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Time for Rangatiratanga

Medical students' experience of studying while working part-time and the effects of COVID-19

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Evaluation of community-based CT abdomen for acute abdominal pain during COVID-19

Lauren Arnold, Lucinda Whiteley, Ben Hudson, Andrew McCombie, Grant Coulter, Justin Hegarty, Tim Eglinton

In response to the COVID-19 pandemic and increasing burden on in-hospital surgical services, we trialed a period of community-based CT (computed tomography) scanning for select patients with tummy pain. This trial saw less patients needing to come to hospital for management of their tummy pain, as they were able to be managed in the community with their GPs (general practitioners). This trial showed scanning like this may have use in regular practice after the pandemic is over.

Screening of diabetes in pregnancy in New Zealand: translation of national guidelines into practice

Nuoya Fang, Roshini Peiris-John, Michelle R Wise

In 2014, a new clinical guideline on the diagnosis and management of gestational diabetes (diabetes diagnosed during pregnancy) was published by the Ministry of Health. We evaluated screening rates for gestational diabetes by reviewing 19 audit reports published in New Zealand hospitals from 2015 to 2021. For the recommendation to screen all pregnant women for diabetes early in pregnancy using a simple blood test (HbA1c), rates significantly improved from 28% to 84%, with no difference by ethnicity. For the recommendation to check for diabetes with one of two tests at 24–28 weeks pregnant, Māori had lower screening rates than non-Māori (62% versus 86%). Targeted interventions could be implemented to meet the standard of care, especially for Māori women.

Contemporary management of isolated free fluid on computed tomography scan in blunt abdominal trauma—experience from a Level 1 trauma centre in New Zealand

Priscilla Leow, Victor Kong, Nigel Rajaretnam, Damien Ah Yen, Janet Amey, Bronwyn Denize, Gina Marsden, Damien Clarke, Grant Christey

Patients presenting to the Emergency Department with blunt abdominal injury for example in motor vehicle accidents and falls often require a trauma CT scan. In some instances, free fluid in the abdomen may be isolated, without any obvious injuries or causes seen. Isolated free fluid can be normal, especially in females, or pathological due to injury within the abdomen. This paper has found that the presence of fluid itself does not indicate the need for surgery. The volume of fluid however can differentiate patients who are likely to require an operation and those who can be managed without surgery.

Medical students' experience of studying while working part-time and the effects of COVID-19

Elizabeth Stevenson, Helen Nicholson, Kelby Smith-Han

The costs of being a medical student are large and increasing. This study explored the impact of part-time paid work on medical students' well being and study. We found that nearly half of the students who responded worked part-time while studying and of those who worked, 24% said they would not be able to continue studying if they did not work. Working part-time had both positive and negative effects on student wellbeing. However, the findings also suggest that medical school guidance may not reflect the realities that students experience in their life, such as increasing financial pressures. Medical school educators and advisors should be encouraged to work with students collaboratively to explore how they can minimise the negative impacts for students who work part-time while studying.

Thunderstorm asthma: a review, risks for Aotearoa New Zealand, and health emergency management considerations

Carol Stewart, Nicole L Young, Nicholas D Kim, David M Johnston, Richard Turner

In this article we review thunderstorm asthma (TA) events worldwide and identify individual risk factors, environmental conditions and suspected triggering allergens. To date, a single TA event has been reported in Aotearoa New Zealand, in Hamilton in December 2017. While TA events are globally rare, they will likely become more common as the Earth warms. For preparedness for future events, we recommend developing public messaging and the instigation of routine aeroallergen monitoring.

Time for Rangatiratanga

Jonathan Koea

Ki ngā whakaeke haumi

Join those who can join sections of the canoe.

As July the first rolls around, in the time of renewal following Matariki, and the proposed revamp of the public health system is operationalised, Howard et al.,[1] in the current issue of the *Journal*, provide a timely reminder of the importance and responsibilities of clinical leadership in the health system. The history of clinical leadership in the New Zealand health system has similarities to the well-known children's story. The initial iteration of district health boards was in response to hospitals largely managed by medical superintendents and chief nurses—too much clinical leadership, while the subsequent Crown Health Enterprises were considered to have too little. The latest and last iteration of district health boards were often considered to have it just right with the term "Clinical Co-Governance" frequently used—"co-governance" attracting less disapproval from parts of our communities than currently. However, the phasing out of the district health board model would suggest that this was not case.

As Howard et al.[1] point out, the assumption of management positions by clinicians has, at times, been by a default process. The person with the available time, with fewer clinical, teaching and research commitments, was often the individual appointed. Some were recently employed and relatively junior, or occasionally older clinicians looking to move out of front line clinical careers did so via the management suite. With some notable exceptions, few had any managerial experience and even fewer had managerial experience outside the public health system, and tertiary commercial or managerial qualifications were rare. To be fair, these caveats also apply to many full-time managers as well. Admittedly, appointment was based on clinical qualification and what that might bring to the management suite and, ironically, usually final signoff was by management staff meaning that they, not clinicians, determined who represented the clinical perspective. Unsurprisingly, Savage et al.[2] have shown that such "incidental leaders" are less effective than trained and willing leaders, and struggle to bridge the management-clinician divide.[1] Clinician managers are often a solitary presence at meetings numerically dominated by full-time managers, there to confirm consultation rather than to directly contribute to the setting of organisational priorities and resource allocation. For their own part, clinicians involved in management often relocated offices to the hospital management suite, reinforcing the divide and often losing touch with the people they were appointed to represent, becoming a conduit for management to communicate with clinical staff, rather than representing the views of clinical staff to management. Frequently, clinician managers have been used only to assist in the operationalisation of organisational strategy, already decided at a higher governance table, and to help manage the fallout when such strategies have come unstuck. In their defence, many clinician managers have been appointed to very part-time positions, expected to fit management work around pre-existing clinical commitments, not provided with administrative support and no resourced time to work on organisational strategy or big picture projects.

Howard et al.[1] rightly advocate that development of a management expertise and skillset should become a *bona fide* and respected career path for those clinicians who wish to pursue it. They should be supported, by their colleagues and institutions, in obtaining relevant qualifications and experience. To avoid "incidental" or "default" clinician managers, recruitment should be formalised with clear financial incentives and administrative resource allocation. Identification of clinician managers should commence early and should be facilitated with opportunities for both theoretical and practical learning.[2] Selection of clinician managers should be part of every departmental talent identification system in the same way that clinicians with teaching, research or other skill sets are targeted, recruited, developed and contribute to departmental, divisional and institutional achievement. Clinician managers should be subject to audit and assessment of their qualifications and achievements, commit to continuing education in the area and be prepared to undergo regular 360° assessments with detailed feedback[1]—in the same way that clinical and research workstreams are regularly assessed.

However, clinician managers in Aotearoa New Zealand face another challenge that is unique in a global sense, in that the primary aim of the coming health reforms will be to ensure that the public health system delivers equal access and outcomes for all—

particularly Māori and Pacific peoples.[3] The recent issues around the provision of COVID-19 vaccination to Māori and Pacific communities in early 2021 clearly demonstrate the limitations of the vertical, "command and control" system of management historically used throughout our health institutions and also the persistent divide between health management and clinicians. As was well documented, qualified clinicians repeatedly indicated to central government and health institutions that new approaches to create meaningful relationships with these communities would need to be used in order to optimise vaccination rates.[4] For their trouble, many were ignored and some vilified before being permitted to implement their own systems when the crisis had arrived and time was almost up. We all owe them a great debt for the dignity with which they have conducted themselves and for the whānau focus they have maintained. Vertical management practices restrict nuanced assessments and dynamic responses to health issues, particularly across distinct communities with differing health needs and, when coupled with time and political imperatives, encourage authoritarian behaviour to achieve predetermined goals—even when those goals do not correlate with the best available clinical advice.[5] This also discourages clinicians who are genuinely interested in system change from engaging. For these reasons vertical management systems are no longer favoured for health providers internationally.[6]

Te Tiriti o Waitangi is entrenched in health and a cornerstone of the new reforms. The term "Rangatiratanga" has been extensively discussed in relation to Te Tiriti and is referred to in Article 2, defining the concepts of sovereignty, chieftainship, leadership and self-determination.[7] Rangatiratanga guides a philosophy of bringing people together, learning from one another, sharing wisdom, and building mana. This form of leadership embraces collectivism, nurturing relationships, reciprocity, and a system of interdependent leadership that accounts for the common goals of all people.[8,9] Incorporating Māori knowledge systems into health leadership will help foster a safe, equitable operational culture driven by a governance strategy that is inclusive and informed by all.[9] Rangatiratanga can be described as an admixture of servant leadership (where leaders do so with humility and empower followers) and ethical leadership (where leaders exemplify actions that are driven by moral and ethical values and admonish actions that are not).[10] Shifting health leadership to adopt an integrative, collectivist, and future-focused model has been associated with improved organisational processes and improved team outcomes in health systems in way that vertical leadership systems have not.[10]

For Aotearoa New Zealand, our health issues are similar to those seen in many countries; however, our communities are unique, and we need to address these issues in a way that that reflects who we are. Expediency cannot be allowed to drive simplistic and crude interventions to address our equity issues. Historically, clinical co-governance has not consistently equated to power sharing or co-design. Now more than ever well qualified clinician managers are needed, who must be prepared to demand a place at high table and who, with data driven strategies, drive the creation of a health system that does provide equal access and outcome, high quality care for all of us. This must be done carefully listening to their colleagues and to our communities. This is no easy task right now, with every part of the health system essentially managing crises only, but if not now, when, and if not us, who?

COMPETING INTERESTS
Nil.

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Evaluation of community-based CT abdomen for acute abdominal pain during COVID-19

Lauren Arnold, Lucinda Whiteley, Ben Hudson,
Andrew McCombie, Grant Coulter, Justin Hegarty, Tim Eglinton

ABSTRACT

AIM: The purpose of this study was to determine the utility of community-based imaging to reduce use of inpatient surgical resources and enforce social distancing at the outset of the COVID-19 pandemic.

METHOD: A prospective evaluation of community-based CT for patients presenting to Christchurch general practitioners with acute abdominal pain from April to November 2020. Eligible patients were discussed with the on-call general surgical team, and then referred for CT abdomen rather than hospital assessment. The positivity rate of CT scans, the 30-day all-cause hospital admission rate, and the proportion of patients where community scanning altered management setting and the number of incidental findings, were all assessed.

RESULTS: Of 131 included patients, 67 (51%) patients had a positive CT scan. Thirty-nine (30%) patients were admitted to hospital within 30 days, 34 (87%) of whom had a positive CT scan and were admitted under a surgical specialty. Ninety-two (70%) patients did not require hospital admission for their acute abdominal pain, thirty-three (35%) of whom had a positive CT scan. There were three deaths within 30 days of the community CT, and the setting of the community CT did not contribute to the death of any of the cases. Forty patients (30%) had incidental findings on CT, 10 (25%) of which were significant and were referred for further investigation.

CONCLUSION: Community based abdominal CT scanning is a feasible option in the management of acute abdominal pain. While trialed in response to the initial nationwide COVID-19 lockdown in New Zealand, there may be utility for acute community-based CT scanning in regular practice.

Acute abdominal pain is common, accounting for 5–10% of emergency department presentations and with many potential causes ranging from benign to life-threatening.[1] It is important to identify diagnoses quickly and accurately in order to start appropriate treatment, and to ensure optimal outcomes for patients.[2] In addition, rapid and safe identification of patients who do not require inpatient care avoids unnecessary admissions and reduces healthcare costs. In the last two decades, the number and rate of admissions with acute abdominal pain under general surgical departments have increased, including an increase in non-surgical causes of pain.[2] Many initiatives have been employed by departments to manage this increasing workload, including the establishment of acute surgical units and dislocating acute and elective service provisions.[3]

This period has also seen an increase in the use of Computed Tomography (CT) abdomen to diagnose abdominal problems.[1] Improvements in CT technology, such as multi-planar reformatting, means it is now highly accurate in diagnosing many abdominal conditions.[4] The effective use of CT abdomen for the assessment of acute abdominal pain has been demonstrated in many studies, including both emergency departments and in hospital-based settings in the after-hours.[5] One 2011 study of atraumatic abdominal pain in the emergency department found that CT abdomen increased diagnostic certainty, and altered the management plan in up to 42% of patients.[6]

While the use of CT abdomen for acute abdominal pain has been well documented in the inpatient population, there was no literature describing its use in the community setting for this indication prior to the COVID-19 pandemic. In March 2020, near the beginning of the COVID-19 pandemic, New Zealand went into a nationwide four-week lockdown, and put in place multiple measures to protect hospital resources. Amongst these, in Christchurch, a pathway was established to provide primary care access to community-based CT abdomen for patients with acute abdominal pain, allowing diagnosis and triage prior to attending hospital. This supported social distancing in the early stages of the pandemic, preventing COVID-19 exposure to vulnerable hospital patients and staff, and protecting hospital resources.

This paper describes the implementation and outcomes of this novel initiative. The hypothesis was that community-based CT for acute abdominal pain would safely reduce the need for surgical admission.

Method

A prospective evaluation was conducted of community-based CT for patients presenting to a General Practitioner (GP) with acute abdominal pain in Christchurch, New Zealand between 1 April and 30 November 2020. Christchurch Hospital is an 833-bed hospital (including Children's Health, Surgical, Maternity and Medical), one of five larger hospitals in the Canterbury District Health Board that serves a population of 560,000 people. Within the General Surgery Department at Christchurch Hospital, there are on average twenty-five acute general surgical admissions every twenty-four hours.

During the study period, selected patients with acute abdominal pain referred by their GP to the on-call general surgical team for admission were instead considered for suitability for community-based CT scanning. Advice and eligibility criteria for this trial were published for GPs on Canterbury Community HealthPathways. HealthPathways is national, but the Canterbury version of the website is where locally agreed clinical and referral guidance is available for GPs. The pathway describes investigation and management for various clinical presentations with abdominal pain. Many presentations are suitable for investigation with CT; however, notable exclusions in the pathway are those with suspected gallstone disease, and females under 40 years who are often better served with ultrasound scanning.

Patients deemed suitable for the intervention by the referring GP and the on-call surgical team then underwent CT abdomen within twenty-four hours at an outpatient radiology facility remote from Christchurch Hospital. CT was available from 0800 to 1800 on weekdays. CT abdomen was performed on 128 slice scanners from multiple vendors. Intravenous contrast (Omnipaque 350, GE Healthcare) was administered by weight. Images were reconstructed in 3mm slices in axial, coronal and sagittal planes and sent to PACS for radiologist interpretation.

The local Acute Demand Management Programme was used to fund general practitioners for the consults,[7] the triaging of radiology referrals, and the community radiology costs. The CT result was reported to the referring GP, who was then able to determine whether the patient required admission to hospital or could be managed in the community. The Acute Demand Management Programme provided after-hours support for result handover and safety-netting, and the on-call surgical team was available via phone call for any advice required post scan. The inclusion and exclusion criteria are provided in Table 1.

Evaluation of outcome data included information on age, biological sex and ethnicity. Outcomes assessed were; the number of "positive CT scans" (i.e., CT results judged by the study team to have explained the presentation of acute abdominal pain), the proportion of people admitted to hospital within 30 days of the community CT scan (all-causes of admission), the proportion of patients where the management setting was altered by community CT, and the proportion of incidental findings (i.e., findings unrelated to the clinical indication of acute abdominal pain).

Table 1: Inclusion and exclusion criteria.

Inclusion criteria
Any patient aged ≥20 years of age referred to general surgery by their general practitioner for discussion of further assessment/work up.
Presenting complaint of which acute abdominal pain is the main symptom.
Patients in whom the symptom of acute abdominal pain has been present <1 week.
Patients discussed with general surgical team as being suitable for community assessment of symptoms.
Exclusion criteria
Patients with signs or symptoms of sepsis or haemodynamic instability on referral.
Patients requiring parenteral medications, or pain/other symptoms otherwise unable to be managed in the community.
Pregnancy.
Renal insufficiency.

Univariate analyses were performed using the Fisher's exact, or standard Chi-squared tests for categorical data, followed by multivariate logistic regression. All statistical analyses were performed using IBM SPSS, version 25 (Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

Results

Of 141 patients who entered into this pathway between April 2020 and November 2020, ten were entered inappropriately (not acute abdominal pain or not CT abdomen imaging) and were therefore excluded, leaving 131 patients in the analysis. All scans were performed within 24 hours, and the mean time from scanning to formal reporting was two hours.

The age range by sex is shown in Figure 1.

Figure 1: Age distribution of patients with community CT abdomen with age intervals separated by gender.

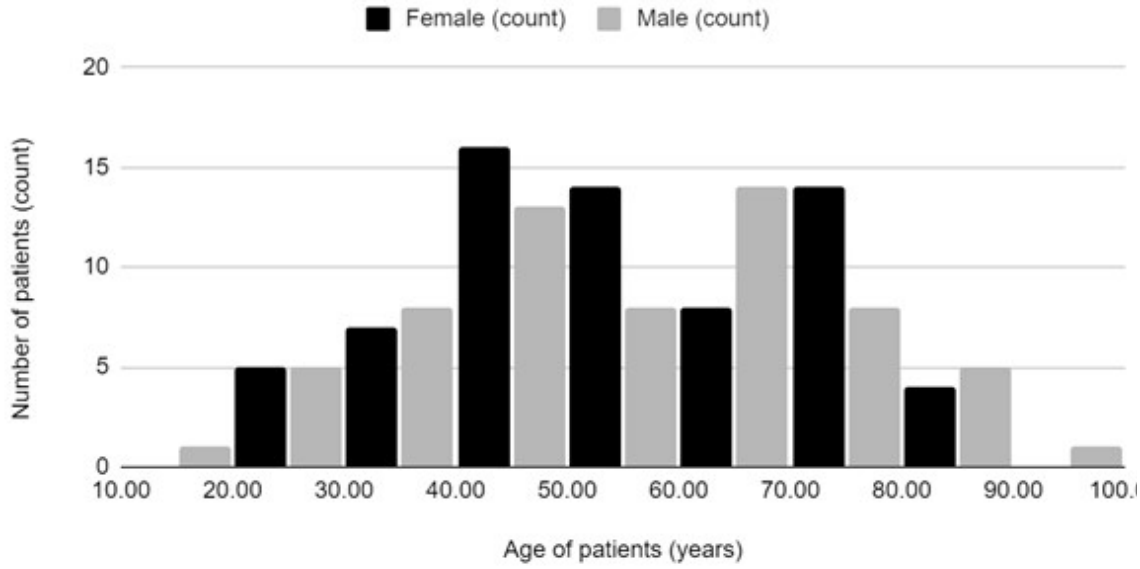

Figure 2: CT abdomen result by age range and scan result.

