mean body mass index of patients undergoing primary joint replacement surgery in 2015 was 31.2kg/m^2 for knees and 28.9kg/m^2 for hip replacements.[12] Regarding joint injury, which together with obesity form the two major risk factors for osteoarthritis,[25] while there is good evidence for neuromuscular training programmes to substantially reduce the risk of anterior cruciate ligament (ACL) injury,[26] there has been limited widespread implementation of these prevention programmes. At present, osteoarthritis management is fragmented and episodic, with little inter-disciplinary collaboration to support optimal care. Moreover, there is substantial regional inequity in access to chronic care services across New Zealand despite attempts to embed health equity for all population groups into policy on chronic disease management.[27] Case study 1 illustrates an example of primary care osteoarthritis management within the present system.

A number of high-quality clinical practice guidelines have been developed by expert groups to guide evidence-based osteoarthritis management.[28] Although

recommendations vary across these guidelines, exercise, education and weight loss (as indicated) are consistently recommended as interventions supported by strong evidence. Yet despite this knowledge, a considerable evidence-practice gap remains, in particular for conservative, non-pharmacological management.[29] In the first case study, while Agnes' GP is aware of these clinical guidelines and recommends for Agnes to lose weight and increase her physical activity, these recommendations are not supported in practice by the healthcare system as there are no established pathways for referral to other healthcare professionals. While there are many reasons for this, a key limitation of clinical practice guidelines is that although they make valuable and evidence-based recommendations for practice (ie, *what* care), they fail to provide information on *how* to implement evidence into clinical practice and healthcare delivery.

Models of care: informing how to deliver best practice care in a health system

A model of care (MoC) is an evidence-based policy or framework that provides guidance on the ideal development and delivery of condition-specific care principles within a health system.[30] While similar to clinical guidelines in that both are evidence-informed, MoCs emphasise the operational elements of care delivery for the components of care described, hence specifying *what* the care components should be as well as *how* to deliver them within a health system. Outlining 'the right care, delivered at the right time, by the right team, in the right place, with the right resources' is ultimately the purpose of MoCs.[31]

A number of healthcare system-wide osteoarthritis MoCs have been developed and implemented in Australia,[17–19] the UK[32] and Europe.[33] These programmes share the common features of a chronic care model, including inter-disciplinary collaboration and coordination, individualised care and evidence-based interventions; in particular exercise, education and weight loss, with a view to self-management. These interventions are particularly relevant given the recognition of obesity and physical inactivity as shared risk factors for a number of chronic diseases. Initial evaluation of these MoCs has been positive in terms of improved patient outcomes and supporting delivery of and access to best practice care as well as a reduction in the number of patients requiring joint replacement surgery.[20] In light of a growing body of evidence and widespread acceptance of MoCs as a driver of health service reform, there is scope to adopt a similar shift in osteoarthritis care delivery in New Zealand.

A step in the right direction: The Mobility Action Programme

Currently, the burden of osteoarthritis in New Zealand is not adequately addressed through national health policy. While the problem of long-term conditions, including musculoskeletal conditions, is recognised in the 2016 New Zealand Health Strategy, insufficient attention has been paid to osteoarthritis specifically, particularly given its burden of disease and healthcare costs. This is in contrast to countries such as Australia where arthritis and musculoskeletal conditions have been recognised as a National Health Priority Area since 2002, and where a national service improvement framework for osteoarthritis, rheumatoid arthritis and osteoporosis has been developed to reduce the impact of these chronic conditions.[34]

As part of the New Zealand Government's mission to improve pain management in the community, in 2015 six million dollars were released over three years specifically to improve care for people with long-term musculoskeletal conditions. The Mobility Action Programme (MAP) is a resulting initiative of this funding, and is providing support to create community-based, multi-disciplinary teams to improve early intervention for people with hip and knee osteoarthritis as well as other musculoskeletal conditions such as low back pain.[35] The aim of the MAP is to improve health outcomes, namely to reduce pain and maximise function, for people with these long-term conditions through the optimisation of osteoarthritis care delivery in the community. Key objectives are enhanced diagnosis, self-management, education, exercise and pain management directed to those most in need. A range of practitioners and services are involved, including primary care physicians, physiotherapists, nurses, psychologists and dietitians. Care is individualised and emphasis is placed on evidence-informed strategies such as

self-management and conservative interventions, including exercise and weight loss.

The MAP is set to run until 2019. While the MAP is yet to be formally evaluated, and as such conclusions regarding its effectiveness cannot be made at present, formative evaluation of the individual sites is underway to identify those most viable in terms of outcomes, cost and utilisation. This evaluation will inform decision-making regarding the continuation of successful models of service delivery at different locations across New Zealand. If the MAP is found to deliver improved patient outcomes and provision of care, action would be needed to upscale this initiative and deliver best practice osteoarthritis care nationwide.

The next step: a New Zealand osteoarthritis model of care?

There is as yet no policy mechanism to adopt and implement any positive outcomes that may emerge through the MAP process. A New Zealand osteoarthritis MoC has the potential to bridge the evidence-practice gap by facilitating delivery of evidence-informed care for osteoarthritis, thus optimising outcomes for people with osteoarthritis and addressing the substantial cost burden. Adoption of a MoC for osteoarthritis would also accomplish the strategic themes identified in the New Zealand Government's 2016 Health Strategy by creating a health system that is "people-powered, closer to home, designed for value and performance and working as one team in a smart system".[36] It would also align with the World Health Organization's global strategy and action plan on ageing and health 2016–2020. These would be achieved through the provision of care by multidisciplinary teams, facilitating delivery of care through local services, improved access to primary care services to alleviate the burden on secondary care, and enhanced coordination and communication between healthcare professionals involved in providing care. Furthermore, consumers expect (and deserve) to be delivered a consistent standard of care across all regions of New Zealand. Recognising the increasing prevalence of multimorbidity in people aged 50 years and over, particularly in lower socioeconomic classes, it is important to adopt an integrated approach to chronic disease management, where policy and services for osteoarthritis are integrated with those for other chronic health conditions.[4]

The predicted cost benefits of improved osteoarthritis care are substantial. Better symptom management will enable working-age adults with osteoarthritis to stay at work for longer, addressing the $1.5 billion cost to the economy associated with absenteeism.[7] In light of evidence supporting the role of exercise to delay or avoid the need for surgery,[37] improved conservative management through a model of care could reduce waiting lists for joint replacement surgery, decreasing the healthcare burden. Formal economic evaluation of the MAP is due for release in 2020.

What could a New Zealand osteoarthritis model of care look like?

While thorough consultation is required to inform development of a New Zealand MoC, there are several guiding principles based on successful overseas examples. An osteoarthritis MoC would embody the principles of chronic care management: multi-disciplinary team interventions, collaborative care planning, evidence-based practice and a self-management focus. Components of care could include exercise, education and weight loss, in line with international guidelines.[28] In Case study 2, Bill's conservative management is optimised by his undertaking specific exercises for his hip, increasing his physical activity levels, improving his diet and optimising his analgesia.