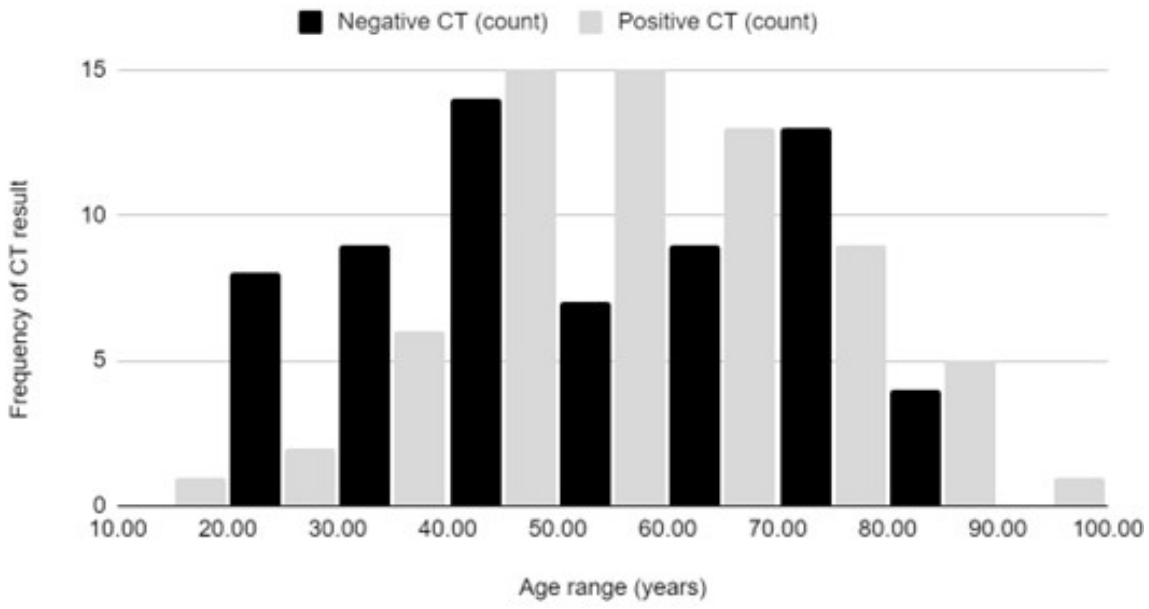

Table 2: Positive CT abdomen diagnoses.

Scan diagnoses	Subtype	Count	(%) of total	No admitted (% of diagnosis)
POSITIVE SCANS		67	51%	34 (-)
Diverticulitis	Total Uncomplicated Complicated	17 13 4	 10% 3%	4 (24%)
Appendicitis	Total Uncomplicated Early NOS	13 5 3 5	 4% 2% 4%	12 (92%)
Malignancy	Total Pancreatic Bowel Other*	9 1 4 (2 perf, 2 obstruct) 4	 0.7% 3% 3%	5 (50%)
Colitis	Total IBD Other	6 1 5	 0.7% 4%	3 (50%)
Abscess/collection	Total Perianal horseshoe Other	3 1 2	 0.7% 1.5%	3 (100%)
Obstruction	Total Obstruction Pseudo-obstruction	2 1 1	 0.7% 0.7%	1 (50%)
Gallbladder aetiology	Total Cholecystitis GB stone aetiology	3 1 2	 0.7% 1.5%	2 (66%)
Hernia	Total Inguinal hernia Umbilical hernia	2 1 (obstructing) 1	 0.7% 0.7%	0
Pancreatitis	Total NOS	2 2	 1.5%	2 (100%)
Epiploic appendagitis vs omental torsion	Total NOS	1 1	 0.7%	0

Table 2 (continued): Positive CT abdomen diagnoses.

Scan diagnoses	Subtype	Count	(%) of total	No admitted (% of diagnosis)
Other	Total Lung Urology Vascular Gynae Trauma Faecal loading	8 3 (effusion, pleural lesion) 1 (ureteric calculus) 1 (renal/splenic infarct) 2 (abscess/PID, ovarian cyst) 1 1	2% 0.7% 0.7% 1.5% 0.7% 0.7%	- - 1 (100%) 1 PID (50%) - -
NEGATIVE SCANS		64	49%	5

*NOS: not otherwise specified.
*malignant other: bladder TCC, gastric cancer, widespread metastatic disease, and lymphoma.

The median age of the patients scanned was 55 years. Included in analysis was a male patient aged 19 years old who was deemed clinically suitable for the study, despite being younger than the original age threshold for inclusion. Sixty-eight of the cohort (51.9%) were female. Of note, 105 (80.2%) of the patients scanned were over 40 years of age. Eleven percent of the study cohort were Māori, one percent Pasifika, eighty-two percent New Zealand European, five percent Asian, and one percent did not state their ethnicity.

The distribution of CT scan result by age range is shown in Figure 2.

Sixty-seven (51%) patients with abdominal pain had a positive scan explaining their presentation. In a multivariate model, including age under 40 years, gender and their interaction, males (65.1%) had positive scans more often than females (38.2%) (p=0.021). There was no significant difference in CT scan positivity in those aged 40 and over compared with those aged under 40 (55.2% vs 34.6%, respectively, (p=0.482)). Females under 40 years old were very unlikely to have a positive scan (8.3%) as compared to females 40 and older (44.6%), and this difference between age categories was less pronounced for males (57.1% vs 67.3%, respectively), and neither were significant (p=0.160).

Following CT abdomen, 39 (30%) patients were admitted to hospital within 30 days. Of these, thirty-four (87.1%) had a positive CT and were admitted directly either to general surgery (n=31), vascular surgery (n=1), gynaecology (n=1), or haematology (n=1) for management of their acute diagnosis. Table 2 shows a breakdown of the frequency of diagnoses on positive CT scans, and the proportion of admissions for each diagnosis.

Five patients had a negative CT and were admitted to hospital later in the thirty-day period. Two of these patients were admitted under general surgery, requiring analgesia despite the negative CT. One of these was eventually diagnosed with a gallbladder calculus without obstruction, while for the other no diagnosis was made. The other three patients with a negative CT were admitted under general medicine. Pneumonia was diagnosed in two of these patients, and no diagnosis was made in the other. Hence, 59 of 64 (92.1%) patients with a negative CT did not require admission.

Of the 92 patients not admitted to hospital after their CT scan, 33 (35.8%) had a positive CT. The diagnoses that were managed in the community are provided in Table 2. Five patients with a positive CT did not require acute admission but were referred to urgent outpatient clinics. The findings in these patients were a possible bladder TCC (n=1), primary pancreatic cancer (n=1), gastric wall thickening, possible malignancy (n=1) and ureteric calculi (n=1). One patient with widespread metastatic disease had an urgent community palliative care referral made by their GP.

Incidental findings were noted in 40 (30.5%) CT scan reports. Twenty-eight (70%) of these were deemed to be clinically insignificant and did not require follow-up. The most common of these insignificant findings were liver cysts (n=7, 16%) and renal cysts (n=6, 14%). Ten (25%) of these incidental findings were referred on for further specialist assessment. These significant incidental findings are listed in Table 3.

Table 3: Frequency of significant incidental findings on CT abdomen requiring further assessment.

Incidental findings	Number (n)
Adrenal lesions	2
Liver haemangioma	1
Renal cell carcinoma	1
Ovarian cysts	2
Prostate mass	1
Bladder diverticulum	1
Abdominal aortic aneurysm	1
Pulmonary nodule	1
TOTAL	10

There were three deaths in the cohort within 30 days of the CT. Two were patients admitted to hospital following their CT. A 94-year-old male had a malignant bowel obstruction that was managed with successful colonoscopic stenting. He was transferred to a rehab facility but subsequently deceased at day 28 after suffering a fall and a large MCA CVA. An 81-year-old female had a contained acute on chronic intestinal perforation that was deemed for non-operative management and passed away at day 25. One patient, a 72-year-old male, was not admitted to hospital as the CT demonstrated widespread intra-abdominal metastases from an unknown primary. Urgent community palliative care was initiated, and the patient passed away in the community at day 28.

Discussion

This evaluation showed that appropriately selected patients presenting to a GP with acute abdominal pain can be safely and effectively investigated with urgent community-based CT abdomen. The majority (70%) of patients who underwent a community-based CT scan did not require hospital admission and were not subsequently admitted within 30 days of the scan. If patients had a negative scan, in 92% of cases, their abdominal pain was successfully managed out of hospital.

Hospital admission was not just avoided with negative CT scans. Of the 51% of patients with a positive CT scan, approximately one third were managed in the community and avoided hospital admission. The three most common CT abdomen diagnoses were diverticulitis, appendicitis and suspected malignancy. All but one of the patients with radiological diagnoses of appendicitis were admitted to hospital for further management. The available literature supports CT scanning as the best imaging tool for identifying acute appendicitis, reducing negative-finding appendicectomy rates and decreasing overall cost per patient (in unnecessary hospital admissions and operations).[8] Of the patients with diverticulitis, 70% were radiologically uncomplicated and as such managed in the community in keeping with local management guidelines. Five percent of patients had a non-general surgical diagnosis identified permitting admission directly to the correct specialty.

Over time, there has been a general increase in the use of CT scans to aid with diagnosis but associated with this, a corresponding higher number of scans negative for acute pathology.[1] Despite the described high sensitivities and specificities for CT scanning in patients with acute atraumatic abdominal pain,[1–2,9] there remain risks associated with CT scans. These include radiation exposure, contrast reactions and nephropathy. In appropriately selected patients, these risks are generally outweighed by the benefits of the increased diagnostic certainty. In the present study, half (50.1%) of patients with acute abdominal pain had a positive community CT result that explained the cause of their abdominal pain. Overall, this positivity rate remains within the range reported in other studies of CT in acute abdominal pain performed in hospital settings. Those most likely to have a negative scan were females under 40 years of age. The numbers in the present study are too small to draw firm conclusions but raises the possibility that this group

may be better managed with other diagnostic pathways. At present in our institution, females of childbearing age with lower abdominal pain undergo ultrasound in the first instance. Ultrasound is also the first line investigation for right upper quadrant pain where gallstone disease is suspected.

The older age group pose a particular challenge in the setting of acute abdominal pain for two reasons. Firstly, the incidence of serious pathology as a cause for pain increases in the elderly and secondly, clinical assessment and basic laboratory test are less reliable.[10] One retrospective study of patients aged over 80 showed that CT abdomen identified significant clinically unsuspected diagnoses in 43% of patients. The present study suggested a trend of positivity increasing with age supporting the utility of CT in this group.

A potential criticism of the use of CT in this setting is the associated cost. No formal cost analysis was performed in the present study; however, the approximate cost of the community-based CT was $516NZD (including tax). Admission to the surgical admission and reassessment area costs approximately $1000–1800NZD per night. Many patients admitted will also undergo a CT abdomen as an inpatient, and a recent 2021 audit in our institution found 56% of admissions with abdominal pain have a CT during the admission (unpublished data). Based on this, accounting for GP time and costs, it is likely community-based CT is cost saving.

This study has a number of limitations. It was assumed that all patients referred would be admitted if community CT was not available. While this cannot be verified, the pathway was designed such that it would only be used in this circumstance. Secondly the study has not recorded outcome data including morbidity and surgical complication rates. There were three deaths within 30 days of the community CT, and the setting of the community CT did not contribute to the death in any of the cases. In fact, it facilitated community palliation in one of the cases of advanced malignancy. Admissions in the subsequent 30 days were recorded and none of the patients managed in the community were admitted with abdominal complications during that period subsequent to the CT. Scans were obtained and reported rapidly, so there was no anecdotal evidence that performing CTs in the community delayed hospital treatment. Delay in treating unwell patients was also avoided with exclusion of obviously unwell patients by direct admission to hospital.

Acute abdominal pain has multiple possible causes ranging from common conditions such as appendicitis and diverticulitis through bowel obstruction to rarer, but life-threatening, conditions such as bowel ischaemia. In most series, around a third of admissions are for non-specific abdominal pain where no clear diagnosis is made and, other than analgesia, no specific treatment is required. In many cases, it will be obvious that hospital admission is mandatory on clinical grounds due to severe pain, signs of sepsis or haemodynamic instability. Many patients who are not this unwell, but need a serious cause of their pain excluded, are admitted for diagnostic work-up including clinical assessment, laboratory tests and imaging. Of the investigations available, CT is the most accurate for diagnosis, and multiple studies have demonstrated its utility in increasing diagnostic certainty and altering admission and surgical management plans.[11] In the present study, the ability to rapidly access CT in the community allowed improved triage and avoided unnecessary hospital admissions.

Even pre-COVID, population growth and demographic changes were increasing the burden on acute inpatient and diagnostic services,[1,12] and the pandemic has now presented an opportunity to change the way acute healthcare is delivered. Prior to the pandemic, there was no body of literature exploring the use of urgent community-based CT imaging for managing acute abdominal pain in the community. In October 2020, the National Health Service (NHS) released a guideline for diagnostics services in a post-COVID world that identifies a significant need for expansion of imaging capacity, using that within redefined diagnostic pathways, and where possible, locating that imaging capability in community diagnostic hubs to reduce hospital admissions.[13] The findings in this study align with that approach, suggesting there may be utility in establishing acute diagnostic services out of hospital sites, thereby streamlining patient care and increasing efficiency. It is important to note the impact these changes may have on those working in primary care, and any additional burden this may place upon these services needs to be accounted for in redesigning the system. In addition, in times of COVID-19 surges, care must be given to protect "green sites" outside hospitals, so that stringent screening is required for community facilities. Despite these limitations, the initial encouraging results from piloting this pathway has seen it continue in its present form in the host institution. It is acknowledged that during the initial lockdown and subsequent COVID-19 surges there may have been heightened anxiety amongst clinicians and patients alike that may impact referral patterns. For these reasons, and to ensure the ongoing efficacy of the pathway, outcomes will be closely monitored prospectively.

In conclusion, community-based abdominal CT scanning is a feasible option in the management of

acute abdominal pain. As a diagnostic tool it has significant potential to decrease the number of general surgical hospital admissions and further streamline the referral/admission process from community to inpatient specialties. While it was trialled in response to the first COVID-19 lockdown in New Zealand, there may be utility for community-based CT scanning in regular, post-pandemic practice.

COMPETING INTERESTS
Nil.

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Screening of diabetes in pregnancy in New Zealand: translation of national guidelines into practice

Nuoya Fang, Roshini Peiris-John, Michelle R Wise

ABSTRACT

BACKGROUND: Diabetes in pregnancy represents a significant risk for adverse pregnancy outcomes and implications for the future maternal and child health. Disparities in screening rates and discrepancies in clinical practice led to development of the New Zealand Ministry of Health Guideline on screening, diagnosis and management of gestational diabetes (GDM) in 2014.

AIM: To evaluate the proportion of pregnant women who completed screening for pre-existing diabetes and GDM, following publication of the Guideline.

METHODS: A stocktake was conducted of clinical audits by University of Auckland medical students in nine New Zealand public hospitals between 2015 and 2021. Audits were included if they investigated whether women who gave birth were screened for diabetes in pregnancy according to Guideline recommendations.

RESULTS: Nineteen audits of 3213 women investigated the screening rates for (1) pre-existing diabetes, by 20 weeks' gestation, using HbA1c [n=16]); (2) oral glucose tolerance test, OGTT, follow up of abnormal HbA1c at 24–28 weeks' [n=4]); (3) glucose challenge test, GCT, at 24–28 weeks' [n=9]); and (4) OGTT follow-up of abnormal GCT [n=10]). There was improvement in HbA1c screening, from 28% in 2015 to 84% in 2020. OGTT testing rates were high in all audits. Māori had lower rates of screening for GDM (standards 2 & 3) than non-Māori (62% versus 86%, $p<0.05$; 3 audits, n=837).

CONCLUSIONS: The national guideline made a positive contribution to the quality of care provided, however, further targeted interventions need to be implemented to meet the standard of care, especially for Māori women.

The prevalence of gestational diabetes mellitus (GDM) and pre-existing diabetes is increasing in Australia and Aotearoa New Zealand.[1–3] Indigenous populations in both countries are disproportionately overrepresented among women with diabetes in pregnancy, including Māori (5.7% cf. 2.5% NZ European women) and Aboriginal and Torres Strait Islanders (pooled prevalence odds ratios of Indigenous cf. non-Indigenous women for pre-existing diabetes were 3.63 and 1.42 for GDM).[4]

Appropriate and timely screening and treatment improves maternal and foetal complications.[5,6] Missed opportunities for the detection and management of diabetes in pregnancy have ongoing health consequences for mothers and babies.[7]

In New Zealand, discrepancies in clinical practice and the increasing prevalence of diabetes in pregnancy led to the publication of a clinical practice guideline for gestational diabetes in 2014 by the Ministry of Health (MoH).[2] The guideline provides evidence-based recommendations for the screening, diagnosis and management of GDM in order to improve maternal and infant outcomes. This was quickly taken up by many district health boards (DHBs) across the country, however, some local DHB guideline variations remain.

The purpose of this study is to evaluate the proportion of pregnant women who completed screening for both pre-existing diabetes (using HbA1c) and GDM (GCT or OGTT as indicated) based on the recommendations stated in 2014 MoH guideline.

Methods

At University of Auckland, Year 6 medical students conduct a clinical audit during their Obstetrics and Gynaecology clinical placement in one of nine public hospitals in New Zealand. These hospitals range from regional hospitals with 1,500 births annually to urban hospitals with around 7,000. Students assess hospital performance around a chosen audit topic, select best practice standard/s of care from existing clinical recommendations, or evidence-based guidelines and write a standardised report with de-identified aggregated patient data. Reports are uploaded to the university student learning website.

Study populations of pregnant women are selected by either block sampling within a limited period (e.g., one month) or random sampling over a longer timeframe (e.g., one year) through hospital records or databases. Relevant data are collected through clinical notes, hospital electronic patient information systems, discharge summaries, and/or clinic letters.

For this review, the repository of student audit reports completed between 2015 and 2021 was searched to identify those investigating screening for diabetes in pregnancy, using the key words "antenatal screening" and "gestational diabetes". All audits assessing any of the standards noted below were included.

Screening for pre-existing diabetes

- Standard 1: Offer all women an HbA1c test in their "booking" antenatal bloods to detect undiagnosed diabetes (ideally before 20 weeks).

Screening for GDM

- Standard 2: At 24–28 weeks, for all women not previously diagnosed with diabetes who are at high risk of gestational diabetes (HbA1c of 41–49 mmol/mol), offer a two hour, 75g oral glucose tolerance test (OGTT).
- Standard 3: At 24–28 weeks, offer all other women a one hour, 50g, oral glucose challenge test (GCT).
- Standard 4: If glucose ≥7.8mmol/L to <11.0mmol/L, then arrange a 75g, two hour OGTT without delay.

Each standard was analysed using a run chart showing proportion of adherence over time. Analysis of the run charts required the addition of median lines so that the four run rules (i.e., shift, trend, too many/too few runs, and astronomical point) could be used to identify any non-random signals which may indicate a special cause of variation. The first three probability-based rules enable objective analysis based on an error of $p<0.05$.[8] Rules one and three require more than 10 data points before they are applicable.[8]

Some reports provided data on screening rates by ethnicity, which were collated and reported in the current study for Māori vs non-Māori, based on how reports presented this information. For each audit, proportions were calculated by number of Māori participants screened/total number of Māori participants included in the audit. A Chi-squared test of independence was performed using data from the audits to examine the relationship between ethnicity and screening of pre-existing diabetes.

Ethics approval for the study was received from the Auckland Health Research Ethics Committee on 23 March 2021 (AHREC Ref. AH22104).

Results

Twenty-five audits were identified during the study period; six were excluded due to inadequate data provided, leaving 19 audits for analysis (Table 1).

Screening for pre-existing diabetes—Standard 1

Sixteen audits (of 2,376 participants) evaluated the proportion of women who had HbA1c testing <20 weeks' gestation. In 2016, a shift can be seen from below to above the median, indicating there was a significant increase in the proportion of pregnant women who met the standard of care (from 28% in 2015 to 84% in 2020) (Figure 1). Overall, the proportion who met the standard of care was greater for women in urban sites (average 70% across eight audits) cf. to rural sites (average 48% across nine audits).

Increases were seen in the proportion of women who had HbA1c testing over time, for hospital sites where more than one audit was done. For example, at four sites where audits were performed longitudinally, there was at least a 24% increase from the previous reported audit. At Site 1, testing rates improved from 15% in 2015 to 93% in 2016. At Site 2, testing rates went from 47% in 2016 to 84% in 2019. At Site 6 rates went from 16% in 2015 to 73% in 2019. At Site 7, rates went from 16% in 2015 to 40% in 2016.

Screening for GDM—Standard 2

Four audits, all based at regional sites, evaluated the proportion of women with HbA1c 41–49 mmol/mol who had an OGTT at 24–28 weeks. Each included only one to four women, thus, no conclusions could be reached.

Screening for GDM—Standard 3

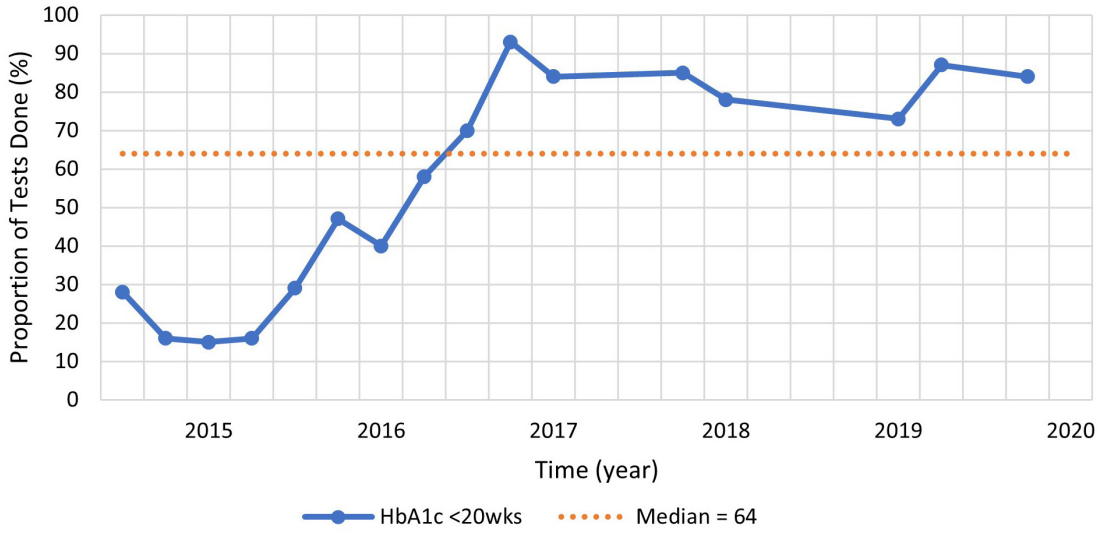
Two audits evaluated the proportion of women with normal HbA1c who had a GCT at 24–28 weeks' gestation, and another seven included all women in the sample (Figure 2). We were unable to test for significance as there were not enough data points. Overall, the proportion who met the standard of care was slightly greater for women in rural sites (average 44% across seven audits) cf. to urban sites (average 41% across two audits).

Table 1: Summary of audits investigating screening of diabetes in pregnancy, by site.

Hospital setting	Year	Sampling strategy	Sample size	Māori participants	BMI ≥25 at booking	Standard/s assessed†
Site 1 urban	2015	Random	100	11	37%	Standard 1
Site 1 urban	2016	Block	100	13	31%	Standard 1
Site 1 urban	2019	Random	200	50		Standards 3 and 4
Site 2 urban	2016	Block	578	126		Standard 1
Site 2 urban	2016	Block	158			Standard 1
Site 2 urban	2017–2018	Random	120			Standards 1, 3
Site 2 urban	2018	Random	94			Standard 1
Site 2 urban	2019–2020	Random	150	37		Standards 1, 4
Site 3 urban & large regional	2019	Random	200	38		Standard 1 – offer HbA1c test in 1st trimester
Site 4 large regional	2015	Block	123			Standards 1, 2, 3
Site 5 small regional	2016	Block	98	37		Standard 1
Site 6 small regional	2015	Block	118			Standards 1, 3
Site 6 small regional	2017	Block	148	25		Standards 1, 2, 3, 4
Site 6 small regional	2019	Block	138	92		Standards 1, 3, 4
Site 7 small regional	2015	Block	69	21		Standards 1, 3, 4
Site 7 small regional	2016	Random	95	42		Standards 1, 2, 3, 4
Site 7 small regional	2017	Block	337	148		Standard 4
Site 7 small regional	2020	Block	300	143		Standard 4
Site 8 small regional	2015	Block	87			Standards 1, 2, 3, 4

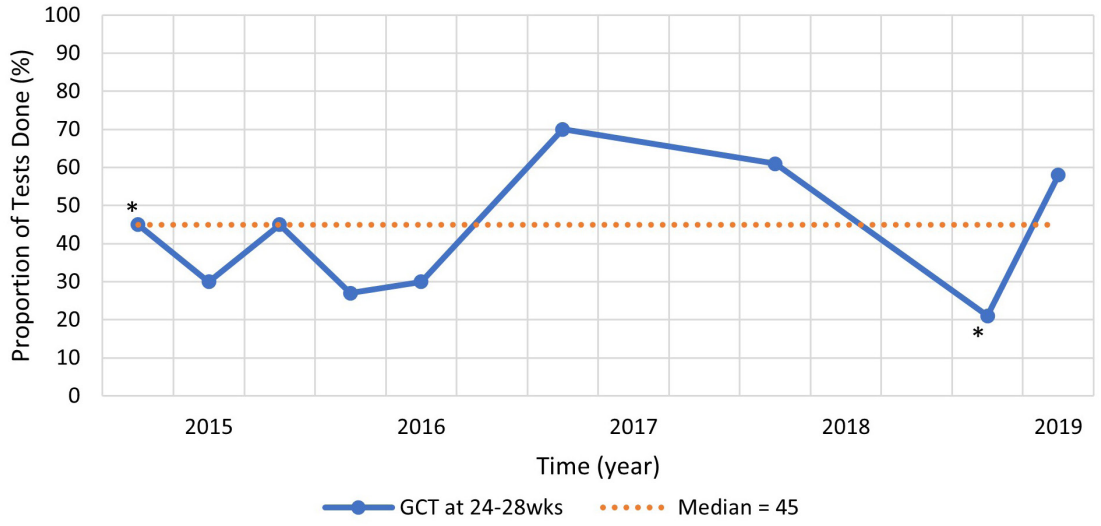
† Standard 1. All women offered an HbA1c test in their "booking" antenatal bloods to detect undiagnosed diabetes (ideally before 20 weeks); Standard 2. At 24–28 weeks, for all women not previously diagnosed with diabetes who are at high risk of gestational diabetes (HbA1c 41–49 mmol/mol), offer a two hour, 75g oral glucose tolerance test (OGTT); Standard 3. At 24–28 weeks, offer all other women one hour, 50g, oral glucose challenge test; Standard 4. If glucose ≥7.8mmol/L to <11.0mmol/L, then arrange 75g, two hour OGTT without delay.

Figure 1: Standard 1; HbA1c testing before 20 weeks' gestation over time.



*HbA1c within first trimester.

Figure 2: Standard 3; glucose challenge test (GCT) at 24–28 weeks' gestation, over time.



*HbA1c <41.

Screening for GDM—Standard 4

Ten audits (of 1,724 participants) evaluated the proportion of women who had an OGTT without delay following an indeterminate GCT. Testing rates were high overall (range 34%–100%, median of 92%), with two audits meeting 100%. No non-random variation was found. Overall, the proportion who met the standard of care was greater for women in rural sites (average 85% across eight audits) cf. to urban sites (average 73% across three audits).

Screening rates by ethnicity

Standard 1: four audits evaluated screening for pre-existing diabetes using HbA1c by ethnicity and found no differences between Māori and non-Māori. The average screening rate for Māori was 53%, compared to 49% for non-Māori, $X^2(1, N=955)=1.37$, p=0.242. In one site (Site 2) there was improvement in both groups over time (in 2016, 34% for Māori, 35% for non-Māori; in 2019–2020, 86% for Māori, 82% for non-Māori).

Standards 2,3,4: three audits evaluated screening rates for GDM (i.e., GCT or OGTT) by ethnicity, and differences were found between Māori and non-Māori. Māori (n=341, 62%) were less likely than non-Māori (n=496, 86%) to be screened for GDM, $X^2(1, N=837)=65.36$, p<0.001, with odds ratio=0.72. In one site (Site 7) there was no improvement over time (in 2017, 65% for Māori vs 84% for non-Māori; in 2020, 58% for Māori vs 85% for non-Māori).

Discussion

A review of 19 audits conducted at nine New Zealand public hospitals from 2015 to 2021 following the publication of the national guideline on GDM in 2014 found significant improvement over time in screening for pre-existing diabetes at less than 20 weeks' gestation using HbA1c. Moreover, around 92% of women whose GCT result indicated an OGTT, had one.

An audit by the national GDM Committee found that in 2005, screening for GDM using GCT varied by DHB, from 20% to 89% of pregnancies.[9] Another audit conducted in the Bay of Plenty Region in 2013/2014 provides an indication of baseline screening rates in New Zealand prior to the 2014 national guideline.[10] Of 656 women who gave birth, 12% had an HbA1c test and 57% underwent a GCT between 24 and 28 weeks' gestation.[10] This compares to a 2012 survey of healthcare providers in Australia conducted prior to the introduction of new Australian diabetes in pregnancy guidelines, where they made a new recommendation for an OGTT to be done at the first antenatal visit. They found that 66% of respondents offered diabetes screening at the first antenatal visit, 21% included an HbA1c screen, and 43% an OGTT.[11] However, this study was based on provider self-report, unlike the current study.

A lower GDM screening rate in Māori women (cf. non-Māori) was reported in the Bay of Plenty audit referred to above where GDM screening rates were 56% for Māori and 76% for non-Māori (p<0.001).[10] Similar findings are reported in an observational study of 11,246 women in Christchurch, recorded during 2008–2010, where 39% of Māori were screened for GDM compared to 55% of European women [IPR 0.71 (0.66–0.77)].[12] The authors concluded that the introduction of routine HbA1c testing with the first-antenatal bloods would increase the proportion of women screened for diabetes in pregnancy among Māori by 40% (two-fold increase).[12] This appears to have occurred—in our study, the HbA1c screening rates under 20 weeks' gestation were similar for Māori and non-Māori women. However, the screening rates for GDM at 24–28 weeks were still lower for Māori (odds ratio=0.72), similar to that found in Australia in 2013 which were lower for Aboriginal women compared to other ethnic groups (odds ratio=0.45).[13] Missed opportunities for health services to detect and manage diabetes in pregnancy have ongoing health consequences for Māori women and their offspring.[7]

Lower screening rates are unlikely to be due to selective screening of high-risk women, as Māori have a higher rate of diabetes in pregnancy, and experience poorer outcomes, compared with European women.[4,14,15] In the current study, in one small regional hospital, the disparity in GDM screening results for Māori compared with non-Māori actually worsened over time. In 2017, the screening rate for Māori was 65%, but in 2020 it decreased to 58%, whereas the rate for non-Māori remained about the same (84% then 85%). Therefore, more targeted interventions are required to reduce inequities faced by Māori women. For example, access to antenatal care is a determinant of healthcare and Māori women on average utilise less antenatal services than other ethnic groups.[16] Potential solutions to overcome this specific barrier could include working together with local iwi and providing marae-based antenatal care, to enable Māori women easier access to care as well as receiving more targeted and culturally appropriate care. This will also facilitate easier follow-up of test results and providing additional tests if required, hence helping to improve the discrepancy between the difference in proportion of Māori women screened using Standard 1 and Standards 2/3.

Similar incidence of screening in Pasifika women who are also at high risk of pre-existing diabetes and GDM (median 7.2% in New Zealand)[2], as well as poor

pregnancy outcomes are also found in several studies.[17] A systematic review of 49 observational studies conducted up to 2013, and including studies from New Zealand, identified both Māori and Pasifika women, as being at higher risk of having undiagnosed type 2 diabetes.[17]

The audit reports in the current study suggested several root causes as contributing to rates of screening lower than the targets set. One cause was late booking with a lead maternity caregiver (LMC), which in one audit occurred in 83% of women. Most audits found that for some women, the GCT or OGTT was either completed earlier or later than 24–28 weeks' gestation. Timing of the test is important because of the physiological metabolic changes that occur during pregnancy.[18,19]

Other barriers identified in the audit reports include the distance it takes to get to the chosen setting for the screening test to be performed; the time and money that it may cost the woman to attend the appointment; poor patient awareness of the importance of screening; poor LMC awareness of the national guidelines; difficulty adding HbA1c to booking blood forms; the need to book the appointment before coming in; the appointment setting not being child-friendly; a lack of culturally appropriate venues; women who have had a low HbA1c already could be considered low risk, and so the health provider may be less likely to book a GCT; and discrepancies between national and local guidelines.

Possible solutions to overcome these barriers were also identified. Some reports included stakeholder engagement and they found out changes that had occurred in their local settings that may have contributed to improvement in screening and testing rates. For example, one urban centre introduced a change in the community Labtest protocol to include HbA1c as part of the package of "first antenatal booking bloods", unless a woman opted out. An article was also published aimed at general practitioners about the importance of testing for undiagnosed diabetes in early pregnancy due to the benefits of early intervention to improve outcomes for pre-diabetes in pregnancy.[20] The effect of these interventions was shown by an improvement in HbA1c screening within 20 weeks' gestation in that site from 15% in 2015 to 93% in 2016.

Other interventions included patient reminders via mail/SMS/email/phone; easily accessible information pamphlets for pregnant women and women intending pregnancy; incorporating an HbA1c tick box onto the antenatal booking blood forms; fridge magnets with important dates during pregnancy distributed with initial booking visit; LMC or general practitioner education. Another recommendation was for a two-step approach, as opposed to the one-step process recommended by ADIPS and RANZCOG.[21,22]

The evaluation of Standard 4 showed that many hospitals already met the standard of care. However, as there was no non-random variation shown during this time period, we posit that perhaps there was a previous well-known national awareness of the recommendation for OGTT testing after an abnormal GCT, likely due to the consistency of international guidelines with each other and over time.[21–24]

Strengths of this study include individualised audits allowing the identification of differences between hospitals, and the use of run charts to assess the impact of health care interventions. Limitations include the absence of baseline data prior to the 2014 guideline, on which a baseline median could have been established; inability to perform run chart analyses for Standards 2 and 3 due to inadequate data points; variations in the standards (e.g., Standard 1 was based on the 2014 guideline, which recommended that HbA1c be completed with the first antenatal booking bloods; however, most audits reported when the test was completed, not whether completed with the booking bloods); women who were not enrolled with a midwife/hospital were not included; it is unknown whether screening was offered and declined; data gathered during 2020 may have been affected by the disruption to normal health services by COVID-19 restrictions.

In conclusion, whilst this review found that there is improving quality of care for screening of diabetes in pregnancy, further interventions and local policies are needed to improve adherence rates to all standards of care. Targeted interventions should be applied to Māori women who are shown to be under-screened at 24–28 weeks' gestation. A formal analysis of barriers and enablers to implementing the GDM guideline in New Zealand, similar to that done in Queensland,[25] would be helpful. Further research on implementation of national maternity guidelines is warranted.

COMPETING INTERESTS
Nil.

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Appendix 1: Patients audited for each standard by year.

Standard	2015	2016	2017	2018	2019	2020	2021	Total
1	497	1029	268*	214*	488†	150†	0	2376
2	210	95	148	0	0	0	0	453
3	397	95	268*	120*	338	0	0	1098
4	156	95	485	0	688†	450†	0	1724

*An audit conducted over 2017–2018 with sample size 120, included in sums for both 2017 and 2018.
†An audit conducted over 2019–2020 with sample size 150, included in sums for both 2019 and 2020.
*†Both audit numbers were included only once in the total for each standard.

Contemporary management of isolated free fluid on computed tomography scan in blunt abdominal trauma—experience from a Level 1 trauma centre in New Zealand

Priscilla Leow, Victor Kong, Nigel Rajaretnam, Damien Ah Yen, Janet Amey, Bronwyn Denize, Gina Marsden, Damien Clarke, Grant Christey

ABSTRACT

AIMS: The management of patients with blunt abdominal trauma (BAT) who have isolated free fluid (IFF) with no solid organ injury (SOI) on computed tomography (CT) remains controversial. This study aims to determine if the volume of free fluid (FF) is a predictor of the need for operative management of traumatic intra-abdominal injuries, by reviewing the local cumulative experience with IFF at a major trauma centre in New Zealand.

METHODS: A retrospective study was undertaken over nine years at a Level 1 trauma centre in New Zealand. Patients aged over 15 years who sustained BAT and had IFF with no SOI demonstrated on CT were included. All CT scans and patient notes were reviewed. The volume of free fluid was classified by the local interpreting radiologist on the CT report.

RESULTS: Eighty-two out of 1,177 BAT patients (7%) had IFF with no SOI on CT. Thirty-eight percent were males, with a median age of 31 years. Nineteen (23%) underwent immediate operative management (OM) at the time of presentation. The remaining 63 patients had a trial of non-operative management (NOM), 10 (16%) of which were unsuccessful and required an operation. Overall, 29 patients (35%) required operative management. Eighty-nine percent of the OM group and 90% who failed NOM had positive operative findings, giving an overall true positive of 32%.

CONCLUSIONS: The presence of IFF in itself is not an absolute indication for operative exploration and many patients with trace IFF can be managed non-operatively. Small amounts of IFF should be regarded with suspicion, and moderate or large amounts of fluid are likely to require operative exploration. Further work must make use of clinical scoring systems and laparoscopy or laparotomy to assess patients at high risk of surgically remediable intra-abdominal injury post BAT.

Blunt abdominal trauma (BAT) can be either hollow viscus injury (HVI) or solid organ injury (SOI).[1] These two injury types are distinct, in that HVI mandates operation whereas SOI may be managed non-operatively in many instances.[2] The diagnosis and recognition of HVI, however, remains challenging.[1,8,9] Although computed tomography (CT) is the gold standard for the assessment of haemodynamically stable BAT patients, the sensitivity of CT in detecting HVI, as well as mesenteric injuries is less than ideal.[2,3,4,8,9] One of the features of HVI on CT scans is the presence of free intra-abdominal fluid, without an obvious source.[2,4,8] This is commonly referred to as isolated intra-abdominal free fluid (IFF). Once identified, IFF needs to be explained. There are a number of potential sources of IFF. These include bleeding from a mesenteric tear, small bowel content, urine and minor bleeding from a tear in the peritoneum.[2,5] Although the peritoneum itself is relatively avascular, tears in the abdominal wall musculature and peritoneum can result in muscular bleeding through the peritoneal defect, therefore causing IFF. In the previous millennium, the presence of IFF was generally considered to be an indication for operative intervention.[2,6] However, the rapid development in CT technology since then has meant that even smaller amounts of IFF can be detected and the clinical significance of IFF is now disputed.[2,8] While there is a general trend away from mandatory laparotomies for IFF, there is no international consensus as to the exact management approach to these patients.[2,7] There is presently no literature documenting the New Zealand experience with IFF following blunt abdominal trauma. This study reviews the cumulative experience with IFF at a major trauma centre in New Zealand. We hypothesise

that volume of free fluid (FF) may be associated with intra-abdominal injuries that require operative intervention. It seeks to provide quality data to support our ongoing attempts to develop clinical algorithms for trauma care in our region.

Methods

Clinical setting

Waikato Hospital is located in Hamilton, New Zealand. It is a tertiary centre and a university hospital, with the clinical school affiliated to the University of Auckland. It is one of the largest acute hospitals in the country and is the only Royal Australasian College of Surgeons (RACS) certified Level 1 trauma centre in New Zealand. Waikato Hospital manages approximately 3,700 trauma admissions per annum, over 400 of which have Injury Severity Score (ISS) >12.

The study

This was a retrospective study conducted between 2012 to 2020, which included all adult patients who sustained BAT. Only adult patients over the age of 15 years who underwent a CT as a part of their initial assessment were reviewed. Only those with a formal report of IFF and no solid organ (or any other intra-abdominal) injury were included for final analysis. Those who had FF and associated organ injuries identified on CT were excluded.