Specific upskilling of health professionals is likely required, and extended scope of practice roles could be incorporated. For example, in the NSW Osteoarthritis Chronic Care Program an experienced physiotherapist leads the multi-disciplinary team to coordinate program delivery and perform assessments and interventions.[19] A similar component of care could be integrated into a New Zealand MoC, given physiotherapists' skills in exercise prescription and non-pharmacological chronic pain management. At present, 12 of the 17 MAP projects being delivered across New Zealand are physiotherapist-led. A key advantage of a physiotherapist-led component of care would be to facilitate co-care delivery, shifting the burden away from general practitioners. In Case study 2, Bill's physiotherapist is responsible for coordinating his care and facilitating referrals to other healthcare professionals.

Development of an osteoarthritis MoC must also consider vulnerable populations. Paradoxically, some population subgroups face the highest osteoarthritis disease burden, yet have poorer access to care.[38] Potential strategies to target management towards those most in need include understanding the population demographics of the area in which the MoC is being delivered, providing different modes of access and delivering culturally appropriate services. Attention must also be given to residents of rural areas, with telephone, video-conferencing, web-based and mHealth services offering potential solutions to implementation. For example, in Case study 2 if Bill were living in a rural area his physiotherapist might follow up with him regarding his progress via telephone.

There is now an internationally accepted framework to guide the development, implementation and evaluation of musculoskeletal MoCs.[39] Planning must involve relevant primary care stakeholders, including physicians, nurses, allied health professionals, policy makers and consumer representatives. Coherent teams are needed for delivery, and ongoing evaluation of programmes is essential.

Over the next two years, evaluation of successful MAPs will be undertaken to identify 'what works' in various local settings to inform MoC development. Policy support is needed to scale up successful programs and deliver best practice osteoarthritis management nationwide. In the first instance, this would entail recognition of osteoarthritis as a national priority area for intervention. Placing emphasis on the 'front end' of management in primary care would alleviate the burden placed on the hospital system. The primary care that Bill receives in Case study 2 has been subsidised by his local district health board and has the potential to delay or even avoid his need for surgery, saving hospital costs in the long run.

A system-wide approach: implementing primary prevention through public policy

While a MoC targeting osteoarthritis care delivery would go a long way to addressing the evidence-practice gap, more also needs to be done in the area of primary prevention to reduce the overall disease burden. Obesity and joint injury are the two major risk factors for the development of osteoarthritis.[25] Both of these are modifiable, yet not enough public health action is being taken to address these risk factors. Although primary prevention of obesity is challenging and will likely require a number of cross-sectoral strategies, weight loss as a public health intervention would be very effective in reducing new cases of lower limb osteoarthritis.[40] Interventions such as the Ministry of Health's Healthy Families New Zealand provide an example of a system-wide approach. Addressing the burden of osteoarthritis will require such system-wide approaches involving public policy responses to address primary prevention as well as development of a MoC to optimise care planning and delivery.

Key points

- Osteoarthritis is a highly prevalent, disabling and costly condition, however current management is unsustainable and with poor translation of evidence into practice.
- Models of care address the evidence-practice gap by informing *what* best practice care should involve as well as *how* to deliver it within a particular health system.
- A number of osteoarthritis models of care have been developed and implemented in Australia, the UK and Europe with evidence of improved patient outcomes and care delivery, as well as a reduction in the number of patients requiring joint replacement surgery.
- The Ministry of Health's Mobility Action Programme is providing support to create community-based, multi-disciplinary teams to improve early intervention for osteoarthritis in a number of locations in New Zealand.
- Evaluation of the Mobility Action Programme could inform development of a New Zealand osteoarthritis model of care to deliver best practice osteoarthritis management nationwide, however policy support is needed.

The current patient pathway

Case study 1: Agnes

Agnes is a 66-year-old lady who has lived with knee pain for many years. Over the past 12 months the pain has been getting worse to the point where she now has trouble walking up and down the stairs at home and doing household chores. At night the pain keeps her awake, and she is often tired and short-tempered as a result. Since retiring she cares for her two young grandchildren two days a week while her daughter works, but lately this is becoming increasingly difficult. She used to play social tennis twice a week but was forced to stop playing several months ago as her knees felt too sore and weak. She hasn't been getting out to visit her friends and as a result she is becoming increasingly isolated and is showing signs of depression.

Agnes saw her GP six months ago during a particularly bad episode of knee pain and swelling. She was given a referral for an x-ray which showed she had moderate radiographic osteoarthritis in both knees. Her GP noticed that her weight had increased since her last visit one year prior and she was now classified as obese. The GP prescribed pain-relieving medication and advised Agnes to take anti-inflammatory medication as needed. She also provided Agnes with information about weight-loss and exercise although Agnes was not referred on to other health professionals.

Agnes has been referred to the orthopaedic department of her local district health board. She is worried as she might have to wait six months to see the surgeon, during which time she feels she won't be able to cope. Her daughter will have to reduce her workload as Agnes likely won't be able to keep caring for the grandchildren. Agnes is very anxious and feels like her quality of life is getting worse and worse.

An anticipated patient experience under a model of care

Case study 2: Bill

Bill is 61 years old and a long-time sufferer of left hip pain. Recently the pain has been getting worse and he has been limping quite badly, especially on busy days. He has been overweight for many years and had taken up jogging to try to lose weight and improve his heart health, however he has found that this makes the pain worse so he has stopped exercising. He still works part-time but is starting to feel as though his hip will force him into retirement earlier than planned.

Bill decided to see his local physiotherapist upon recommendation from a friend who had knee pain. The physiotherapist performed a comprehensive assessment and advised Bill that he may have osteoarthritis. Bill's GP referred him for an x-ray which confirmed this diagnosis. The physiotherapist recommended for Bill to take part in a programme to help manage his symptoms and together they developed a care plan. The physiotherapist talked to Bill about the causes of osteoarthritis and outlined what could be done to help apart from surgery and drugs. Bill also joined a group exercise program to improve the strength and movement in his hip. He was then referred to a local pharmacist for advice on pain medication, to an exercise physiologist for a general exercise plan and to a dietician for a healthy eating plan. Bill was happy to hear that all of these services would be partially funded by his local district health board.

Six weeks into the program, Bill has made good progress. His hip feels stronger and his limp has reduced, and he has been walking for half an hour three times a week. He has lost 3kg and feels much healthier. He is even considering taking on extra hours at work as he enjoys his job and wants to save for retirement. The physiotherapist has discussed the possibility of referring him to the orthopaedic surgeon but they are both happy with his progress and are delaying this for now. Bill feels as though he is in control and is confident to continue his exercise and diet regime on his own, knowing he can return to the physiotherapist if his condition changes.

Competing interests:
Dr Briggs reports grants from Australian National Health and Medical Research Council, grants from Bone and Joint Decade Foundation outside the submitted work; and Andrew Briggs led the development of an osteoarthritis model of care for Victoria, Australia, during 2015–2016. Dr Larmer reports affiliation with Ministry of Health and Arthritis New Zealand during the conduct of the study.