The patient charts were reviewed and the following data sets were extracted: patient demographics, injury mechanism, CT report, clinical progress and outcome. All CT scans and reports were reviewed by the primary author (PL) on the picture and archive communication system (PACS). The volume of FF was classified into "trace", "small", "moderate", "large" or "extensive" by the local interpreting radiologist on the CT report. In Waikato Hospital, the amount of FF on CT is quantified based on a subjective assessment by the interpreting radiologist. This audit was approved by the Clinical Audit Support Unit (CASU) of the Waikato District Health Board. Reference: 4167

Current management

The management approach to IFF is controversial, with some authors advocating serial examination and others mandatory diagnostic laparoscopy or laparotomy depending on the nature of the clinical scenario.

Statistical analysis

All relevant data were extracted and initially summarised onto a Microsoft Excel© spreadsheet for review. Categorical data were described descriptively. All statistical analyses were performed using R(v.4.0.2; R Foundation for Statistical Computing, Vienna, Austria). All normally distributed continuous variables were described using the mean and standard deviation (SD). Continuous variables with non-normal distribution were reported using the median and interquartile range (IQR). Independent samples t-test and Mann–Whitney U test were used to compare normal and non-normally distributed continuous data respectively. Chi-squared tests were used to compare categorical variables.

Results

During the nine year study period, a total of 1,177 patients underwent a CT for BAT, of which 82 (7%) had IFF with no SOI reported. There were 31 (38%) males and the median age was 31 years. The median ISS was 12. In 28% the BAT was isolated, and the remainder had an injury to more than one body region. In 73 (89%) cases, the patients were conscious and could be examined at the time of primary trauma survey, while in nine (11%) cases the patients were intubated and sedated and thus unexaminable. These findings are summarised in Table 1.

Management

Of the 82 cases, 19 (23%) underwent immediate operative management (OM) at the time of presentation and the remaining had a trial of non-operative management (NOM). Figure 1 provides a breakdown. A direct comparison was made between the two groups, and this is summarised in Table 2. Amongst the 63 patients who had a trial of NOM, in 10 (16%) this trial of NOM was unsuccessful and required an operation. A full comparison was made between those with successful NOM versus failed NOM and is summarised in Table 3. Eight patients who failed NOM were haemodynamically stable with mild abdominal pain on arrival, which led to the decision for NOM. Indications that NOM was unsuccessful amongst these patients were worsening abdominal pain in five patients, delayed onset of abdominal pain in two patients, and haemodynamic instability in one patient. Of the two patients who were haemodynamically unstable on presentation, one had severe brain injuries that required more urgent neurosurgery, and no specific reasons supporting NOM was provided for the second patient despite being hypotensive on arrival. Both patients were eventually taken to theatre due to continued haemodynamic instability.

Table 1: Characteristics of the population

	n=82
Age (years)	31 [24–55]
Sex (male)	31 (38%)
Mechanism of injury	
MVA	68 (83%)
Fall	8 (10%)
PVA	2 (2%)
Others	4 (5%)
Concurrent body systems Injury	
0	23 (28%)
1	24 (29%)
2	19 (23%)
3	9 (11%)
4	6 (7%)
5	1 (1%)
6	0
7	0
Examinable	**73 (89%)**
pH (median)	7.34 [7.31–7.39]
Lactate (median)	1.6 [1.2–2.7]
Length of stay (median)	5 [3–10]
Complications Resp Wound Renal Cardiac Others	26 (32%) 10 (12%) 2 (2%) 5 (6%) 1 (1%) 9 (11%)
No complications	55 (67%)
Mortality	4 (5%)

Table 2: Management of IFF.

	Operative Management (OM) n=19 (23%)	**Non-Operative Management (NOM) n=63 (77%)**	**p-value**
Age (years)	31 [23–55]	31 [24–57]	0.856
Sex (male)	11 (58%)	20 (32%)	0.039
Mechanism of injury MVA Fall PVA Others	 15 (79%) 1 (5%) 1 (5%) 2 (11%)	 53 (84%) 1 (2%) 7 (11%) 2 (3%)	0.394
Concurrent body Systems injury 0 1 2 3 4 5 6 7	 5 (26%) 3 (16%) 4 (21%) 4 (21%) 2 (11%) 1 (5%) 0 0	 18 (29%) 21 (33%) 15 (24%) 5 (8%) 4 (6%) 0 0 0	0.184
Examinable	15 (79%)	58 (92%)	0.109
pH (median)	7.34 [7.31–7.38]	7.35 [7.31–7.41]	0.352
Lactate (median)	1.7 [1.2–2.6]	1.6 [1.2–2.9]	0.977
Volume of FF Trace Small Moderate Large Extensive Not Stated	 0 5 (26%) 11 (58%) 2 (11%) 0 1 (5%)	 17 (27%) 39 (62%) 5 (8%) 0 1 (2%) 1 (2%)	<0.001

Table 2 (continued): Management of IFF.

	Operative Management (OM) n=19 (23%)	**Non-Operative Management (NOM) n=63 (77%)**	**p-value**
Failed Conservative Management		10 (16%)	
Complications	11 (58%)	15 (24%)	0.005
Resp	6 (32%)	4 (6%)	0.009
Wound	1 (5%)	1 (2%)	0.416
Renal	1 (5%)	4 (6%)	1.000
Cardiac	0	1 (2%)	1.000
Others	4 (21%)	5 (8%)	0.203
Length of stay (median)	10 [8–17]	4 [2–9]	<0.001
Mortality	0	4 (6.3%)	0.569

Figure 1: Summary of results.

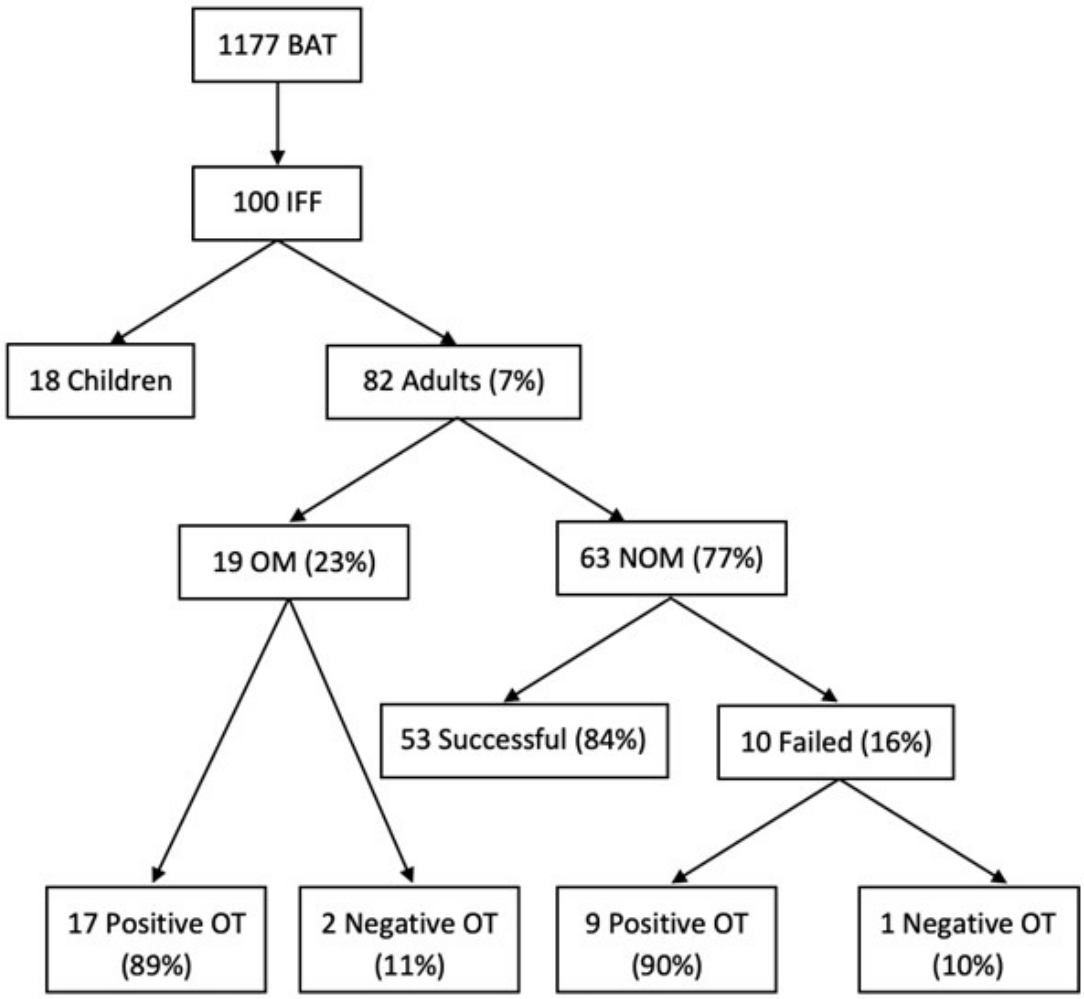

Table 3: Non-Operative management.

	Failed NOM n=10 (16%)	**Successful NOM n=53 (84%)**	**p-value**
Age (years)	24 [17–27]	34 [25–58]	0.005
Sex (male)	4 (40%)	16 (30%)	0.713
Mechanism of injury MVA Fall PVA Others	 10 (100%) 0 0 0	 43 (81%) 1 (2%) 7 (13%) 2 (4%)	0.515
Concurrent body systems injury 0 1 2 3 4 5 6 7	 1 (10%) 7 (70%) 1 (10%) 1 (10%) 0 0 0 0	 17 (32%) 14 (26%) 14 (26%) 4 (8%) 4 (8%) 0 0 0	0.086
Examinable	9 (90%)	49 (92%)	1.000
pH (median)	7.33 [7.31–7.36]	7.36 [7.31–7.41]	0.347
Lactate (median)	1.8 [1.3–2.8]	1.6 [1.2–2.9]	0.680
Volume of FF Trace Small Moderate Large Extensive Not stated	 2 (20%) 6 (60%) 2 (20%) 0 0 0	 15 (28%) 33 (62%) 3 (6%) 0 1 (2%) 1 (2%)	0.529

Table 3 (continued): Non-Operative management.

	Failed NOM n=10 (16%)	**Successful NOM n=53 (84%)**	**p-value**
Complications	2 (20%)	13 (25%)	1.000
Resp	0	4 (8%)	0.604
Wound	1 (10%)	0	0.161
Renal	0	4 (8%)	0.604
Cardiac	0	1 (2%)	1.000
Others	1 (10%)	4 (8%)	1.000
Length of stay (median)	7 [5–11]	4 [2–6]	0.013
Mortality	1 (10%)	3 (6%)	1.000

Table 4: All positive operative findings.

Pattern of injury	**Operative management (OM) n=17**	**Failed non-operative management (NOM) n=9**
Diaphragm	0	0
Liver	1 (6%)	1 (11%)
Gallbladder	0	0
Spleen	1 (6%)	0
Pancreas	1 (6%)	0
Stomach	0	0
Small intestine	14 (82%)	5 (56%)
Large intestine	10 (59%)	4 (44%)
Vasculature	2 (12%)	3 (33%)

Of the 19 patients who had OM for IFF, 17 (89%) had positive findings. Fifty percent of OM patients with positive findings and all with negative findings were male. Multisystem injuries (>4 body systems) were significantly higher in patients with negative findings (100%) as compared to those with positive operative findings (6%) (p=0.018). Both patients who had negative findings were unexaminable at presentation due to low Glasgow Coma Scale, hence there was a lower threshold for proceeding with operative management. The median length of stay (LOS) was nearly four times longer in those with negative findings (38 days) than those with positive findings (10 days) in the OM group. The two patients who had negative OM had prolonged LOS of 62 days and 14 days respectively, due to non-abdominal injuries and complications. The former patient had an extended admission due to two episodes of post-operative sepsis secondary to pulmonary infections, requiring prolonged ventilatory support in ICU and surgical tracheostomy. The latter patient required orthopaedic surgeries post laparotomy, and his admission was also complicated by failed extubation and hospital-acquired pneumonia.

In total, 29 (35%) patients underwent surgery, 19 at time of presentation and 10 as a result of failed NOM. Eighty-nine percent of the OM group and 90% of the failed NOM group had positive operative findings, giving a total of 26 positive and three negative operations. The patterns of injury in positive operative findings are shown in Table 4.

With 26 positive findings out of a total of 82 patients, the positive predictive value (PPV) of IFF in identifying the presence of injuries in patients with BAT is therefore 32%. Amongst those with positive findings, the volume of IFF was trace to small in 11 patients (42%), moderate to large in 14 patients (54%), and one unspecified volume. Of the three negative findings, two had trace to small volumes and one had moderate to large volumes of IFF on CT. The odds ratio (OR) of having positive operative findings is therefore 2.545 (0.203–31.86) times higher in patients with moderate to large volumes of IFF than trace to small volumes. IFF was categorised into two larger groups for calculation of OR due to the small sample size and zero counts in several volumes of IFF.

Discussion

CT scan is the mainstay of investigation in haemodynamically stable patients who sustain BAT, and technological improvements have increased the rate of detection of IFF. Historically, IFF was considered to be an indication for mandatory laparotomy, but with the increased ability of CT scans to detect even smaller amounts of IFF this certainty has been replaced by a degree of confusion, and there are currently no internationally agreed upon criteria to guide management.[2,7,8]

This is especially problematic as delay in diagnosis of HVI has been demonstrated consistently, to be associated with significant morbidity and mortality.[1,9] A recent systematic review of eight studies involving 7,763 patients noted that the incidence of IFF was present in 722 (9.3%) patients of which 490 underwent NOM and 232 underwent immediate laparotomy.[2] Almost all of the significant intra-abdominal organ injuries found at operation were large or small bowel injuries, either of which can have major consequences if left undiagnosed or unrepaired. This is similar to the findings in this study, with an incidence of IFF of 7% and a primary operation rate of 23%. Of the cohort who underwent immediate operative intervention, 90% had positive intra-abdominal findings.

NOM was attempted in 77% of all patients and failed in 16% of cases. Of note, the pathologies associated with failed NOM were all HVI, either to the small bowel or the large bowel. This reflects the ongoing challenge of diagnosing HVI post BAT. Despite modern advances in imaging, HVI remains associated with delays in diagnosis and intervention. There is now convincing evidence that delay in recognition and treatment translates into poor outcomes.

Overall, the PPV of IFF in our study was 32%, highlighting the difficulty in identifying BAT patients with intra-abdominal injuries based on the presence of IFF on CT, hence the dilemma in the management of these patients. It was noted that 62% of our cohort were female. It is plausible that the small amount of free fluid commonly detected on CT in females may be physiological. However, following BAT, it is not possible to distinguish (and thus assume) if the IFF is physiological or otherwise and thus management decisions remain challenging. The only significant risk factor associated with positive operative findings in our cohort was the volume of fluid present. The mechanism of injury or initial physiological parameters including age, blood pH and serum lactate were not predictive. This suggests that the finding of IFF with no SOI reported on CT in the setting of BAT is a distinct entity and the response should be always one of extra vigilance. Large amount of IFF should alert clinicians to the possibility of intra-abdominal injury (especially HVI not detected radiologically), which may warrant operative management via laparoscopy or laparotomy.

The role of diagnostic laparoscopy in BAT with IFF needs further clarification. It may well be that this will allow earlier detection of intra-peritoneal injuries. Injuries to retroperitoneal structures such as the

duodenum may not be easily recognisable with laparoscopy. The recent interest in blunt injury prediction scores (BIPS) reflects this concern and it may well be that these clinical scoring systems can be used in conjunction with CT findings to identify patients who should be subject to diagnostic laparoscopy.[10,11,12]

Some of the limitations of this study were its retrospective nature and the lack of objective criteria in defining the exact volume of fluid detected on CT. The only study that attempt to objectively quantify IFF was by Gonser-Hafertepen et al. and the current reporting at our institution remains somewhat subjective.[13]

Conclusion

The presence of IFF in itself is not an absolute indication for operative exploration and many patients with trace IFF can be managed non-operatively. Small amounts of IFF should be regarded with suspicion and moderate or large amounts of fluid are likely to require operative exploration. Further work must make use of clinical scoring systems and laparoscopy or laparotomy to assess patients at high risk of surgically remediable intra-abdominal injury post BAT.

COMPETING INTERESTS
Nil.

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Medical students' experience of studying while working part-time and the effects of COVID-19

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ABSTRACT

AIMS: The costs of being a medical student are large and increasing, and many students need to work part-time to meet financial pressures. This study explores the impact that part-time extracurricular paid work during the academic year has on medical student wellbeing, their interactions with the curriculum, and the effect of COVID-19 on work in 2020.

METHODS: An online survey in 2020 gathered demographic, quantitative and qualitative information from medical students and their work experiences. Descriptive statistics analysed quantitative data; qualitative data were analysed using qualitative content analysis.

RESULTS: Of the 36% (n=530) of students who responded, 255 (49%) reported undertaking paid part-time work, with 59 (24%) reporting they would not be able to remain studying if they did not work. When interacting with the medical programme, 43% of students reported their work conflicted with scheduled medical school commitments, and 70% reported conflicts between work and individual study. COVID-19 disrupted 57% of paid work during the year. Impacts on students' wellbeing were both positive and negative. Positive aspects included developing new skills, self-confidence and resilience. Working also provided an escape from the study demands of the medical programme. Negative aspects were predominantly about the increased stress working had on students, specifically on the impact of paid work on their own health.

CONCLUSIONS: Almost half of medical students work part-time while studying. Understanding the perceived implications that part-time work has on student education and wellbeing could help medical schools provide appropriate advice and pastoral support for their students.

Worldwide, cost of living and accrued debt causes stress for medical students.[1–3] In addition to having one of the longest periods of study and paying fees twice that of many of their student counterparts,[4] tuition fees for medical students are large and increasing. Accommodation and general living costs also continue to rise year on year,[5] resulting in some students working part-time during the academic year to meet financial pressures. This presents a dilemma for medical students, as there are significant demands on their time to attend their extensive course commitments, which means there is less time to participate in part-time work to meet their financial needs.[6,7]

A limited number of studies have investigated medical student part-time work,[6, 8–14] but few of these explore why students participate in part-time work, and the direct impact that this can have on their wellbeing and course interaction. The research demonstrates conflicting findings on whether part-time employment whilst studying medicine has positive, insignificant, or negative impacts on students. Studies in the USA have found that part-time work can reduce financial stress and risk of burnout, and positively impact student wellbeing.[15,16] Conversely, studies carried out in Azerbaijan and Australia have found that working while studying has negative impacts on medical students, largely through increasing stress.[17,18] It is important to gain clarity on the impact of part-time work on medical students in order to understand how best to support them. For example, should we encourage or discourage students from working part-time and/or offer better tailored pastoral care to support students?

The immediate and continued disruptions of COVID-19 may also have affected medical students' paid work in 2020. Whilst growing literature has found that COVID-19 has caused major job shortages globally[19] and added stress for final year medical students,[20,21] the impact it has had on younger medical students is not clear.

Therefore, the aims of this study were to explore how medical students negotiate their degree while undertaking concurrent paid part-time work; investigate student perceptions on how this work impacted interaction with the curriculum and their wellbeing and, because of the timing of this study, to also investigate the effect COVID-19 had on this work.

Methods

An anonymous online mixed method survey was employed to gather data regarding Otago Medical School (OMS) students' experiences with working and studying. Students enter the medical programme through either a competitive Health Science First Year (HSFY) course (71%), postgraduate (22%), or alternative entry (including older applicants from a diverse, but often health-related, range of backgrounds, 7%). The programme consists of two years of Early Learning in Medicine (ELM 2 & 3), followed by three further years of clinical based learning in Advanced Learning in Medicine (ALM 4, 5 & 6).