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Waking up to poor vision after a night out

Nishanthan Ramachandran, Riyaz Bhikoo, John Ah-Chan, Harry Bradshaw

A significant reduction in vision is an emergent problem and requires prompt ophthalmic assessment.[1] However, not all causes of visual impairment carry a poor prognosis. We present a case of valsalva retinopathy in which prognosis is often good.[2–4]

Case report

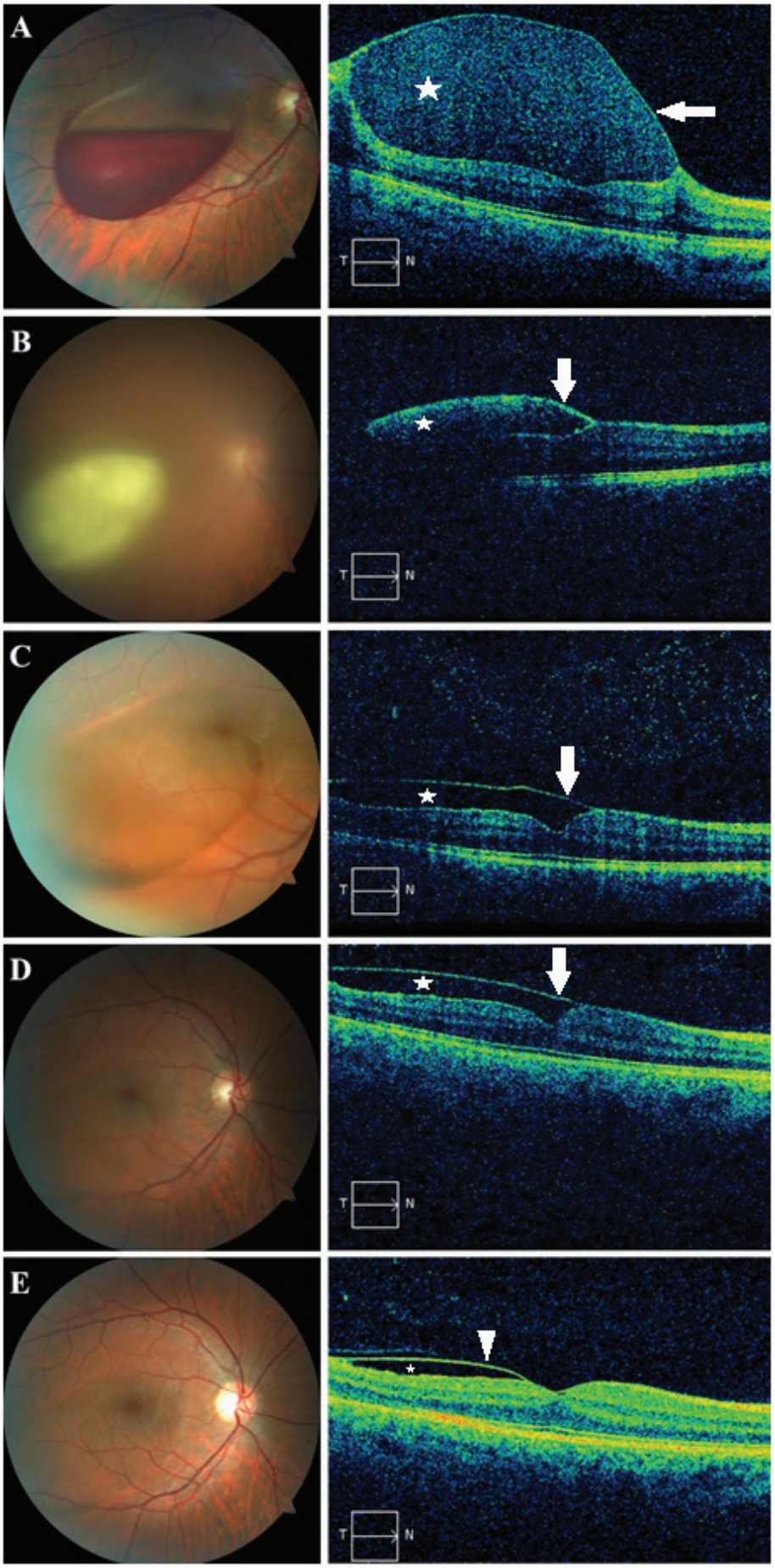
A 27-year-old normotensive healthy male woke with a large central scotoma in his right eye, after a night of inebriation and frequent vomiting. His best corrected visual acuities (BCVA) were 6/24 right eye and 6/5 left eye, with normal intraocular pressures (16mmHg both eyes). The significant exam finding was an encapsulated fluid mass at the right macula with a haemorrhagic condensate inferiorly sparing the fovea, and serous component superiorly. Optical coherence tomography (OCT) of the right macula showed extensive fluid beneath the internal limiting membrane (ILM) (Figure 1A). The left eye was normal (Figure 2). The history and examination findings were consistent with valsalva retinopathy. Both conservative and surgical options were relayed to the patient and the joint decision was to treat conservatively. At one month follow-up, the accumulated blood had broken through into the vitreous cavity causing further blurring of vision and a temporary drop in BCVA to 6/36 (Figure 1B). BCVA continued to improve at two (6/12), four (6/9) and 10 months (6/6) as the remaining fluid resorbed with a significant improvement noted on OCT (Figures 1C to 1E). At the final follow-up, a persistent separation of the ILM (premacular membrane) was noted; however, the patient reported no distortion in vision and was subsequently discharged to the care of the optometrist.

Discussion

Valsalva retinopathy is typically observed in healthy young adults,[5,6] and was first described by Thomas Duane in 1972.[2,5] As the name implies, valsalva type manoeuvre from activities of excessive physical strain (vomiting, violent coughing, sexual intercourse and child birth)[7] causes a rise in intraocular venous pressure with subsequent perifoveal capillary rupture,[3,5,7] and premacular haemorrhage (in subhyaloid, sub-ILM or both layers).[4,7–9] In our patient the premacular haemorrhage had accumulated under the ILM with subsequent spontaneous evacuation into the vitreous.

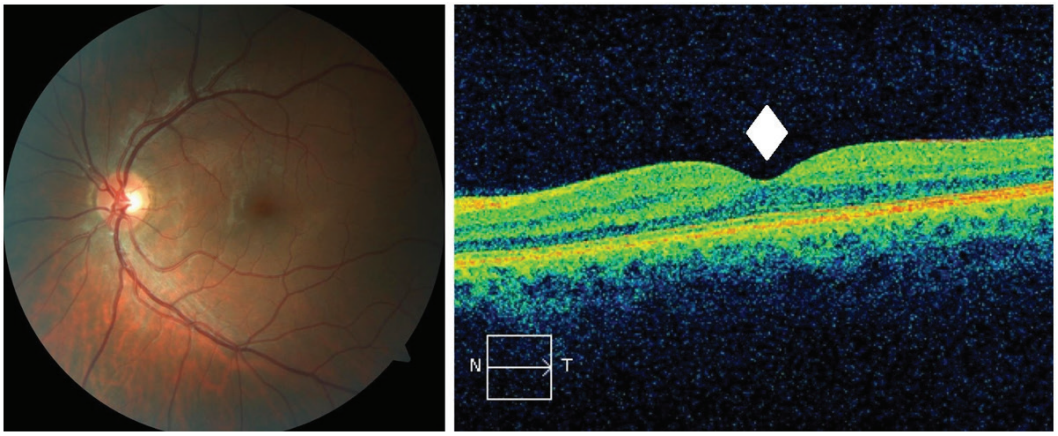
The prognosis of valsalva retinopathy is often good; with spontaneous resorption of pre-retinal haemorrhage over several months.[4,5] There is a theoretical risk of iron-related toxic retinopathy leading to long-term visual impairment.[2,5,6] More invasive treatment modalities include LASER (Nd:YAG, argon or krypton),[5] pneumatic displacement and pars plana vitrectomy (PPV).[6] LASER membranotomy of the posterior hyaloid face allows the haem into the vitreous cavity reducing retinal exposure to iron and accelerating visual recovery. There is a risk of inadvertent LASER damage to surrounding retina and choroid.[2,5,6] Pneumatic displacement of haemorrhage using an intravitreal gas injection +/- tissue plasminogen activator can shift the blood from the fovea but carries restriction on driving and predisposes cataract formation.[6] In recalcitrant cases PPV may be necessary to evacuate the haemorrhage; but complications include cataracts, retinal detachment and macular hole formation.[2, 6]

Figure 1: Colour fundus photograph and macula OCT of the right eye at each visit. OCT images show cross-sections of the macula from temporal (T) to nasal (N).



Arrow = ILM, arrow-head = premacular membrane, star = fluid. A = at presentation with sub-ILM haemorrhage and serous fluid overlying fovea, B = at one month with haemolysed blood in vitreous cavity, C = at two months with further resorption and clearing of blood, D = at four months showing ILM still separated from retina, E = at 10 months showing premacular membrane and eye returning almost to baseline.

Figure 2: Colour fundus photograph and macula OCT of the left eye at presentation. OCT image shows cross-section of the macula from nasal (N) to temporal (T). Diamond overlies fovea.



Even with a clear clinical presentation of valsalva retinopathy, important differentials in a young adult are blood dyscrasias, diabetic retinopathy and retinal artery macroaneurysm.[4,5] Although not all causes of visual loss are recoverable, valsalva retinopathy is a rare recoverable cause of visual impairment.

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The Quality Improvement Residency: a model to address the lack of pre-registration education in quality improvement in New Zealand healthcare professionals

Allan Plant

I read with interest Robb, Stolarek, Wells and Bohm's article published in the recent edition of the NZMJ pertaining to the lack of education of our country's future health professionals in the domains of quality improvement and patient safety. Like many readers I'm sure, I found it astounding that of 43 institutions surveyed, only two provided focused teaching on improvement science. In the spirit of systems improvement, I thought that I'd share our hospital's model for improving education in this area.

Tauranga Hospital offers house officers in their second year of work the opportunity to undertake a supervised quality improvement (QI) residency with the support of our local service improvement unit. The residency offers junior staff the chance to choose an area where they feel that change is needed and to apply a QI methodology taught via the Institute for Healthcare Improvement (IHI) Open School online course. Practically, the residency entails one house officer completing their relief rotation taking one day a week out of the clinical roster to work on a QI project with 1:1 support from our change manager. Established in 2015 and with four residents each year, projects completed thus far have focused on a range of topics from the implementation of standardised weekend plans, the introduction of a hospital-wide ceiling of care form, to the trial of electronic devices to access results in real-time on surgical ward rounds. These projects are not always successful in terms of achieving systems change but they undoubtedly foster an understanding of QI methodology and an interest in improvement science among our junior staff; the success of this programme has subsequently prompted a rollout at Whakatane Hospital as well as the extension of a similar programme to nursing staff.

From personal experience—and having graduated from one of the two institutions surveyed who have formal teaching on QI science—I can confidently say that my understanding of QI pre-registration was limited to enough theory to pass an exam. While learning about tools such as PDSA cycles and small tests of change are a valuable framework for developing skills, it is the real-life application of these tools in a way that brings about tangible improvement to our patients and colleagues that fosters lifelong interest in the field. It is also the practicalities of managing a three-month project that challenges your colleagues to change their practice that offers true learning opportunities; I don't recall any of my pre-registration training arming me with the skills to tell my senior clinical colleagues that I feel our current practice is inefficient. Yet the residency teaches junior staff how to

challenge and innovate without prompting disapproval, and it is this innovation which can keep healthcare fresh and receptive to new ideas.

Although I can't offer solutions to the problem of providing pre-registration education to future healthcare professionals in the domains of QI and patient safety, I can encourage you not to give up on those who have already passed through an education system which has failed to prepare us to take up the mantle of improvement. The QI residency model has now been adopted by DHBs beyond our own, and we would encourage anybody interested in learning more to get in touch. Robb, Stolarek, Wells and Bohm hoped for a future where "improvement is an intrinsic part of [health professionals'] everyday work", to which I leave the quote:

"Better is possible. It does not take genius. It takes diligence… It takes ingenuity. Above all, it takes a willingness to try"[1]—Atul Gawande.

Competing interests:
Nil.

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Research opportunities for medical students: how much time do you have?

Yassar Alamri

We read the article by Al-Busaidi et al[1] with immense interest. Opportunities for early exposure to research during medical school vary greatly between universities; we have previously reviewed the various degrees that can be attained if a student conducts formalised research through university.[2]

Several factors have been identified in the literature to influence the extent of student involvement in research. A positive research culture during medical school is likely to foster interest in research in students. Engagement in research at such an early stage has been previously shown to increase the students' future involvement in research and scholarly activities.[3] Furthermore, the perceived competitiveness of a student's intended training specialty of choice may directly influence their involvement in research.[4]

An important consideration is the time commitment expected of the student to complete the research project. Regardless of underlying motives, longer time commitment to research has repeatedly been cited as a major deterrent to student engagement in research during their medical course.[5]

Durations of research projects range from short-term (weeks) to medium-term (months) to long-term (years). The current literature does not concisely capture the time commitment required to complete such projects.

Short-term research projects

These projects typically represent reports of clinical electives[6] or competition entries; the latter represent research bursaries whereby a professional society, for example, proposes a research topic or question which students have to research and answer. Such essays often require literature review and critical analysis, both of which are valuable skills for medical students. They are a good first step into promoting research to students,[7] but given their limited scope, skills obtained are not as mastered or extensive.

Another type are research ventures that only take several weeks to complete, including research selectives and electives.[8] Unless completely pre-organised, the time-frame does not usually allow for a complete project to be conducted. Rather, these opportunities often require a defined task to be completed (eg, review notes or enter data into a database).

Introduction of such short-term research projects may not only lead to a significant increase in research-related activities, but also increase involvement by supervising faculty—who may otherwise be too busy to supervise students for medium- and long-term projects. Such 'short stunts' can also offer valuable first-hand experience into the collaborative nature of research and the need for coordinated efforts for the successful completion of a project.