Following ethical approval (University of Otago Human Ethics Committee, reference number D20/371), an email was sent to all current OMS students (1463) studying in 2020 (years 2–6), inviting them to participate in a survey investigating their experiences of working part-time while studying medicine. The survey was further promoted for each year group using a student social media forum. The survey was carried out through the online survey tool Qualtrics[22] and was available for a period of five weeks at the end of the academic year. The survey gathered demographic, quantitative and qualitative information about the students and their work experiences (see supplementary information). Quantitative data were analysed using Microsoft Excel. Qualitative content analysis was used to categorise and establish emerging themes from qualitative student responses.[23] The survey investigated both paid and unpaid work while students were studying but due to the amount of data collected, we are only reporting on students' experiences of paid work during the academic year.

Results

The response rate for the survey was 36% (n=530). The demographic data from respondents were broadly representative of the total OMS student cohort. However, there was a slightly higher response rate from female students, and those entering via the alternative pathway (Supplementary Table A).

Students used a variety of ways to financially support themselves through their medical degree, with some using a combination of methods (Table 1). Part-time work during the semester was undertaken by 49% of students.

Of those students who undertook part-time work, the proportion of students who worked was higher in the middle years of the medical programme (Table 2). Those who entered by the alternative category had the highest percentage of students who worked (60%). The areas of employment are shown in Table 2. The majority of students (85%) who had regular jobs worked 14 hours or less per week, (median 5–9 hours) but a small number of students worked more than 20 hours per week.

Thirty-six (14%) students reported working out of necessity, 64% (168) for a "bit of both", whilst 22% (56) answered that they worked purely out of choice (Table 3). However, 59 (24%) students also stated that they could not remain studying at medical school if they did not work. Most students identified more than one reason why they worked. Fifty-seven (43%) students were planning to work in the following year (2021).

Students who chose not to work gave a variety of reasons for their decision. These included having sufficient money to cover costs, lack of time, wanting to increase focus on their studies, it being too difficult to manage time and coordinate unpredictable work and school schedules, and previous bad experience of trying to do part-time work alongside study.

Wellbeing

The impact of work on students' wellbeing is shown in Figure 1a. The number of students reporting either positive or negative impacts (n=81) were the same 25 (31% each), while 28 (35%) of students said that their wellbeing was impacted in both positive and negative ways by part-time work.

When commenting on the positive impacts of working, one student said: "it helped me develop new skills, experience and self-confidence". Another said: "it allowed me to escape from constantly studying – positive for my mental health". Other reported positive aspects of working were that it gave "a sense of purpose, fulfilment, satisfaction", and that it "keeps [them] attached to the real world of what matters to people". Finally, working provided financial stability and improved wellbeing because students could afford the comforts of a healthier lifestyle (e.g., food, gym).

The most commonly reported impact on student wellbeing was increased stress. However, many students commented that, while working and studying was stressful at times, the impact was generally positive. Other reported impacts included learning to be resilient, effectively managing ups and downs of work and study, and gaining increased capacity to work in high workload/stressful situations. Examples of negative impacts included that it affected their health, and one student explained: "it made it hard to prioritise myself and having rest/recovery time, as that always fell to the bottom of the list of things to do". It contributed to feelings of fatigue because students felt "…way more tired. Working every weekend makes it mean [they] never get a break and so never feel rested." It also limited students' free time.

Table 1: Financial and living situation of Otago medical students (n=530).

Variable	Response	Method of support
Methods of financial support during medical degree (students were asked to include all forms of support and could have more than one response)	447 (85%)	Government Student Loan
	370 (70%)	Summer holiday job
	264 (50%)	Supported by family
	255 (49%)	Part-time work
	191 (36%)	Government Student Allowance
	175 (33%)	Scholarship
	103 (20%)	Savings/Trust fund
	45 (9%)	Partner's income
	23 (4%)	Personal loan
	9 (2%)	Other
Students paying mortgage	33 (6%)	
Students living with partner with income	73 (14%)	
Students living with dependents	28 (5%)	

Table 2: Details of students undertaking part-time paid work during the academic year.

Variable	Response	Respondents
Students who undertook paid work during the academic year in 2020	Yes	255 (49%)
Number of students who worked in each year (percentage of the year group who responded to the survey) (n=255)	ELM2	44 (44%)
	ELM3	61 (51%)
	ALM4	71 (55%)
	ALM5	41 (53%)
	ALM6	38 (37%)
Number (percentage) of students who worked by entry pathway	HSFY (n=339)	152 (45%)
	Graduate total (n=115)	63 (55%)
	Alternative total (n=67)	67 (60%)
Sectors where students worked (respondents=236, n=316 as some students worked in more than one job)	Education/research	100 (32%)
	Hospitality	51 (16%)
	Sales/retail/customer service	42 (13%)
	Pastoral care	35 (11%)
	Health care	23 (7%)
	Arts (musician, photographer, teacher, artist)	10 (3%)
	Administration	10 (3%)
	Other	45 (16%)

Table 2 (continued): Details of students undertaking part-time paid work during the academic year.

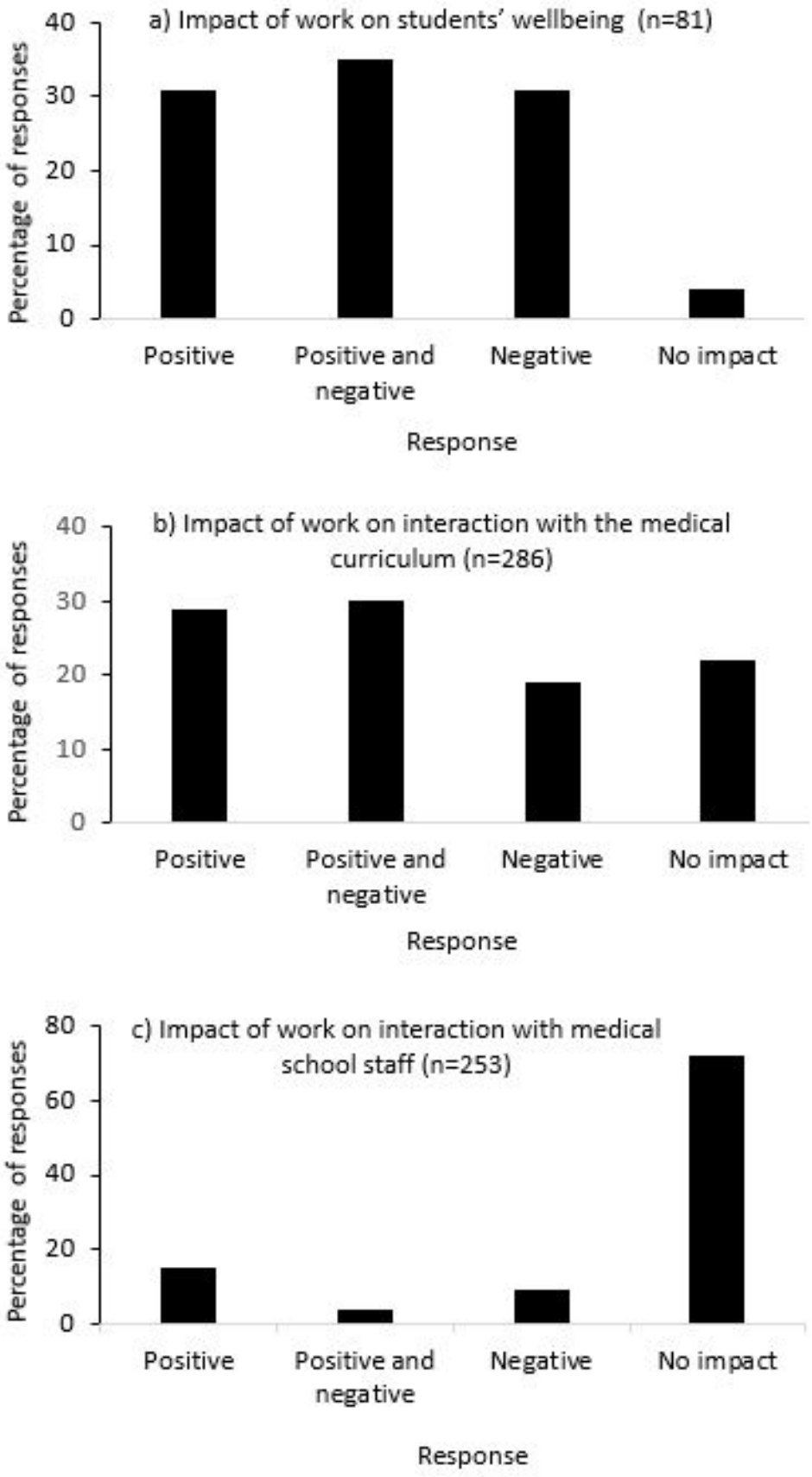
Variable	Response	Respondents
Hours worked in regular and casual part-time paid jobs (n=253)	Regular work	
	1–9	135 (54%)
	10–19	49 (19%)
	20–29	14 (6%)
	30+	2 (1%)
	Casual/shift work/contract work (hours/year)	53 (21%)
	1–49	8 (3%)
	50–99	16 (6%)
	100–299	18 (7%)
	300–500+	7 (3%)
	Unable to answer	4 (2%)

Table 3: Reasons why students undertake part-time paid work

Reasons students do paid work (n=252)	**Choice** **Necessity** **Bit of both**	**56 (22%)** **36 (14%)** **160 (64%)**
Specific reasons why students work (n for each category=250)	For extra spending money after paying basic living costs	209 (84%)
	To cover basic living costs (rent, food, power, etc.)	170 (68%)
	To fund leisure/hobbies/sporting interests	155 (62%)
	To fund social life	130 (52%)
	For skills/knowledge/experience gained	124 (50%)
	As a break from studying medicine	111 (44%)
	To keep up my skills/registration in another profession	57 (23%)
	To pay my fees	48 (20%)
	Other reasons	23 (10%)
Could students remain studying if they didn't work? (n=246)	Yes	187 (76%)

Definitions: "**Choice"** (I work for many reasons—satisfaction, experience, extra spending money, but I don't have to work to meet my basic living costs), "**Necessity"** (if I don't work, it wouldn't be possible to meet my basic living costs), or "**Bit of both**" (I work for many reasons (satisfaction, experience etc.) but I also work to meet my basic living costs).

Figure 1: a) impact of work on students' wellbeing; b) impact of work on interaction with the medical curriculum; c) impact of work on interaction with medical school staff.



Prioritisation of work and medical school attendance and study time

Part-time work conflicted more with study time (226 students, 70%, n=323) than it did on students' scheduled medical school timetable (139 students, 42%, n=323). Thirty-six percent (116) of students stated that part-time work conflicted with both study time and the scheduled timetable.

School attendance

Few students prioritised work over school attendance (5 students, 3%, n=182) and those who did tended to have a very specific reason for doing so, such as financial pressures of supporting children. Other factors that contributed to choosing between clashing work and medical school commitments included the perceived value of the activity (33 students, 18%, n=182) and if the activity was available at another time (23 students, 13%). Some students commented on the difficulty of an unpredictable, changing timetable and limited recognition by some staff (teaching and administration) of the other activities that students need to carry out in order to survive.

Interaction with staff

Many students (182, 70%, n=262) found that working part-time did not impact their interaction with medical school staff, and 38 (15%) said work had a positive impact on their interactions with staff. However, some students avoided interaction with staff because they felt guilty about having to work to keep themselves financially afloat, perceiving that the medical school actively discourages part-time work: "I've struck a good balance and always kept my head under the parapet. I certainly didn't advertise the hours I was doing". For some, this meant that they were uncomfortable approaching staff if they had a work-related issue, which might cause a negative interaction and possibly expose the fact that they work in order to meet their financial needs.

Some students reported that staff were understanding, accommodating and appreciated students' other work commitments. Skills learnt from the workplace helped some students feel more confident when communicating with staff and lessons gained from work gave some students a greater appreciation of staff and what they do for students.

However, 23 (9%) of students found that work had a negative impact on their interaction with staff. The most common themes were that staff were not understanding, flexible or sympathetic about the necessity for students to work, and emphasised that medicine should be the priority, making some students feel less confident, and bad about themselves and/or their abilities: "they say that everything in medical school takes top priority over working but this is easy to say when they aren't the ones who aren't left with enough money to buy enough food for the week." Some commented on the fact that the medical school had unrealistic expectations in this regard: "I personally think it's ridiculous that the uni still has the stance that you must not work during med school."

Students' suggestions to future medical students

Students' suggestions to future students were mixed, and can be summarised by the statement: "it's an individual basis, if you need to/want to and can work it in with medical school, then do it". Students talked of the need to be organised and plan ahead (28 students, 15%, n=192), not overburden yourself (52 students, 27%), and to get a job with flexible hours (22 students, 12%). In general, they commented that, where possible, medical school should be the priority (six students, 3%) and that it was easier to work in the earlier years of medicine (five students, 3%).

Students' suggestions for the medical school

Students' suggestions of how the medical school could assist students included allowing more flexibility with timetables (99 students, 33%, n=303) such as permitting students with heavy workloads (e.g., those with families) to select a stream that works for them and, where possible, alerting students in advance of their timetable commitments. Some students commented on the benefits of the flexibility of online learning that occurred during the COVID-19 lockdown period, and they wondered whether this could become a more permanent option for students.

It was also suggested that staff need to recognise that not all students are the same and all have differing circumstances outside of medicine (62 students, 20%, n=303). They reflected that "maybe instead of telling people they shouldn't work, it may be more helpful aiding them in achieving a good work/study balance." Being more supportive and providing suggestions on how to cope with study and working at the same time would be appreciated (57 students, 19%, n=303).

Effects of COVID-19 on work

COVID-19 disrupted 57% (142, n=250) of students in paid work. Some students were able to work remotely and still get paid. Others had to stop working and while some received government subsidies, many did not. A major impact of COVID-19 was a decrease in the amount of work and therefore a decrease in

the amount of payment. Conversely, some students found that the demands of their jobs increased over the COVID-19 period e.g., ambulance officers, essential workers. Whilst this was a welcome distraction for some students, others found this increased stress levels and potentially impacted negatively on their learning.

Discussion

This study investigated the impact of concurrent part-time work on medical students during the year 2020, including the impacts of COVID-19. Our data show that 49% of students who responded undertook part-time paid work, and that there were approximately equal numbers of reports of positive and negative impacts on students' wellbeing and their interactions with the medical curriculum, with a further third reporting concurrently positive and negative effects.

Students used a variety of methods to fund their medical education with 85% taking out a government loan. These findings are similar to those described by Versteppen & Poole (2017) who reported 92% of New Zealand domestic students left medical school with some form of student loan debt, with 28% owing NZ$90,000 or more.[10] The proportion of students who worked part-time was similar across the middle years of the programme but were reduced in the final year of the programme. Several factors may account for this. Firstly, final year students receive a stipend from the government which provides some financial assistance. Secondly, the final year were expecting to undertake a 12-week elective period where students typically travel overseas. The nature of the employment pursued reflects the availability of opportunities for students, particularly in education and research.

Students' reasons for working varied, and while many students worked out of choice, 14% said that working was a necessity and almost a quarter of students said that they would not be able to afford to continue studying if they did not work. These data are similar to a Nigerian study, which found the predominant factors motivating medical students to work were for financial support and to gain self-development skills.[24]

Part-time work is reported to reduce financial stress and risk of burnout, and positively impact student wellbeing.[15,16] While we found these positive impacts, we also found negative impacts relating to increased student stress, supporting results from other studies that suggest that being employed lowers quality of life.[17,18] This study's results support those found in a study carried out by Duggan and Keefe (2007) in Australia, where both positive and negative impacts on medical curriculum interaction were identified. These included decreased amount of time to study, difficulty balancing demands of work and study, as well as increased life and social skills and good time management.[17] Thus, understanding both negative and positive impacts on students is important.

How working while studying impacted students' interaction with staff is unclear, due to the qualitative data providing some evidence of students avoiding communicating with staff that they were in fact working part-time. This may show students are uncertain about how staff will react if they do disclose that they are working part-time. Interestingly, it was apparent that students tended to be more flexible regarding prioritising work over study than with scheduled medical commitments. This could be because scheduled times in class or the clinical environment are often compulsory and are required in order to pass the year, whereas study can be more easily caught up at a later time and has less of an immediate consequence.

What is surprising is the number of students who undertook some paid employment, when they perceived that the medical school discouraged working while studying. When students enter medical school, they are reminded that: "the MBChB is a contact-intensive programme that does not leave much time for part-time work, which is not recommended".[25] The medical school also states: "students are reminded that having their personal and financial affairs in order to undertake the full course of study is a condition of acceptance into the medical programme".[25] The level of financial need reported suggests that the medical school's recommendations regarding working while studying may not be realistic for all students.

Students expressed a desire for change in how staff perceive students working part-time, to better recognise the demands that students are balancing in order to allow them to lead a life of "living" instead of just "survival". This may reflect differences in the financial pressures faced by previous medical student generations (who are now medical educators) compared to current students. Our findings suggest that an institutional mindset shift to becoming more accepting of part-time work as an important and inevitable part of some medical students' lives would be helpful; one that recognises the benefits for student's wellbeing and enhanced interaction with the curriculum. As medical education programmes try to increase diversity (e.g., pathways for students from lower socioeconomic backgrounds), and as living costs rise, there may be an increasing number of students that need to work in order to study. To maintain an equity of educational opportunity for such students, medical school staff and the curriculum may need to become more

adaptable in order to support their student cohort appropriately. As a country perhaps there is a need to consider the way medical programmes are funded so that the costs to students are reduced to encourage a diverse population of students. Also, while the University provides some scholarships for students, mainly from philanthropic donations, increasing the number and value could also be explored.

COVID-19 effects

It has been hypothesised that loss of work as a consequence of COVID-19 may increase financial stress for medical students.[26] Our study found that COVID-19 did disrupt some students' opportunities for paid work. That the disruption was not greater may reflect New Zealand's response to COVID-19 and the timing of the survey. By the end of 2020 when the survey was undertaken, day to day life was largely back to normal, albeit that the country's border was shut. Also, the onset of infections in New Zealand occurred after the beginning of the academic year, so students who were planning to work may have already secured employment.

Limitations

The survey was carried out at the end of the academic year when many students had already left the University, which may have affected the response rate. While only 36% of the total medical student population, this is not dissimilar to response rates for other online surveys across the University, and included 530 responses. The survey respondents broadly mirrored the overall population of the medical school class, although there was an increased proportion of females and those who entered via the alternative category. The latter represent students who are usually older, previously employed, and have a more diverse background. Due to the nature of the study, students who worked part-time may have been more likely to self-select for this study, despite encouragement for all to participate in the survey.

Conclusions

This research highlights the impacts, both positive and negative, of part-time work on a medical student population. Despite the inevitable challenges and stress that balancing work and study bring, many students have positive experiences from concurrently working. However, the findings suggest that medical school guidance may not reflect the realities that students experience in their life. Medical educators are encouraged to work with students to explore how they can minimise the negative impacts for students who work part-time while studying.

COMPETING INTERESTS
Nil.

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Appendix 1: Demographic data from study participants.