Medium-term research projects

Summer studentships and intercalated honours and master's degrees make up the majority of research opportunities on this time-scale—taking a few months (up to a year) to complete. Advantages of these projects include obtaining more in-depth experience of research and, in the case of research degrees, obtaining a degree by leading a supervised project from start to finish.[9]

Projects on such time-scale may offer a middle-ground opportunity for medical students desiring more substantial research experience than short-term projects offer,

but less time than long-term projects require. In a study of graduates of an intercalated honours degree from New Zealand, the majority of the cohort agreed it was a valuable experience and a third had gone on to obtain higher research qualifications after graduation.[10]

Long-term research projects

Projects that take more than a few months range from projects undertaken part-time (eg, concurrent honours or masters degrees) to intercalated doctoral projects. The latter types of projects lend to a mastery of research skills, albeit at the expense of longer times to completion.

The combined medical/PhD programme has been reviewed elsewhere.[11] In brief, medical students dedicate a substantial period of time (usually 2–4 years), typically between their pre-clinical and clinical years. Although the time to complete both degrees is long (often a major deterrent),[5] the graduating student obtains two doctoral-level degrees; more importantly, however, such clinician-scientists are particularly equipped to make the leap in translational research and see interventions move from bench to bedside.[12]

Outcomes of the MBChB/PhD programme in New Zealand have not been evaluated to date.[1] The University of Auckland does, in fact, offer medical students the opportunity to complete both MBChB and PhD degrees in a quasi-intercalated fashion. The uptake of such programmes, however, has been extremely low (Roger and Bagg, personal communication). We are currently evaluating the outcomes of MBChB/PhD students and graduates at the University of Otago (Alamri and Wilkinson, unpublished).

Conclusions

Medical students have ample opportunity for research; time constraints, student goals/motives and institutional availability may play key roles in influencing uptake of such opportunities. By attending to barriers to research identified by students, such as prohibitive time commitments and lack of financial assistance, a tangible increase in medical student research (and ultimately physician-scientist) is hoped to be observed. Academic institutions, industry and non-governmental organisations ought to work together in order to address such barriers and offer collaborative solutions, including elective research opportunities (ie, short-term), overseas research fellowships (ie, medium-term) and exposure to prospective research career tracks (ie, long-term).

Competing interests:
Nil.

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Funding public healthcare is an investment, not a cost

M Gary Nicholls

The editorial article "Time for Healthy Investment"[1] is excellent. As the article notes: "Health spending does not drain the economy. Instead (it)…grows our economy". The evidence to support this premise, as supplied in the references with the editorial article, is robust. Funding of New Zealand's healthcare system has fallen in real terms in recent years and is well below the average in OECD countries.[2] It is indeed time to fund the system adequately.

Many will ask where the money could come from to adequately fund our public healthcare system. In the long-term, the return on investment ("..near $5 for each $1 of government spending on health"—as noted in the editorial article) will kick in. In the short-term, one obvious source of revenue is from stopping the failed, expensive "war on drugs" and moving towards decriminalization—as practised in Portugal and increasingly elsewhere. Other sources exist also—along with the need to reduce spending on the bloated bureaucracy in the public healthcare system, which developed from the late 1980s.

The timeframe of benefit to health (and the economy) from an increased investment in the public healthcare system will be immediate for patients who are clinically unwell, medium-term (years) for some preventive public healthcare measures and for the teaching/training of healthcare personnel, and long-term (many years) for other preventive healthcare measures and for medical clinical research. Indeed many of the benefits from funding healthcare adequately will not be seen for many years, even decades. This may be, in part, the reason why successive governments, with our brief (three year) parliamentary term, have opted to underfund the system.

Whatever the reasons, austerity has been key in the approach to funding and supporting public health, social benefits and education in New Zealand over recent decades. The results have been devastating. An excellent expose on this issue can be found in the book "The Body Economic: Why Austerity Kills" by David Stuckler and Sanjay Basu, published in 2013.[3] It is brief, readable for non-economists and clear on the disastrous human cost when governments underfund healthcare and social benefits. It also emphasises the positive economic outcome from adequate funding.

Now might be the right time for the New Zealand Medical Association to join with other healthcare organisations (NZNO, specialty health colleges, etc) in making a combined, coordinated approach to our new government, making the case that adequate funding of the public healthcare system will indeed grow the economy.

Competing interests:
Nil.

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Mesh abdominal wall hernia surgery is safe and effective—the harm New Zealand media has done: response to Dr Steven Kelly's article

Robert Bendavid

I have read with interest, but also a degree of disappointment, the article by Dr Steven Kelly from Christchurch.[1] There are several errors:

Synthetics were discovered before WWII, more exactly Nylon in 1935 (Carothers at Dupont) and was used in the first description of a true tension free repair by a French surgeon Don Aquaviva from Marseille, France in 1944.[2] The Lichtenstein repair brought nothing new!

Subsequently, nylon was re-used by Henri Fruchaud in 1956 in a technique which has been known more recently as the Rives-Stoppa repair for inguinal hernias.[3]

There have been dozens of reports of chronic pain following all types of hernia repairs, from Denmark, Sweden, Canada, the US and many other countries.[4,5] Though such statistics range from 0 to 60%, the most reliable, rigorous reports place the incidence at 12%. This means that in the US alone, there are, conservatively, 120,000 patients who will be exposed to life-altering changes every year. This is a high incidence, which must be outlined to patients so that they may decide whether the risks are too high. We have presently collected within our practices (US, Canada and Germany), 2,400 mesh explants due to severe chronic post- herniorrhaphy pain for which we have reported preliminary studies.[6,7] This pain syndrome was non-existent prior to 1995 as quoted in Lloyd Nyhus classic textbook on hernias,[8] and Joseph Ponka's.[9] Ponka mentions ilioinguinal and genitofemoral involvement in scar tissue and entrapment as a cause of pain (pages 601–602).

The European Hernia Society World Guidelines (which have not yet been updated officially since 2009) have been severely criticised at the last meeting of the Americas Hernia Society in Cancun (March 2017). The criticism was even more evident at the last conference of the European Hernia Society in Vienna this year (May 2017). A sad sequel of this mesh invasion is that it is difficult today to find a surgeon who can do a pure tissue repair. It seems that we have lost a whole generation of surgeons to the industry. No doubt, our universities must take the brunt of the blame.

Dr Kelly emphasises that repairs with mesh have reduced the incidence of recurrence. This is not corroborated by David Urbach who, last year, analysed 235,109 hernia repairs in Ontario, Canada in a 14-year study with an additional two-year follow-up. This study was carried out to compare the Shouldice repair with the meshes used throughout the province. The patients treated with mesh showed on average, a four- to five-times increase in the incidence of recurrences than observed at the Shouldice Hospital.[10] Our hospital was never involved directly in the study, which was based on the data of our state-run health system!

In that same time period, mesh was used at the Shouldice Hospital in 1.46% of the cases. The main asset of the Shouldice surgeons is that they know the anatomy of the groin.

What is becoming more evident nowadays is that many surgeons are not familiar with the process of mesh removal. It can be tedious, difficult and dangerous, especially when the meshes have been inserted

laparoscopically, which makes the surgery essentially irreversible because of adhesions to adjacent vital structures! Most surgeons will avoid the challenge and obligation by referring patients to pain clinics and eventually to psychiatrists.

It has been a habit of the industry that, when a problem arises, changes are brought in which 'resolve' the issues. This is why we have seen the introduction of so many varieties of lighter meshes, larger pores, various resorbable coatings on the polypropylene mesh (Vicryl, Omega-3 fatty acids, etc). But in fact nothing new has been introduced since it is and always will be polypropylene once its added coats have been digested away.

If the various meshes were as safe as the industry claims them to be, why are there hundreds of thousands of patients involved in class actions, resulting in billions of dollars in fines? Not only for pain and suffering but punitive damages to an industry which has been less than forthright. Neither the industry nor the FDA, nor any world organisation that I am aware of is keeping track of such complications. If one looks at the FDA website, a patient must have died, or come close to death before it is registered by the FDA!

Whether mesh is used in vaginal surgery, pelvic organ prolapse or hernias, the pathology is the same. Women are exposed to earlier complications because of the nature of the thin vaginal wall allowing earlier erosions, breakthrough, recurrent infections, bleeding and pain.

Karl Ziegler and Giulio Nata were awarded the Nobel Prize in Chemistry in 1963 for the discovery of Olefins (of which polypropylene is one). I do not foresee a Nobel Prize in medicine for the use of polypropylene meshes in trusting and unsuspecting patients.

Competing interests:
Nil.

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Timeliness of melanoma management

Keith Monnington, Sharad Paul, Dirk Venter

Brian[1] and Simcock[2] have highlighted that in one of our major hospitals, the timeliness of melanoma management is failing to meet national standards. Conic[3] has shown that a short time to surgery improves survival in Stage 1 melanoma.

The first integrated skin lesion service was set up at Waitemata DHB in 2001.[4] Trained GPs were used to excise skin lesions suspected of being melanoma in a primary care setting. While wider excisions were still referred to hospital, waiting times reduced from 291 days to 31 days.[3] This was highlighted in the Government's "Better Sooner More Convenient" discussion paper.[4]

In 2007, the Bay of Plenty DHB provided funding for contracted GPs to perform excisional biopsies of suspected melanoma and wide local excision of most confirmed in situ and T1a melanomas. In the Eastern BoP, from January 2016 to September 2017, 37 such patients were referred to contracted GPSIs for treatment. The median number of days from referral to treatment completion was 20 days (range 8 to 75 days). The mean number of days was 26.[5]

In the past 12 months, approximately 2,100 non-melanoma skin cancers and suspected melanomas were removed in the community by trained GP surgeons in the Waitemata DHB catchment. This initiative has freed up hospital specialists to deal with more serious and complex melanomas in a timely manner.[6]

Of 18,907 melanomas uploaded to the Skin Cancer Audit and Research Database (SCARD), 13,074 were in situ and only 1,048 had a Breslow thickness of >1mm.[6] General practitioners who have received upskilling in skin cancer medicine and surgery are therefore able to manage the majority of melanomas within primary care, leaving the complex cases for the overstretched public system. The timeliness of melanoma treatment would be greatly improved if the rest of New Zealand adopted a funding model similar to that used in the Bay of Plenty and Waitemata DHB areas.

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Nil.

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New Zealand's legal action against IQOS postponed, consultation with Big Tobacco follows: a response from the Ministry of Health

Jane Chambers

Marta Rychert[1] has raised several matters that we would like to comment on.

The proceedings underway against Philip Morris International are a criminal prosecution, not a civil proceeding, and there is no irregularity with the prosecution process. There is no relationship between the consultation process and the prosecution, which is managed separately through the Ministry's legal team with the Wellington Crown Solicitor.

The consultation meetings with the tobacco industry that Ms Rychert mentioned were part of a wider consultation with a range of stakeholders, including academics and health sector agency staff on options for the regulation of emerging tobacco and nicotine-delivery products. Stakeholders were informed at the beginning of the process that IQOS was out of scope.

The Ministry has been and will continue to be transparent in its tobacco control policy development, including in the area of e-cigarettes and emerging tobacco and nicotine-delivery products.

The Ministry also takes seriously its obligations under Article 5.3 of the FCTC and publishes records of all meetings with tobacco industry representatives.

We are always available to meet with Ms Rychert or any other academic researchers to discuss any aspect of tobacco control, including emerging tobacco products.

Competing interests:
Nil.

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Trends in international asthma mortality

International time trends in asthma mortality have been strongly affected by changes in management and in particular, drug treatments. The authors of this paper from the Medical Research Institute of New Zealand note that high asthma mortality rates seen between the 1960s and 1980s were probably associated with the overuse of the high-dose, potent, poorly selective β2 agonists isoprenaline forte and fenoterol.

In the late 1980s such treatments were replaced by the use of inhaled corticosteroids. These changes in treatment resulted in a two-thirds reduction in the global mortality rates between 1985 and 2005. However, the trend for reduction in global asthma mortality observed since the late 1980s might have stalled, with no appreciable difference in asthma mortality from 2006 to 2012.

The authors conclude that novel strategies will be required to achieve a further substantive reduction in global asthma mortality.

***Lancet* 2017; 390:935–45**

E-cigarette use linked to higher smoking cessation rates

Was the increase in use of electronic cigarettes in the US between 2010 and 2015 associated with a change in overall smoking cessation rate at the population level?

Smoking cessation rates from 2014–2015 were compared with those from 2010–2011. The main outcome was defined as having quit smoking for at least three months.

The increase in e-cigarette use among US adult smokers was associated with a statistically significant increase in the smoking cessation rate at the individual level as well as the population level. It would be interesting to know what the cessation rates would be years later. The outcome of long-term use of e-cigarettes is also of some interest.

***BMJ* 2017; 358:j3262**

Weight and metabolic outcomes 12 years after gastric bypass

The authors of this paper report the 12-year follow-up results of an observational, prospective study of Roux-en-Y gastric bypass that was conducted in the US.

Four hundred and eighteen patients with severe obesity who underwent the surgery were compared with 738 patients with severe obesity who did not have the operation. The follow-up rate exceeded 90% at 12 years. Durable weight loss was significantly greater in the surgery cohort. Remission of type 2 diabetes was significantly greater in the surgery cohort. The incidence of hypertension and dyslipidaemia were also lower in the surgically treated patients.

This study showed long-term durability of weight loss and effective remission and prevention of type 2 diabetes, hypertension and dyslipidaemia after Roux-en-Y gastric bypass.