Variable	Response	Respondents (%) (n = 530)	Total cohort figures
Age (years)	18–24	405 (76%)	1218 (83%)
	25–29	79 (15%)	159 (11%)
	30–34	29 (6%)	53 (4%)
	35–39	13 (3%)	23 (2%)
	40–44	4 (1%)	10 (1%)
Gender	Female	371 (70%)	869 (60%)
	Male	155 (29%)	594 (40%)
	Other	4 (1%)	0
Ethnicity	NZ European	326 (62%)	925 (54%)
	Māori Pacific Island	68 (13%) 13 (2%)	285 (16%) 113 (7%)
	Chinese	44 (8%)	155 (9%)
	Indian	20 (4%)	77 (4%)
	Other	59 (11%)	213 (12%)
Year level	ELM2	99 (19%)	293 (20%)
	ELM3	119 (22%)	294 (20%)
	ALM4	130 (25%)	282 (19%)
	ALM5	78 (15%)	290 (20%)
	ALM6	104 (20%)	306 (21%)
Entry pathway	HSFY Entry	348 (66%)	1028 (70%)
	Graduate Entry	115 (22%)	326 (22%)
	Alternative Entry	67 (13%)	109 (7%)

Thunderstorm asthma: a review, risks for Aotearoa New Zealand, and health emergency management considerations

Carol Stewart, Nicole L Young, Nicholas D Kim, David M Johnston, Richard Turner

ABSTRACT

AIM: To provide an up-to-date review of thunderstorm asthma (TA), identifying causative factors, and to discuss implications for management of TA in New Zealand.

METHODS: A literature search was carried out to identify articles that investigate the characteristics and causative factors of TA. Nine electronic databases were searched, yielding 372 articles, reduced to 30 articles after screening for duplication and relevance.

RESULTS: TA is globally rare, with 29 reported events since 1983, but is expected to increase in frequency as Earth warms. Triggers include both pollen (particularly ryegrass pollen) and fungal spores. Individual risk factors include outdoor exposure, sensitivity to triggering allergens and history of seasonal allergic rhinitis. History of asthma is not a strong risk factor but is associated with severity of outcome. Limited data on demographic characteristics suggests that individuals aged between 20 and 60 and (in Australasia) of Asian/Indian ethnicity are at higher risk. A single TA event has been reported in New Zealand to date, but much of New Zealand may be at risk of future events given that ryegrass pastures are widely distributed, and summer thunderstorms can occur anywhere.

CONCLUSIONS: We recommend developing rapidly deployable public messaging to support the health emergency management response to future TA events, together with the instigation of routine aeroallergen monitoring.

Until recently, thunderstorm asthma (TA) was thought to be a relatively rare phenomenon, but recent events have resulted in it being labelled as a growing threat to public health.[1] TA refers to an observed increase in asthma (acute bronchospasm) cases within hours of thunderstorms, brought about by a combination of specific meteorological conditions, the presence of high concentrations of aeroallergens, the formation of respirable allergen particles <10 μm diameter and the exposure (usually outdoors) of populations who are sensitised to the allergens.[2,3]

Aeroallergens are airborne allergen particles, primarily pollen and fungal spores. While whole pollen grains are strongly correlated with symptoms of allergic rhinitis, they are too large to penetrate deep into the airways, with a typical size range of 12–60 μm.[4,5] Ryegrass pollen, for example, which has very strong allergenic properties and is known to be a primary cause of allergic rhinitis in humans, has a diameter of 30–40 μm.[6]

The aetiological role of thunderstorms in reported TA epidemics is thought to be the fragmentation of whole pollen, and other aeroallergen, grains, into large numbers of fine, respirable particles (SPPs, or sub-pollen particles) of size ≤2.5 μm that can pass into the lower respiratory tract where they can induce bronchoconstriction.[6,7,8,9] The proposed mechanism involves pollen, and other aeroallergen grains, being lifted into thunderstorm systems by warm updrafts, followed by rupturing into fragments, transport downwards in cold downdrafts and then dispersion by strong lateral outflows at ground level, exposing populations (Figure 1). Proposed rupturing mechanisms include mechanical friction from wind gusts, water-induced swelling in high humidity conditions, and lightning-induced hydrostatic shock. Although rupturing mechanisms are still poorly understood, Emmerson et al.[6] note that humidity remained very low throughout a severe, and comprehensively documented, TA event in Melbourne, Australia in November 2016,[10] and that of the range of mechanisms they investigated using atmospheric modelling, only lightning counts generated a pattern consistent with observations of SPP concentrations.

The purpose of this article is to provide a concise, up-to-date review of reported TA episodes worldwide, including New Zealand's first reported cases of TA in Hamilton in December 2017.[5] Contributing factors, where reported, are discussed and analysed, together with implications for New Zealand for emergency preparedness for health services and a discussion of

expected future trends in frequency of TA events in a warming world.

Methods

We carried out a literature search to identify primary research articles that document specific TA events *and* report on environmental conditions, suspected triggers and/or individual risk factors. Here we refer to an epidemic as a greater-than-twofold increase in asthma-related hospital or other healthcare presentations following a thunderstorm.[10,11] Key search terms were drafted and then refined after a trial search to ensure relevant synonyms were included. The final search strategy was as follows:

- Asthma OR hayfever OR hay fever OR pollen OR allergen OR allergic OR allergy OR acute rhinitis OR allergic rhinitis;
  AND
- Outbreak OR event OR epidemic OR crisis;
  AND
- Thunderstorm OR storm OR meteorological OR weather OR airborne;
  AND
- Public health OR health.

Nine electronic databases were searched (Academic Search Premier, Medline, Ovid, Google Scholar, Australia/New Zealand Reference Centre, Science Direct, Health Source Nursing/Academic Edition, Scopus and CINAHL Complete). A total of 372 articles were retrieved and were further screened for duplication and relevance, after which 30 articles remained. Articles not published in English were excluded as no translation services were available.

Results

From the available literature, 29 TA events were identified, with the first recorded event reported in Birmingham, England, in July 1983,[16] and the most recent in Yulin, China, in September 2018.[17] These events are presented in chronological order in Table 1.

Suspected triggers

The most commonly reported aeroallergen was pollen, in 19 of the 23 events (83%) where suspected triggers were reported (Table 1). Grass pollen was the most common (in 12 events, or 52%). Fungal spores were described in 9 of the 23 events (39%). The most common fungal spore types reported were *Didymella exitialis* for four events and *Alternaria alternata* for three events. Triggers varied geographically: for Australia, which has experienced the highest number (11) of TA episodes of any country, grass pollen is the primary triggering allergen, but in the UK, where seven TA episodes have been reported, allergens are more varied and more commonly include fungal spores. In Yulin, China, mugwort pollen is an important seasonal aeroallergen.[17]

Figure 1: Indicative processes associated with uptake and discharge of aeroallergens in a mature cumulonimbus cloud.

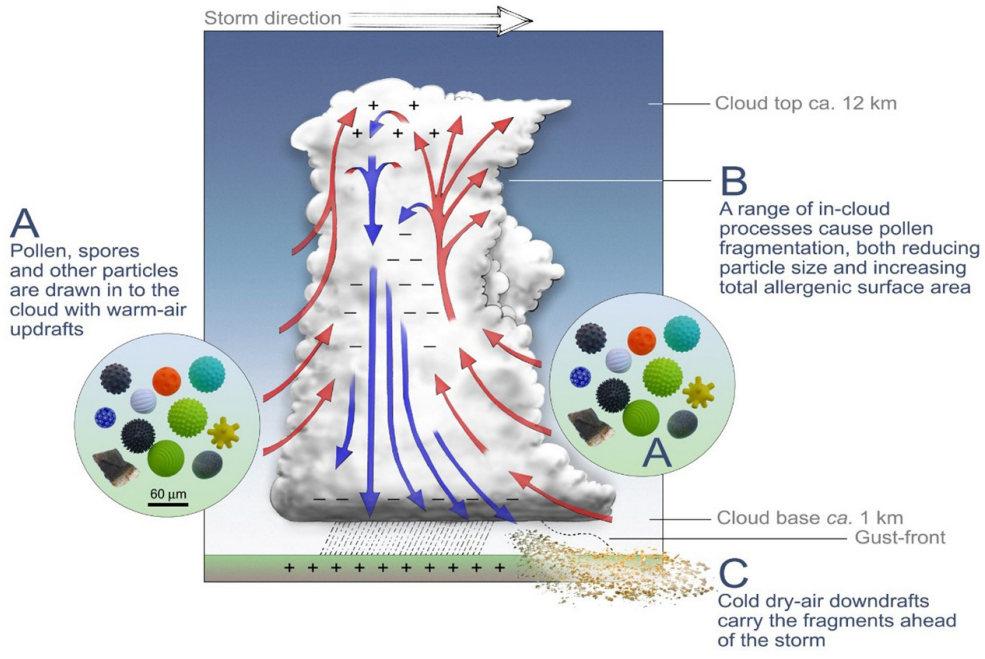


Table 1: Reported epidemic thunderstorm asthma events.

Month and year	Location of event and reference	Hospital presentations	Hospital admissions	Deaths	Fold-increase in hospital presentations	Age, gender and ethnicity where reported	Suspected triggers	Climate & environment conditions	History of related conditions
July 1983	Birmingham, England[16]	106	32	0	5	Age range 14 months–63 years; mean age 24.7 years. 58% male.	FS (*Didymella exitialis, Sporobolomyces*)	Temp: 30 °C	-
June 1984	Nottingham, England[35]	19	2	0	5	-	FS (*Didymella exitialias*)	Temp: 25 °C Wind: 40 kph	53% hx asthma 47% hx allergic rhinitis
November 1984	Melbourne, Australia[36,37]	85	16	0	-	-	NS	Temp: 22 °C Rain: 12.4 mm / 24 hours	95% hx of asthma 95% hx of allergic rhinitis
November 1987	Melbourne, Australia[37,38]	154	26 (one to ICU)	1	10	-	GP (ryegrass) & tree pollen	Temp: 27 °C Rain: 45.6 mm / 24 hours	-
July 1989	Leicester, England[11]	-	32	0	7	Median age: 24	FS (*Didymella*)	Rain & recent harvests	Majority had hx asthma
November 1989	Melbourne, Australia[37,38]	277	47 (three to ICU)	0	12	-	GP (ryegrass) & tree pollen	Temp: 25 °C Rain: 7.8 mm / 24 hours	-
November 1990	Tamworth, Australia[37,39]	233	110	0	7	-	GP	-	80% hx asthma
June 1994	London, England[40,41]	640	104 (five to ICU)	1	10	57% of presentations aged 21–40	GP	Lightning strikes & rainfall, sudden fall in temperature and increase in windspeed as thunderstorm passed	63% hx allergic rhinitis
October 1997	Wagga Wagga, Australia[22]	215	41; two required intubation and ventilation	0	7	Of 148 TA cases surveyed, 46% male, average age 28	GP (ryegrass) FS: *Cladosporium* (mould); 61% of TA patients allergic.	-	Of 148 TA cases surveyed, 90% recent hx allergic rhinitis, 64% hx asthma. 96% of TA patients surveyed allergic to ryegrass pollen.

Table 1 (continued): Reported epidemic thunderstorm asthma events.

Month and year	Location of event and reference	Hospital presentations	Hospital admissions	Deaths	Fold-increase in hospital presentations	Age, gender and ethnicity where reported	Suspected triggers	Climate & environment conditions	History of related conditions
October 1998	Newcastle, Australia[42]	6	0	0	4	Age range: 16–67	GP	Wind: 80 kph Rainfall Pollen concentration: 120-fold increase	100% hx allergic rhinitis
July 2000	Calgary, Canada[18]	157	0	0	9	Of 46 patients surveyed: median age: 31. Gender: male 65%	FS: *Alternaria*, Myxomycetes (7x), *Ustilaginales*, Helicomyces (3x), *Stemphillium*. Pollen: families *Amaranthaceae* (12x), *Chenopodiaceae* (12x). Algae (25x). Fold-increases in brackets.	Stagnant air mass preceding thunderstorm may have allowed spores and pollens to accumulate. Atmospheric pressure drop was also recorded. Sudden onset of high winds (up to 70 km/h).	Of 46 patients surveyed: 39% hx asthma; 35% hx allergic rhinitis; 17% hx allergies; 78% hx ≥ 1of the above
May 2001	Madrid, Spain[21]	154	-	0	-	Age range: 4–79	GP, olive pollen	-	95% hx asthma
July 2002	Cambridge, England[23]	57	3	1	10	Of 26 cases surveyed, mean age was 38.6 (range 18–67); 58% male	FS (*Alternaria*, *Cladosporium* and *Didymella* species)	During week before, little rain and relative humidity decreased from 93% to 60%. Very high ozone concentrations of 180 µg / m^3. *Didymella* ~43,000 grains / m^3, *Alternaria* 655 / m^3	Of 26 cases surveyed, 23 (88%) had IgE sensitisation to *Alternaria*, 25 (96%) had seasonal asthma symptoms
November 2002	Al-Khobar, Saudi Arabia[43]	NS	0	NS	-	-	NS	Rain	-

Table 1 (continued): Reported epidemic thunderstorm asthma events.

Month and year	Location of event and reference	Hospital presentations	Hospital admissions	Deaths	Fold-increase in hospital presentations	Age, gender and ethnicity where reported	Suspected triggers	Climate & environment conditions	History of related conditions
November 2003	Melbourne, Australia[37,44]	70	0	-	3	-	GP	Daily GP concentration: 128 grains / m^3 Rain: 1.2 mm / 24 hours Wind: >90 kph	Majority had hx asthma
June 2004	Naples, Italy[45]	7 (one to ICU)	0			Gender: male 43%. Age range: 38–60 for 6 adults and one girl of 11.	Nettle pollen (*Parietaria*)	*Parietaria* species pollen concentration: 144 grains / m^3	57% hx asthma 29% hx allergic rhinitis 100% sensitised to *Parietaria* pollen but not grass pollens
June 2005	South-East England[1,11,46]	NS	-	NS	6	-	NS	Lightning strikes & rainfall	40% hx asthma 38% hx allergic rhinitis
May 2010	Barletta, Italy[25]	20	20	0	10	Mean age: 44. Age range: 9–81. Gender: male 55%	Olive pollen	Olive pollen concentration: 278 grains / m^3 Temp: 29 °C	60% hx asthma 30% hx allergic rhinitis
November 2010	Melbourne, Australia[11,37]	36	0	0	10	-	GP	Temp: 35 °C Daily grass pollen concentration: 56–117 grains / m^3 Rain: 23 mm / 24 hours	-
November 2011	Melbourne, Australia[11]	30	-	0	2	-	GP	Pollen grain concentration: 727 grains/m^3	84% hx allergic rhinitis
July 2013	London, England[47]	40	0	0	4	Majority aged between 20–40.	NS	-	Most no hx asthma

Table 1 (continued): Reported epidemic thunderstorm asthma events.

Month and year	Location of event and reference	Hospital presentations	Hospital admissions	Deaths	Fold-increase in hospital presentations	Age, gender and ethnicity where reported	Suspected triggers	Climate & environment conditions	History of related conditions
November 2013	Ahvas, Iran[24]	2000	37 (three to ICU)	0	-	Gender: male 46%; 61% aged 20–40; 24% aged 40–60	NS	-	40% hx asthma 83% hx allergic rhinitis
October 2014	Canberra, Australia[14]	15	-	0	4		GP	Pollen concentration: > 100 grains / m^3	
October 2015	Central Israel[19]	-	-	NS	2.5	-	FS, pollen	Wind gusts of > 130 kph; 17,000 cloud-to-ground lightning strikes; ~10-fold increase in $PM_{2.5}$ and PM_{10} concentration.	
November 2016	Melbourne, Australia[10,15]	3,365	476, with 35 admitted to ICU.	10	6.7	Of 1,435 ED presentations surveyed, mean age 32.0 years, 56% male, 39% of Asian or Indian ethnicity.	GP (ryegrass)	Grass pollen concentrations extremely high (> 100 grains / m^3). As gust front crossed Melbourne, temperatures dropped 10 °C and humidity increased to > 70%, wind gusts of up to 90 kph.	43% of 1,435 ED presentations surveyed had hx asthma, with 28% having current asthma. Of 85 patients assessed by Lee et al. (2017), 100% were sensitised to ryegrass pollen, 99% had hx of allergic rhinitis, 60% had no prior diagnosis of asthma.
December 2016	Kuwait City , Kuwait[26]	844	45, with 26 admitted to ICU.	11	-	At Mubarak Al-Kabir hospital (n = 17 admissions): 58.8% male, average age 39 years.	Salsola pollen (*Chenopidiaceae* and *Amaranthaceae* families), FS (*Alternaria*).	Temp: 28 °C	At Mubarak Al-Kabir hospital (n = 16): 94% hx asthma 44% hx allergic rhinitis

Table 1 (continued): Reported epidemic thunderstorm asthma events.

Month and year	Location of event and reference	Hospital presentations	Hospital admissions	Deaths	Fold-increase in hospital presentations	Age, gender and ethnicity where reported	Suspected triggers	Climate & environment conditions	History of related conditions
December 2017	Hamilton, New Zealand[5]	38	4	0	2.4	Median age: 26. Gender: 37% male. Ethnicity: 39% Asian or Indian.	NS	Wind gusts up to 37 kph, 770 lightning strikes.	53% hx asthma, 48% hx allergic rhinitis.
May 2018	Milan, Italy[48]	2	2	-	-	Gender: female 100%; ages 41, 45.	Pollen	-	Both patients had hx allergic rhinitis, mild asthma, sensitivity to grass pollen.
September 2018	Yulin, China[17]	392	51		16	Pediatric patients, range 3–14 years old, median age 7. Gender: male 74% in ED, 72% of inpatients.	Pollen (mugwort) & FS	Temp: 27 °C	45% hx asthma 77% hx allergic rhinitis

Notes: FS=fungal spores; hx=history; kph=kilometres per hour; NS=not specified; GP=grass pollen.

The level of detail in reporting suspected triggers varied widely across the studies. Some had access to data from aerobiological monitoring stations, which enabled positive identification of pollen and fungal spore species and quantification of their airborne concentrations.[10,18] Others provide only a flowering calendar for various allergenic plants at the study locality,[19] and some do not report suspected triggers at all.[5]

Seasonality of TA episodes

The timing of reported TA episodes is summarised in Figure 2. Strong seasonality is apparent for TA events in Australasia, with all events occurring between October and December (mid-spring to early summer) with a peak in November (late spring). The event in Hamilton, New Zealand, occurred in early December;[5] all other events in Australia occurred in October or November. In the Northern Hemisphere, similar seasonality is observed for TA events in the UK, Canada, Spain and Italy, with events occurring between May and July (late spring to midsummer), building to a peak in July. However, TA events in Saudi Arabia, Iran, Kuwait, China and Israel were more distributed over the months of September through December, with too few events at any of these locations to ascribe seasonality.