N Engl J Med 2017; 377:1143–55

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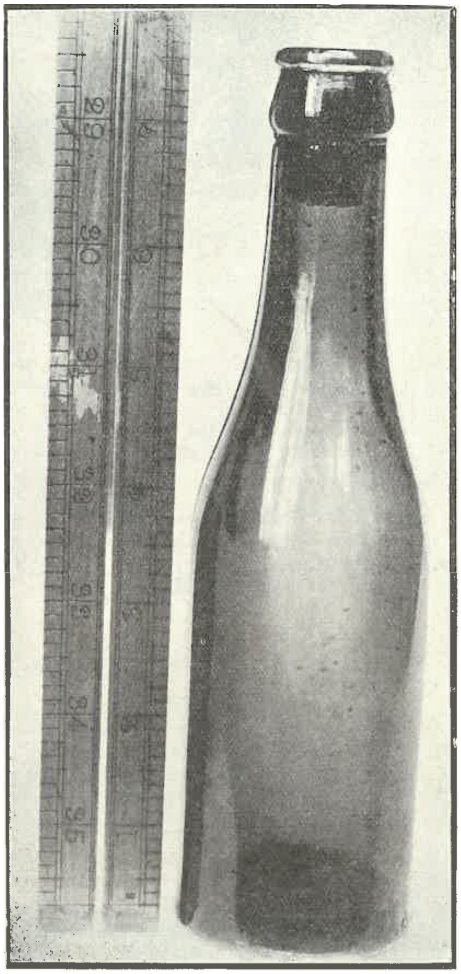
Foreign Body in Rectum

By D. STEVEN, M.D., Medical Superintendent, Stratford Hospital

On 30th October, 1917, at 6 a.m., I was called to the T—— Boarding-house to see Wm. O. He gave a history that the night before, about 10 p.m., he was troubled with constipation, and to get ease he inserted the neck of a bottle into his rectum, but the bottle slipped in and could not be recovered.



Previous health good; total abstainer; in camp a year ago, but discharged September, 1916, because of some old injury to his left elbow, which interfered with him when he was shooting in the prone position; now working at his trade as a painter, but under notice to parade for medical examination on 6th November, 1917.

Patient was a well-nourished and healthy man of 40 years, with powerful muscles and a thick abdominal wall. Two fingers could easily be inserted per rectum, and the smooth base of the bottle could just be felt but not grasped. Three inches to the left of the umbilicus a hard swelling could be easily felt, but with difficulty outlined, it being evidently caused by the upper end of the bottle. All attempts to move the obstruction by getting the man to strain, or by manipulation per rectum, were fruitless, so he was admitted to hospital and deeply anaesthetised by Dr. Cooper. The base of the bottle could then be grasped between two fingers, but was wedged too tightly to be moved; nor had we any forceps or specula that were of any avail. Finally forcible pressure was made over the upper end through the abdominal wall, and the rectal mucous membrane gradually pushed from below the base on to the side of the bottle. In this way it was slowly extracted. The neck was found to be smooth, and examination by sigmoidoscope showed no serious injury of rectal mucosa.

The bottle was an ordinary rennet bottle, exactly eight inches high (the rule shown in the photograph was not vertical), and with a diameter at the base of two and an eighth inches. This diameter is the same for about four inches from the base, and then gradually lessens to one inch at the top of the bottle.

There were a few abrasions of the mucous membrane caused by the rather violent manipulations, but no haemorrhage to remark about, and the man had no ill-effects at the time of his discharge, 36 hours later.

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The proceedings of the 239th and 240th meetings of the OMSRS

28 June and 23 August 2017

Increased right cardiac sympathetic and parasympathetic nerve activity in type 2 diabetes

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Heart function is regulated by sympathetic and parasympathetic nervous inputs, which are unbalanced in type 2 diabetes contributing to widespread cardiac dysfunction. Specifically, diabetes disturbs heart rate (HR) regulation, which is under control of the previously unstudied right cardiac sympathetic nerve activity (cSNA) and parasympathetic nerve activity (PSNA).

We measured right cSNA and PSNA in 20-week-old male Zucker type 2 diabetic fatty rats (DM, n=6–9) and non-diabetic littermates (ND, n=6–7). The right cardiac sympathetic and parasympathetic vagal nerves were placed uncut over bipolar platinum recording electrodes, during anaesthesia. Baseline cSNA and PSNA were recorded, followed by injection of β-agonist isoproterenol (1µg/kg) before and after ganglionic blockade with hexamethonium (1mg/kg). Data were expressed as mean ± standard error, with differences assessed via t–test.

Although HR was decreased, right integrated cSNA was increased in DM (ND 1.7±0.4 vs DM 6.0±2.1 µV/s, $P<0.05$), accompanied by increased vagal PSNA frequency (ND 2.3±1.1 vs DM 15.7±5.6 Hz, $P<0.05$). Diabetes reduced β-adrenergic-induced increases in HR and integrated cSNA (ND 21.0±5.9 vs DM 3.9±2.9% change, $P<0.05$). Disrupting transmission through nerve ganglia with hexamethonium indicated diabetes impaired β-adrenergic-induced increases in signalling frequency from the heart to the brain (cSNA: ND 35.2±11.7 vs DM -2.2±14.4 Hz; PSNA: ND 109.0±37.2 vs DM 5.7±56.5 Hz; $P<0.05$).

Thus right cSNA and PSNA are increased in DM, with lower HR suggesting dominant PSNA changes are an underestimated therapeutic target. Reduced β- adrenergic responsiveness of cSNA and PSNA was largely attributable to rarely studied peripheral signalling. Severe impairment of autonomic regulation is likely a key contributor to the burden of cardiac dysfunction in type 2 diabetes.

Low-intensity magnetic stimulation and excitability in the rodent neocortex as measured by local field potentials

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Repetitive transcranial magnetic stimulation is a technique used to alter cortical excitability in patients with depression or stroke, using strong (~1 tesla) magnetic pulses. Outside of the targeted, focal zone, however, are broad areas exposed to lower strength magnetic fields, below the threshold for direct depolarisation for many neurons. Increasing evidence has emerged to suggest that fields 100 milliTesla, or lower, are able to modulate cellular properties such as calcium levels and firing thresholds *in vitro* and excitability *in vivo*.

To better understand the effects of low-intensity rTMS within the cortex, we made local field potential recordings using metal wire electrodes in place of traditional, inflexible glass microelectrodes. We recorded local field potentials from layer V in the motor cortex of urethane-anaesthetised rats. Rats were treated with either one or two rounds of quadripulse (QPS-50ms or sham, followed by QPS-5ms; n=8–9 per group) or theta burst stimulation (iTBS or sham, followed by iTBS; n=3–4 per group).

No significant effects of one or multiple rounds of low-intensity stimulation were observed on the slope of evoked field potentials in animals treated with QPS ($F_{1,14}=2.79$; $P=0.117$) or iTBS ($F_{1,5}=0.121$; $P=0.742$) protocols. The same negative results held true for input/output curves in QPS-treated ($P=0.760$) and in iTBS- treated animals ($P=0.396$). Overall in all measured outcomes, including paired-pulse ratio and power spectral density, no significant changes were observed as a result of low intensity rTMS.

These results suggest that low intensity rTMS, at levels previously shown to modulate MEPs, does not have a substantial effect on the excitability of layer V neurons, measurable under these circumstances. However, the existence of some trends

within the data suggested that potential changes are subtle, and thus require a more sensitive technique.

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Developing *chlamydia*-targeted protease inhibitors as a potential treatment for chlamydiosis

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Chlamydia trachomatis is responsible for the most common sexually transmitted bacterial infection worldwide, and often results in complications such as ectopic pregnancy and reversible blindness. While current treatment with macrolide antibiotics is quite effective, there are growing concerns about their efficacy due to the ever-increasing prevalence of the disease. This in part can be traced to the lack of organism specificity of the drugs. We therefore aimed to develop chlamydia- specific antibacterials as a means of overcoming this drawback.