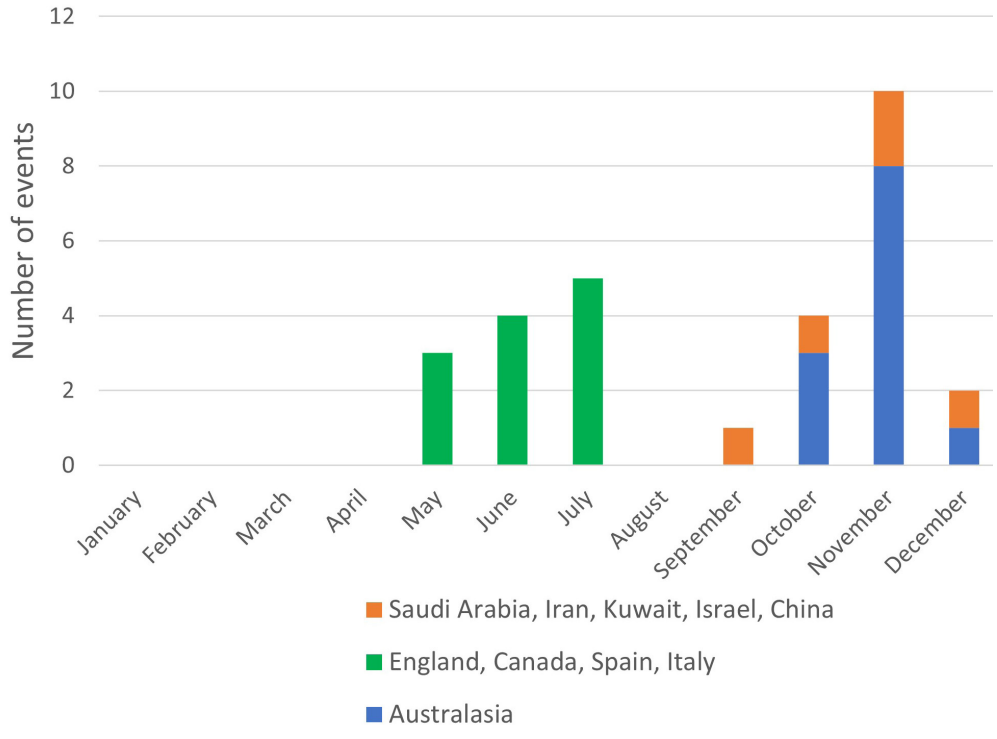
Observed seasonal trends, with TA events confined to mid-spring to early summer for Australasia, and to late spring to mid-summer for England, Spain, Italy and Canada, are expected on the basis that this time of year is the peak of the pollen and outdoor mould seasons and the summer storm season.[20] Peak pollen concentrations typically occur earlier in the season than peak fungal spore concentrations. Within England, Spain, Italy and Canada, TA events in May (late spring) are dominated by pollen triggers, moving to fungal spore dominance for events in July (mid-summer). This knowledge is useful as a basis for location-specific predictions of future events.

Patient characteristics

Allergen sensitivity, histories of seasonal allergic rhinitis and asthma

Sensitivity to the triggering allergen is considered essential for developing TA symptoms.[14,15,20,21] However, patient allergen sensitivity has been reported for just three of the 29 TA events to date (Table 1), using skin-prick tests and/or IgE serology. While there is no clear common allergen globally,[14] patient sensitivity to ryegrass pollen has been a near-universal feature of TA events in Australia.[10,15,22] Of 85 patients tested for allergen sensitivity from the November 2016 Melbourne TA epidemic, 100% were sensitised to ryegrass pollen, as were 96% of 138 patients in a TA event in Wagga Wagga, inland New South Wales, in October 1997.[15,22] However, in the UK, allergen tests carried out on patients from a TA event in Cambridge in July 2002 showed that 23

Figure 2: Reported thunderstorm asthma events by month (from Table 1).



(88%) of the 26 cases were sensitive to *Alternaria* species, 22 (85%) sensitive to grass pollen, and 16 (62%) sensitive to *Cladosporium* species.[23] Grass pollen was considered unlikely to be the primary trigger as airborne concentrations were relatively low at the time of the event. Based on a timeline of meteorological conditions, asthma admissions and aerobiological monitoring, the authors propose that the following sequence of events may have led to the TA event: 1) a prolonged, earlier grass pollen season may have caused bronchial hyperresponsiveness in people sensitised to both grass pollen and *Alternaria;* 2) forecasted thunderstorms caused farmers to increase harvesting activity of barley crops, which host *Alternaria*; 3) combine harvesting liberated large numbers of fragmented *Alternaria* spores; 4) asthma symptoms triggered in sensitised individuals. The authors also noted that high ground-level ozone concentrations and a sudden reduction in temperature, both associated with thunderstorm conditions, may have also contributed to bronchial hyperresponsiveness.

Patient histories of seasonal allergic rhinitis (SAR) are reported for 16 TA events (Table 1): proportions of cases with a history of SAR ranged from 29–100%, with a weighted mean of 74%. Interestingly, proportions of cases with previous histories of SAR were much higher in Australian TA events (84–100%), but were lower in the Hamilton, New Zealand event (48%). Clinical SAR was one of three key "trifecta" risk factors for TA in Melbourne, and for other areas globally where ryegrass is cultivated.[15] It is less clear that SAR is an important risk factor for TA triggered by other aeroallergens.

Patient histories of asthma were recorded for 18 TA events (Table 1). Proportions of cases with a history of asthma ranged from 39–100%, with a weighted mean of 49%. A substantial proportion of people affected by TA have no prior history of asthma and may be at higher risk because they do not have prior education to recognise asthma symptoms and seek medical attention, and also because they do not have ready access to reliever bronchodilator inhalers.[5] However, while pre-existing asthma is not a strong risk factor for TA susceptibility, it is associated with severity of outcome and increases the risk of hospital admission (odds ratio 1.9).[9] All 35 critically ill patients admitted to ICU during the 2016 Melbourne TA epidemic had a previous diagnosis of asthma.[14] Of these, 66% were not on preventer (inhaled corticosteroid) therapy, suggesting suboptimal control of asthma and treatment adherence.

Age, gender and ethnicity

The ages of those affected by TA was reported in 16 of the 29 events (Table 1). For the largest and most thoroughly documented TA epidemic to date in Melbourne in November 2016, 1,435 TA cases were followed up; the mean age was 32.0 years.[10] These authors noted a dominance of patients aged 20–59 and noted the departure from a typical U-shaped age distribution. Similarly, of 2,000 ED presentations in Ahvas, Iran, 61% were aged between 20–40, and 85% between 20–60.[24] Other reports of mean or median age of TA cases are generally consistent with this observation and range from a median age of 24[11] to a mean age of 44.[25] There is limited evidence that outcomes of TA cases may worsen with increasing age: while the mean age of TA cases was 32.0 years, the median age of adult patients admitted to ICU was 42 years, and the mean age of the 10 deaths was 38.5 years.[10] TA has also been documented in pediatric patients (age range 3–14 years, median age 7) in Yulin City, China.[17]

Reporting of gender of TA sufferers is inconsistent across studies. The percentage of males varies from 37–74% (Table 1). For the studies involving the largest numbers of people, there is no clear gender dominance, with 56% male of 1,435 TA cases followed up in Melbourne,[10] but 46% male of 2,000 ED presentations in Ahvas, Iran.[24] There is limited evidence that males may have more severe outcomes; in Melbourne, 63% of the 35 patients admitted to ICU were male and seven of the 10 deaths were male.[10] Similarly, in Kuwait, 10 of 17 (59%) patients admitted to hospital were male, but all 11 people diagnosed with fatal asthma (prior to arrival at hospital) were male.[26]

Few studies report ethnicity of TA sufferers (Table 1), but of those that do a striking finding is that individuals of Asian or Indian ethnicity were over-represented in ED admissions.[5,10] For the Melbourne event, 39% of 1,435 cases followed up were of Asian or Indian descent, compared to 25% in the general population.[10] Patients with Asian/Indian ethnicity were also over-represented in ICU admissions and deaths.[10,14] For the December 2017 TA event in Hamilton, New Zealand, 39% of ED presentations were of Asian or Indian ethnicity, compared to 18.5% of the Hamilton population from 2018 census data.[5] Atopy and asthma are more prevalent amongst migrants in high-income countries, with possible mechanisms including exposure to novel allergens and vitamin D deficiency (who died prior to arrival at hospital) impairment to immunoregulation, and of further note is a significantly higher prevalence of allergic rhinitis in Asians living in Australia.[10] Cultural factors

such as poor knowledge of asthma in migrant populations may also contribute. As TA events are rare globally, these mechanisms remain poorly understood.

Limitations of analysis

While 29 TA events have been documented worldwide from 1983 onwards, we acknowledge that this is likely to be an incomplete record as we did not attempt to search any non-English language databases. Thus, TA may have a much longer history and widespread distribution than described here. It would be surprising if the true global footprint of TA was restricted to the 11 countries with documented TA events (Table 1). Consequently, we emphasise that our findings may not be fully representative. For example, a greater range of aeroallergen triggers may exist, and other ethnicities than described here may be at higher risk of TA.

Further, increases in milder asthma cases following thunderstorms may not result in hospital or other healthcare presentations; and small rises in presentations may not exceed the twofold increase that defines an epidemic TA event.[10,11]

Projected impacts of global warming on frequency and severity of TA events

TA has recently been described as a global health problem that is likely to be exacerbated by climate change, with future events likely to become more common, more catastrophic and more unpredictable.[4] The frequency and severity of thunderstorms is projected to increase in response to rising global temperatures.[27] Furthermore, climate change may exacerbate pollen allergies, including TA, with rising temperatures and atmospheric CO_2 concentrations collectively causing higher pollen production in certain plants due to a "CO_2 fertilisation effect", earlier and longer pollen seasons, and shifts in ranges.[28]

Implications for Aotearoa New Zealand

Potential aeroallergen triggers

For the single recorded TA event in New Zealand to date, in Hamilton in December 2017, suspected aeroallergens were not reported.[5] Newnham[28] has pointed out that New Zealand does not have an airborne pollen monitoring programme and lags well behind other regions in not instigating routine aeroallergen monitoring in major population centres. While the primary purpose of such monitoring would be to inform management of seasonal allergic rhinitis, which has a high prevalence in New Zealand, it would also be critical for identifying triggering aeroallergens in any future TA events. We therefore support Newnham's call for routine aeroallergen monitoring in New Zealand.

Of note is that perennial ryegrass is widely distributed across New Zealand in high-producing grasslands that support dairying, and is also used widely in sports grounds, golf courses, school playing fields and residential lawns. Ryegrass pollen is strongly implicated as the triggering aeroallergen in TA events in Australia,[4,14,15] and more generally, grass pollen is considered the major outdoor aeroallergen source in Australasia.[29] High-producing grasslands are concentrated in the Waikato, Taranaki, the Manawatu, Wairarapa/southern Hawke's Bay, Canterbury and Southland.[30] In some regions there is high potential for priming for grass pollen allergens by prior exposure to tree pollen allergens.[28]

Fungal spores should also be considered as potential TA triggers. While there is very limited information available for New Zealand, high airborne fungal spore levels were recorded for some locations, notably Kaikohe, Hamilton and Christchurch, in a survey of seven population centres.[49]

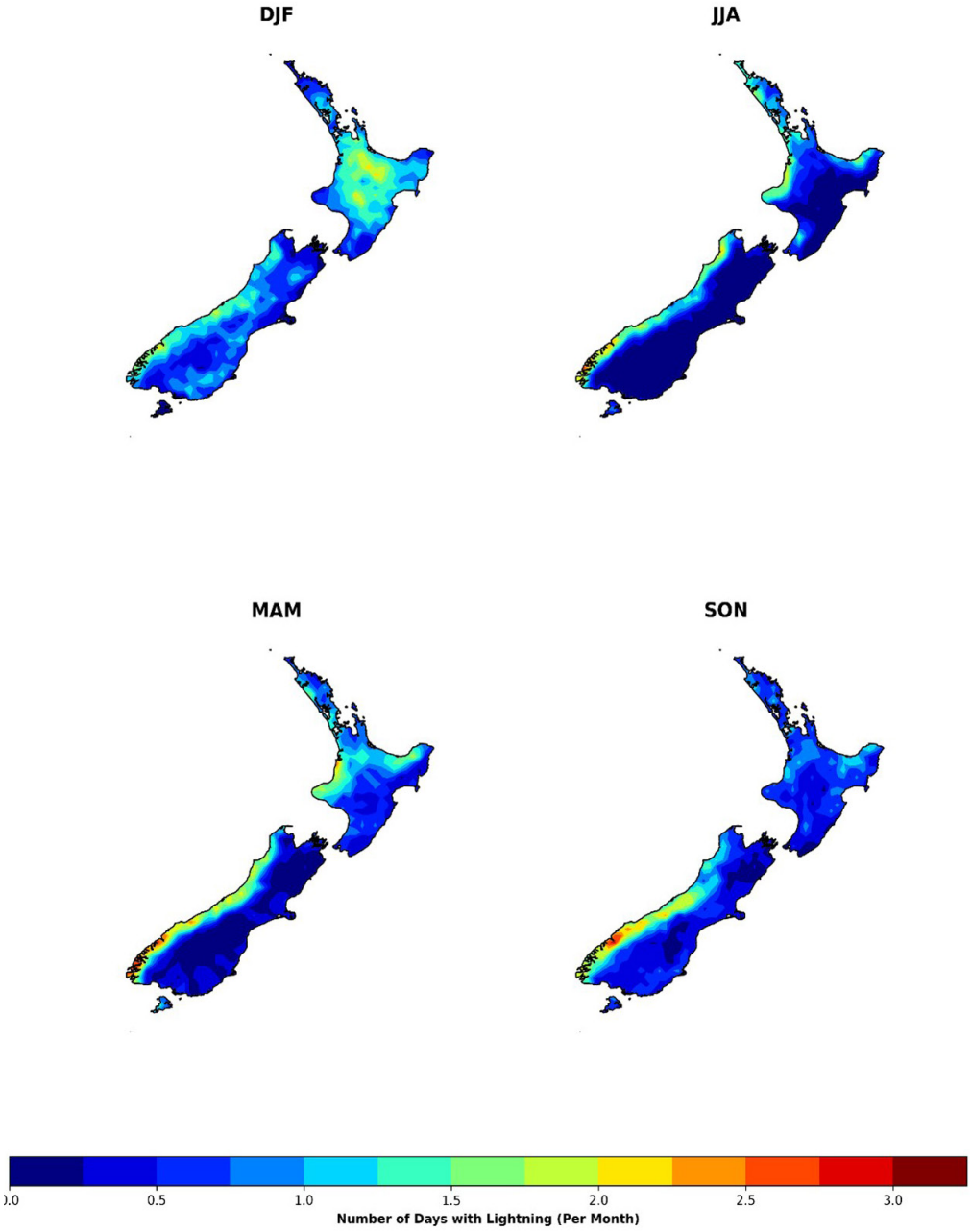
Risk of TA events across New Zealand

The New Zealand grass pollen season runs from November to the end of February, peaking strongly in December in most regions, while fungal spore concentrations peak in January/February.[28,49] Although they can occur anywhere, summer thunderstorms most commonly originate in inland areas and the ranges of the North Island, and the South Island high country and West Coast (Figure 3, which shows expected days per month with lightning by season as a proxy for thunderstorm activity).[31,50] The Waikato therefore emerges as an area at particular risk of TA events due to its extensive pastoral farming, substantial population and inland location associated with a greater probability of summer thunderstorms. However, we emphasise that thunderstorms can, and do, occur anywhere in New Zealand. An investigation of statistical relationships between acute asthma presentations and thunderstorm occurrence may inform a more quantitative assessment of TA risk for New Zealand.[50]

Healthcare services preparedness for future TA events

During TA events, many patients presenting simultaneously may overwhelm local healthcare services thus it is important to consider the capacity of these services, particularly as TA events are expected to become more frequent and severe in future. Treatments provided in intensive care units (ICUs), such as intubation and mechanical ventilation, can be lifesaving for acute asthma cases, thus New Zealand's ICU capacity is an important determinant of preparedness.[12] A recent assessment found that as of

Figure 3: Geographical distribution of predicted number of days per month with lightning for summer (DJF), autumn (MAM), winter (JJA) and spring (SON).



October 2021, there were just 176 staffed ICU beds in public hospitals, with surge capacity (based on the ICU nursing workforce availability) for a further 67 beds.[32] While the current total ICU capacity of 243 ICU beds (4.8 per 100,000 population) is substantially lower than Australia's, which varies by state from six to 10.8 per 100,000, it seems unlikely that this will be a limiting factor in New Zealand's preparedness for a TA event, unless ICU capacity were to become overwhelmed by, for example, current or future pandemics or a mass casualty event.

Health emergency management considerations

A key role for the emergency management sector is preparing for and responding to "rare" events. In rapidly evolving adverse events, there is typically a high level of uncertainty about the nature of the event and likely outcomes, especially in the initial stages.[33,34] Health and emergency management personnel will be called upon to act quickly and provide advice during these periods of major uncertainty.

We suggest that an effective preparedness strategy for "rare" events such as thunderstorm asthma would be to develop evidence-based public messaging in a form ready to be disseminated when required, to help proactively manage a surge in demand for information rather than attempting to develop messaging during an unfolding event. As an example, outdoor exposure to aeroallergens is a critical trigger for TA.[9,15] Therefore, public messaging advising people to remain indoors with doors/windows closed and air conditioners turned off during and after thunderstorms could be a simple, effective risk reduction measure. Messaging could also emphasise the importance of diagnosed asthmatics adhering to regular preventer use and keeping reliever medications at hand.[51] Such messaging should be developed in partnership with the health emergency management sector. Care would need to be taken to deploy messaging only during the high-risk period of ryegrass pollen season to avoid potential warning fatigue.

In conclusion, here we have reviewed reported thunderstorm asthma events worldwide and identified causative factors. TA is globally rare, with 29 recorded events since 1983, but is expected to increase in frequency as Earth warms. Where reported, pollen was the most common suspected trigger in 83% (and fungal spores in 39%) of events. Strong seasonality of TA events is observed in some countries but not others. In Australia, which has experienced the highest number of TA events (11) of any country, all events occurred during October and November, peaking in November. In terms of individual susceptibility, major risk factors are outdoor exposure, sensitivity to the triggering allergen and a history of seasonal allergic rhinitis. Pre-existing asthma does not appear to be a strong risk factor for TA but is associated with severity of outcome. People with no prior history of asthma may be at higher risk as they are unlikely to have access to reliever bronchodilator inhalers and may not recognise symptoms and seek medical attention. Available data on age, gender and ethnicity is limited, but points towards a dominance of patients aged between 20 and 60. In Australasia, people of Asian/Indian ethnicity appear to be at higher risk.

The triggering aeroallergen for the single recorded TA event in Hamilton in Dec 2017 is unknown, but likely to be ryegrass pollen. Much of New Zealand may be at risk of future TA events given that ryegrass pastures are widely distributed across New Zealand and summer thunderstorms (coinciding with ryegrass pollen season) can occur anywhere. We suggest that an effective preparedness strategy for this rare but consequential phenomenon would include the development of rapidly deployable public messaging to support the health and emergency management response, supported by the instigation of routine aeroallergen monitoring.

COMPETING INTERESTS
Nil.

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Consent for teaching

Ben Gray

ABSTRACT

Consent for teaching was introduced as a result of the Cartwright Inquiry and is part of the Health and Disability Code of Health and Disability Consumer Rights. A consensus statement developed by Otago and Auckland medical schools states that the need to gain consent cannot be set aside on the grounds of inadequate time or resource. This viewpoint argues that a singular focus on patient experience, whilst ignoring the other elements of the quality framework, is not appropriate. "Consent" is a poor word in most circumstances to describe the complex interaction with a patient over time. Rather than strengthening codes of behaviour, an approach of a broader view of the overall quality of the interaction and a focus on cultural safety holds more promise.

The issue of consent for student involvement with patient care was raised by the Cartwright Inquiry. Evidence was presented that medical students were required to perform vaginal examination on anaesthetised women without their knowledge or consent.[1] As a result of the Inquiry, the Code of Health and Disability Consumer Rights (HDC Code)[2] was established that includes rights on consent for teaching (Rights 5,6 and 7). There are concerns that this requirement is not being observed, and a Consensus Statement (CS) was developed by Auckland and Otago medical schools on informed consent for teaching.[3] Malpas et al. did a study based on a subset of reflective essays—"Ethics Reports"—that medical students had written that documented significant deviation from these recommendations.[4] They recommended further strengthening processes to ensure that the consensus is adhered to.

Like Auckland Medical School, Wellington campus-based University of Otago students write reflective pieces (called Thought Provoking Episode Reports (TPER)). I read over 100 every year, mostly from final year students. This paper is not based on a formal analysis of these reports, but they have significantly informed its development.