CtHtrA is a serine protease crucial for the survival and virulence of *chlamydia*, and a potential drug target. JO146 (Boc-Val-Pro-Val^{p}(OPh)$_2$) was previously identified as an inhibitor of CtHtrA (IC50=12.5μM) that is selectively toxic to the human pathogen. However, JO146 is not potent enough and may also be susceptible to enzymatic degradation, being a peptide-based compound. To improve these properties, we synthesized 24 new analogues of JO146 belonging to six different chemical classes, and optimised them for binding at the various subpockets of the enzyme. The compounds were tested in *in vitro* CtHtrA inhibition and *C. trachomatis* cell culture assays.

Non-covalent binders (N-methyl amides and valinol) were generally inactive (IC50>500μM), inferring that covalency is crucial for activity. α-Ketobenzothiazole showed comparable activity to JO146 (×0.94 relative IC50). Isoleucine and tertiary leucine were the most active residues at P1 and P3 respectively, yielding Boc-Tle-Pro-Ile^{p}(OPh)$_2$ with an ~1,000-fold increase in cellular activity relative to JO146. A number of these inhibitors showed improved selectivity for CtHtrA over other human serine proteases.

We have successfully developed potent and selective analogues of JO146 suitable for *in vivo* pre-clinical studies. In addition, comprehensive structure activity relationships that would enable the design of clinically relevant inhibitors for the treatment of chlamydial infections have also been built.

Supported by a University of Otago Doctoral Scholarship.

Transport issues affect teenage wellbeing in Southland, New Zealand

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Discussions of teenage transport issues are typically framed from the perspective of crash risk and physical health. This research addresses transport in the context of wellbeing. Issues surrounding mobility affect older teenagers' happiness and autonomy. Why teenagers choose to travel the way they do, and what impact these choices have on wellbeing, should help researchers acquire a more nuanced view of the role transportation plays in overall health.

An online survey gathered data about life satisfaction and self-perceived strengths, peer and parental attachment, transport, licensure and activities. Descriptive results were analysed and unpaired *t*-tests and Pearson's chi-squared tests (χ^2) performed on mean values and categorical data, to assess differences and associations by gender, and multiple linear regressions were used.

Overall response rate was 71.5% (N=786; male=49%; average age = 16.7 years). Eighty percent of respondents reported being "happy" or "very happy"; males were happier than females (t=5.12, P=0.001). There was a significant difference between peer attachment and wellbeing between genders; females showed more peer attachment (t=-5.19, P=0.001). The most common mode of transport was being a passenger in a car, followed by walking (85.1% and 69.9%, respectively). Multiple linear regressions supported the attachment and wellbeing descriptive findings. After adjusting for other variables, significant positive associations existed between having a restricted licence and life satisfaction, between cycling and life satisfaction among females, and negative associations existed between licensure and life satisfaction among males. For males driving a car and for females having a license was positively associated with self-perceived strengths.

Trends, gender differences and associations exist with regard to transport issues and wellbeing. This study provides an evidence base for future research and direction for transport-related intervention to provide transport options and infrastructure to support wellbeing among older teenagers.

Supported by a University of Otago Doctoral Scholarship.

Investigating molecular diagnostic biomarkers for myalgic encephalomyelitis/ chronic fatigue syndrome

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Myalgic encephalomyelitis/ chronic fatigue syndrome (ME/ CFS) is a prevalent but poorly understood illness characterised by severe debilitating fatigue, affecting approximately 1% of the global population and disproportionately affecting females. There are no agreed diagnostic markers or definitive clinical tests, and the causative agent and disease pathophysiology are ill-defined. However, immune dysfunction, chronic viral infection, and recently metabolic and mitochondrial dysregulation are proposed causes of ME/CFS. Abnormal upregulation and activation of an innate antiviral immune response protein, protein kinase R (PKR), has also been observed.

This project aimed at identifying biological pathway dysfunctions by comprehensive analysis of different classes of molecules, including micro-RNA, expressed genes (transcriptome), and cellular proteomes in a study group of 10 ME/CFS patients and 10 age-gender matched controls. For a potential diagnostic test, antibodies against (i) a non-phosphorylated PKR fragment and (ii) a phosphorylated PKR peptide were raised and purified to investigate the ratio of active:inactive PKR in ME/CFS patients.

Principal component analysis and *t*-tests were used to identify significant changes in the molecular data. Regulators of metabolic, immune and oxidative pathways were significantly increased. An example was Interleukin 8 (fold-change = 5.57, P=0.02).

Several key mitochondrial proteins were decreased in the ME/CFS transcriptome and proteome analyses, for example NADH dehydrogenase 1 alpha subcomplex, 5 and NADH dehydrogenase flavoprotein 1 (Fold-change <0.78, P<0.01). Possible disease biomarkers were identified, including plasma microRNAs *hsa-miR-142-5p* (P=0.036), *hsa-let-7g* (P=0.02), *hsa-miR-1825* (P=0.02), and a gene transcript *TNFAIP3* (P=3.23x10^{-21}). Western immunoblots of lymphocyte and neutrophil protein extracts detected an increased ratio of active:inactive PKR in ME/CFS patients.

This study of a range of biologically important molecules within a well-characterised ME/CFS patient group identified significant dysregulation in immune inflammatory, apoptosis, oxidative stress, and metabolic pathways, and in mitochondrial functioning.

Utilisation of preventive medicines in older people approaching end-of-life

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The prevention and treatment of chronic conditions are mainly based on pharmacologic therapy; therefore having multiple chronic conditions means the use of a number of medications in individuals aged ≥65 years. Among these, preventive medicines (PMs) such as antithrombotics, cholesterol lowering and bone preserving medicines are the most commonly prescribed.

Our explorative study aimed to examine the prescribing patterns of preventive medicines in older individuals in their last year of life. This retrospective cohort study included individuals (N=99,809) aged ≥75 years who were in their last year of life. PMs examined in this study included low-dose aspirin (≤325mg/day), clopidogrel, dipyridamole, warfarin, dabigatran, statins and bisphosphonates. Multinomial and logistic regression models were used to examine the influence of age, sex, multimorbidity, socioeconomic status and presence of a life-limiting illness (cancer) on the number and type of PMs prescribed (between 2007–2012).

The number of PMs prescribed to older individuals in their last year of life was higher for males compared to females (Relative Risk Ratio 1.34, 95% CI: 1.26–1.41). The number of PMs prescribed decreased as age increased. However, the use of clopidogrel increased over three-fold from 2007–2012 (Odds Ratio (OR) 7.55, 95% CI: 6.28–9.09). In contrast, bisphosphonates use decreased significantly during the same period (OR 0.44, 95% CI: 0.40–0.49). Individuals with a diagnosis of cancer had decreased odds of PMs utilisation except for antiplatelets, aspirin monotherapy and statins, which had remarkably high odds (OR 4.07, CI: 3.84–4.31, P<0.001).

Over the last decade, a significant emphasis is being placed on the optimal use of medicines and deprescribing unnecessary medicines in individuals with multimorbidity and those approaching end-of-life. Our findings suggest that there is some evidence that the use of preventive medicines in older individuals diagnosed with cancer has declined.

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