Summary of argument

In my view the CS is significantly flawed:

1. It is couched in ethical terms that prioritise patient autonomy. This is inconsistent with the approach of balancing the quadruple aim of quality medical practice.[5]
2. "Consent" as a term is too simplistic and hides all the relational elements that contribute to a patient agreeing to student involvement.
3. In requiring students to obtain consent for teaching, the recommendations are asking students to do something not required of graduate doctors. Whilst the CS refers to the apprenticeship model, the requirement for consent for teaching runs counter to the use of this model in other settings.
4. My hypothesis is that ethics are culture bound so disagreements on ethical practice reflect different cultural views on what is right. In Malpas's examples the views of those writing the CS conflicted with the practicing clinicians that students were exposed to. The concept of "cultural safety" is helpful in approaching this issue. The patient's view of what is right is most important.

Patient autonomy and the quadruple aim

The HDC Code[2] was established in 1996 as a result of an inquiry into practice that significantly impinged on patient autonomy. The focus of the code is to protect patient autonomy, and the CS reflects the recommendations in the HDC Code. It is only in Section 3 of the HDC Code that other considerations of clinical circumstances and resource constraints are mentioned. Apart from the generic right referring to compliance to other law, there is no mention at all of decisions being affected by public health considerations.

The modern quality in healthcare movement was advanced by the US publication "Crossing the Quality Chasm" in 2001,[6] and the New Zealand Health Quality & Safety Commission was established in November 2010. Central to its work is the triple aim, a balance between:

- Improved health and equity for all populations,
- Improved quality, safety and experience of care

for people and their whanau,
- Best value for public health system resources[7] (see Figure 1).

Improved clinician experience has been added to this.[5] This framework provides a better description of clinical practice than the HDC Code. The value of this framework has been illustrated by the COVID-19 pandemic. There have been many instances where the importance of individual care has been secondary to population health. The CS asserts that "in the end the need to gain consent cannot be set aside on the grounds of inadequate time or resource". This runs counter to the aims of the quality framework, which involves balancing the competing priorities. This is a higher standard than achieved in either clinical or research practice. In clinical practice, consent is not required in emergencies with unconscious patients. In research, we would have no information about the use of pharmaceuticals during pregnancy if we insisted on the consent of the foetus.[8] Medical students would never attempt Cardio Pulmonary Resuscitation for the first time if consent was required.

Consent or agreement?

Consent implies a binary decision (consent or no consent) and that there is a choice. Consent, especially signed consent, occurs in a moment in time. Consent implies that the decision is solely that of the patient, and therefore that patient autonomy is prioritised.

This provides a sparse description of a consultation that does not acknowledge all the relational work involved. The Calgary–Cambridge guide to the medical consultation[9] is the framework we use to teach students consultation skills. The focus is on first gaining an agreed understanding of the presenting problem(s), followed by reaching agreement on a management plan. In clinical practice, if a detailed shared decision-making process is followed and an agreed management plan is developed, then consent at the end of that process is of less importance.

Consent for involvement with a conscious patient is an ongoing process. A signed consent for an intimate examination in a conscious patient is no longer relevant if the patient during the exam asks the student to stop. In their study of what affects a woman consenting to an intimate examination, Armitage[10] unsurprisingly found that:

> *"An association existed between being willing to be examined and whether the student had engaged with the woman by finding out what her presenting complaint was."*

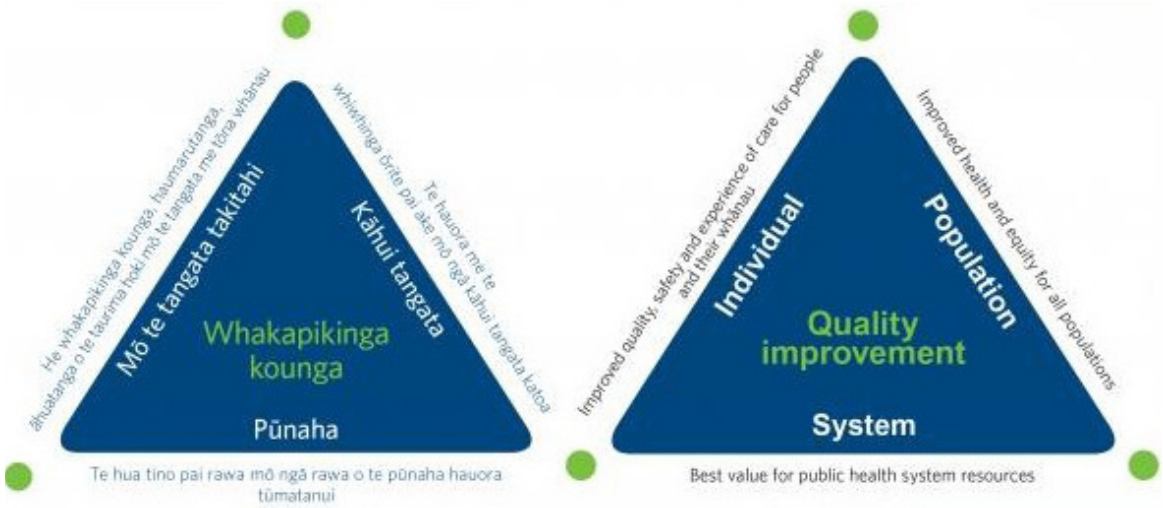
If the student attends to whakawhanaungatanga,[11] building trust, and continues to ensure the patient's comfort through the involvement, then consent for an intimate examination may not need to be so formal.

"Consent" implies that the decision is solely that of the patient, whereas "agreement" implies that the clinician has had input into the decision. This appropriately allows for issues of wise use of resources, equity and population health and clinician wellbeing to be factored into the decision.

Should student standards differ from standards for graduates?

Malpas et al.[4] noted that at the Auckland Medical School their guidelines require that patients give informed written consent for any sensitive examination performed by a medical student. As a clinician,

Figure 1: The Triple Aim.



I have never asked for written consent for a sensitive examination in a conscious patient. seeking such consent would seem to have limited value. For what reason are we asking students to do something that practicing clinicians do not do?

The CS says that "before becoming involved in any patient's care, the consent of the patient must be obtained". From the context this is referring to medical students, but it is true for all clinicians. Any interaction in healthcare requires the patient to agree, and the extent of focus on agreement will vary depending on circumstances. The greater the risk and inconvenience, the greater the focus; the greater the existing relationship of trust, perhaps lesser the focus. If the patient has made an appointment to see a clinician, consent for involvement is implicit and not formally required. Rather than asking students to seek consent for involvement in teaching/learning, we should be teaching students what we do in relation to obtaining agreement for involvement with patients. This varies from grudging acquiescence (the nurse wanting to do observations on a patient before the patient sees the doctor) through to simple agreement ("is it okay if I examine you now?") to formal consent for major procedures.

Agreement for involvement is a much more useful concept than agreement for involvement in teaching/learning. Whilst there are instances where the student involvement is just teaching/learning, as students progress through the course they are increasingly involved in providing care, either by, for example, taking a more detailed history because they have more time, or being actively involved, such as taking blood samples or performing CPR. This case study by one of my fourth-year students is a clear example of student involvement making a significant difference to the outcome for the patient.[12]

Why do we require medical students to seek consent for patient involvement in learning if we do not require graduate doctors to seek consent in the same circumstances? The CS suggests that:

> *"the process by which consent is obtained can and should be proportional to the involvement of the medical student and the nature of the interaction and consequent risk or inconvenience to the patient".*

Risk and inconvenience are important, but they apply just as much to a graduate doctor learning to perform a procedure. Gawande[13] describes how he learned, and later taught, the insertion of a central line, and discusses the broad issue of how surgeons learn their trade. He describes how "learning as hidden behind drapes and anaesthesia and the elisions of language". The risks and inconvenience incurred to patients as a result of involvement the of medical students are less than those resulting from the learning that Gawande describes. It may well be that practice in relation to consent for care by a training postgraduate doctor should be changed, but it makes no sense to have one set of standards for medical students and another for graduate doctors.

Ethical norms

In their book critiquing the use of the term "consent" in research and clinical practice, Manson and O'Neill criticised the term "consent" as being a metaphor for the process that highlights the element of choice but hides the transactional/communicative work that underlies reaching agreement. They pointed out that communication only succeeds within a rich practical and normative framework shared by speaker and audience, and where both parties adhere to and act in accordance with relevant communicative, epistemic and ethical norms. In chapter two, they argue that "consent" as a metaphor hides or downplays these essential aspects of communication.[8]

In referring to ethical norms, they use the term in the sense of descriptive ethics;[14] norms of understanding of what "right behaviour" is that are shared by the patient and clinician. For example, there is an accepted "ethical norm" outside of medicine that consent is not sought for teaching—the apprenticeship model. If you take your car to the mechanic, they will not ask whether you mind if the apprentice does some of the work. If you see your lawyer, they will not ask consent for the intern to do preparatory work on your document. Students learning to teach don't ask for consent before conducting a lesson with children. This is part of the "normative framework". The understanding is that the "senior" is responsible for the work, and that the work may be done by someone junior, including someone who is still learning. Implicitly, you agree to the team, led by the person with whom you reach agreement, providing the service you are expecting. The CS acknowledges that medical students learn in an apprenticeship model, but in requiring specific consent for medical student involvement, deviate from the usual expression of that model.

Culture

My hypothesis is that problems relating to consent for teaching represent different understandings of what right behaviour is, and that this varies according to cultural background.[15] At the time of the Cartwright Inquiry, the practice of medical students

examining women under anaesthetic without telling them was the norm in Auckland Medical School, but also at the University of Otago, Wellington (personal experience) and probably with all medical training in New Zealand at the time. This was not the behaviour of rogue practitioners behaving badly, it reflected the cultural norms of medicine at the time. These were heavily male dominated and paternalistic. The culture in the wider society had moved towards a greater input from women and an expectation of more patient involvement in decisions. The culture of medicine was slow to adapt.

In the pluralist New Zealand society different communities may hold different ethical norms. I had a TPER from a Samoan student who described an interaction on a ward round where an older Samoan man was examined by the team. The team did not notice the extent of his embarrassment and clearly felt that their behaviour was appropriate. The student was very aware that the behaviour was culturally unsafe for this man and after the ward round went back to apologise to him. Arguably, all the cases that Malpas discusses in her study[4] are similar, where what the clinician thought wasacceptable behaviour was unacceptable to the student, and possibly/probably for the patient, although without asking the patient we cannot know.

The CS is the ethical norm of those who wrote the statement. In the New Zealand setting, a norm such as this that makes no mention of what a Māori approach would be, is likely to be incomplete. The Hui process[11] describes a Māori approach to relating to patients that places much greater emphasis on relational work. "Consent" hides the relational work. For Pasifika, similarly, there would likely be a greater emphasis on the relationship and process given the importance of the concept of the Va:

> *"The Va or space that relates, is a tapu (sacred) space that connects and holds separate entities and things together in unity… Observing, nurturing and maintaining the sacred space[va] and respecting relationships is thus pivotal to the fa'asamoa or Samoan way of life and living"*[16]

In arguing that ethics is culture bound I am not suggesting that there is marked disagreement across cultures. I am arguing that different cultures weight the importance of the competing principles differently. The academic teachers of professionalism have prioritised the autonomy of the patient. The active clinicians put more weight on time constraints, the need for their juniors to learn and their own wellbeing. Māori and Pasifika put particular weight on the importance of the relationship. During a pandemic, judgements of what right behaviour is differ significantly from judgements made when public health issues are not so dominant. All these factors are important and in an ideal world would all be attended to in every interaction. In the real world, a judgement needs to be made in each instance as to what is possible.

Cultural safety

Cartwright identified a problem with consent for teaching. Despite 25 years of the HDC Code the problem identified persists. The CS suggests approaching this problem by a narrow focus on consent for student involvement and strengthening guidance documents. In my view, at the centre of the cases documented by Malpas's students[4] is a problem of cultural dissonance. What the clinicians feel is right does not align with the view of those writing the CS, students and patients. This is a good example of a culturally unsafe interaction, and it may be that the best way to approach quality improvement in this area is to focus on cultural safety. The New Zealand Medical Council Statement says:

> *"Cultural safety focuses on the patient experience to define and improve the quality of care. It involves doctors reflecting on their own views and biases and how these could affect their decision-making and health outcomes for the patient".*[17]

This would lessen the focus on the gaining of consent and put more emphasis first on the quality of communication (for how else can you understand the patient experience?) and secondly on the views and biases of the doctors. Examples of inadequate consent are usually related to the clinician (or student) exerting power, often unconsciously, over a patient who is unable or unwilling to object. The statement further notes:

> *"Doctors inherently hold the power in the doctor-patient relationship and should consider how this affects both the way they engage with the patient and the way the patient receives their care. This is part of culturally safe practice".*[17]

An important feature of cultural safety is the concept that it can only be judged at each interaction, and whether an interaction was culturally safe is a judgement of the patient.

Conclusion

The requirement for consent for teaching came about due to the extreme case of teaching being imposed on anaesthetised women without their knowledge. In that setting formal consent is required.

Issues relating to conscious patients are inevitably interwoven with communication, trust and relationship.

Patients need to agree to the involvement of any clinician in their care. The degree of focus on that agreement will vary according to the expectations of the patient, the quality of the existing relationship, and the extent of risk or inconvenience. An interaction conducted in a culturally safe manner is likely to be satisfactory.

We need to focus on the overall quality of care, on the quadruple aim. The patient experience and improved quality, safety and experience of care is important, but so is improved health and equity for all populations, best value for public health system resources, and improved clinician experience. This means that in any setting a judgement needs to be made as to the best course, and that judgement will not be the same for all people. We should maintain a broad view of quality rather than a narrow focus on just patient experience. We should strengthen the emphasis on culturally safe care by paying attention to eliciting patient views, being cognisant of power imbalances and the effects of unconscious bias. Such an approach holds more promise in improving the care of patients when involved with students than strengthening codes of practice.

COMPETING INTERESTS
Nil.

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www.nzma.org.nz/journal-articles/consent-for-teaching

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Doctors as leaders and governors

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ABSTRACT

Doctors working in healthcare are operating in complex adaptive systems that are unpredictable and have complex problems requiring new and unique skills. The Medical Council of New Zealand has specified a scope of practice for doctors involved in health system leadership, and there are several programs of studies that exist in Aotearoa New Zealand (Aotearoa NZ) to gain skills in this domain. It is crucial at this time of change that we understand why doctors as leaders and governors improve outcomes, the importance of training future medical leaders and how we validate these skills as well as the environment in which they operate. As we begin to reorganise our health system, the question we ask is when will we organise our system to recognise, develop and value these skills?

The health system in Aotearoa New Zealand (Aotearoa NZ) is implementing a significant reform agenda derived from the Health and Disability System Review.[1] Unique to the Aotearoa NZ context, a key challenge facing the system and central to the reform agenda is a drive to achieve equitable outcomes, particularly related to Māori, Pasifika, and disabled populations. The opportunity these reforms present is significant. In our previous editorial, we argued for a different approach to leadership and governance to ensure we make progress toward various goals.[2] Central to this is the requirement for diversity in leadership and leadership teams to support the drive toward equity and equitable outcomes.[2] The requirement for strong leadership and governance has never been more acute.

If the current reforms are to realise intended benefits, clinicians will need to contribute to the design and implementation of whatever flows from decisions made by Health New Zealand and/or the Māori Health Authority. Clinicians are also likely to play a role in leadership and governance of the system as the reform agenda continues to roll-out. In this article, our focus is on doctors as leaders and/or governors (medical leaders).

Various commentators have highlighted the importance of including doctors on design and development of future models of care.[3] This commentary highlights that there are compelling reasons to support the inclusion of medical leaders and governors in system design and operation, including improved patient outcomes.[1–3] Nonetheless, many questions arise, and these questions may include which doctors could or should be involved in this work, and how do we identify these doctors?

In recognition of the challenging environment ahead, in June 2021 the Medical Council of New Zealand issued the following advice with respect to the responsibilities of doctors in leadership and governance: "If you make decisions about resource allocation or services in an area outside your experience or expertise, or there are disagreements about whose needs should be prioritised, you should seek advice from colleagues with the relevant expertise".[4]

This advice, supported by an admonishment that the Council's standards on professional conduct would apply to doctors who take part, identifies two issues. The first is a degree of self-regulation, relying on doctors to recognise when they have left their field of expertise. The second relates to the ability to identify a colleague with relevant expertise.

Other jurisdictions such as the United Kingdom have also identified the importance of specific leadership and governance knowledge and skills for doctors in clinical director and head of department roles.[5] Here again, there is support for investment in and use of medical leaders to enhance system performance.[3,5]

In this article, we identify: (i) why leader and governor roles for doctors are important, and the environment in which doctors who want to lead or govern at a system level will need to operate within; (ii) how we train and develop doctors to perform in these roles; and (iii) how we validate the skills and knowledge required to perform these roles.

Doctors as leaders or governors

In any industry, effective leadership and governance requires some understanding of the technical content of the industry, a sound understanding of the skill set and discipline that is leadership and governance, and the ability to navigate through the

informal authority relationships of that industry.[6] Assessment against these criteria further supports the role doctors may play as leaders or governors within the health context[3,5,6] It also provides an opportunity to highlight that simply being of an industry—whether doctor, nurse allied health or any other—does not obviate the need to acquire, by some recognised means, a sound knowledge of management, leadership and governance. It is necessary, but not sufficient, to know how the clinical world functions.

In healthcare, matters are, however, further complicated by a peculiar privilege, namely the ability of doctors to direct the diagnostic and treatment course for any of their patients. For this reason, change without medical buy in often results in little-to-no change. This paradigm is increasingly challenged through empowerment of the consumer; however, the role of the doctor in any health system remains influential.[3]

For decades, the challenge of how to engage doctors and get them to lead has occupied many commentators. At the end of the last century, Scally and Donaldson coined the term "clinical governance" as a way in which some core part of the larger industry could be identified and used to drive improvement.[7] Though well intentioned, this also created problems. First, it set apart some part of the system as clinical and some as non-clinical, creating a division that has endured. Second, it allowed specific consideration of medical leadership to be conflated with clinical leadership, where the word "clinical" contracts or expands depending on the audience. Finally, it potentially widened and continues to reinforce the perceived gap between clinicians and managers, as well as contributing to the notion that leadership operates in isolation from the "shopfloor". Here again, we believe that medical leaders play a crucial role in bridging any perceived gaps, and in demonstrating that leadership must operate across all levels of and indeed, *through* the system.[2,5,8] As a symptom of ongoing failure to appreciate the importance and visibility of this skill in practice, there is often a view that doctors who enter into management have sold out and gone to the dark side. The very framing of this paradigm emphasises where we are coming from and where we need get to.

Rather than providing clarity and a way forward, these issues have continued to shape a situation where the requirements of doctors in leadership, management and crucially, governance are at best elusive and at worst poorly understood.

Doctors have always led and governed at clinical (individual practice) and departmental levels. These leadership positions play a crucial role in ensuring that the quality of care is appropriate. It is, however, important to note that the leadership and governance tasks associated with roles like this can be characterised as simple (not to be confused with easy) or linear, and/or at most complicated, using the Cynefin framework.[2] The leadership knowledge and approaches to manage these tasks can generally be extrapolated from training and experiential learning in the specialty. We note also that many potential leadership tasks in the complex domain[2,10] require broader leadership skills such as facilitation, delegation and enabling others.

There are major challenges to this way of working once medical leaders move into broader leadership roles. The first relates to how a single department starts to integrate into a larger system when the needs of a patient or group cannot be met by more traditional arrangements. The second challenge relates to when a doctor, who is a leader or governor in their own department, enters a sphere of influence that is greater and more complex than what they are familiar with (e.g., at an organisation or system level).

So, what exactly is this system level environment, and what do doctors need to know to lead and govern effectively?

Medical engagement and leadership at a system level

The health system exists to support and improve health and wellbeing outcomes for the individuals and populations that it serves.[8] As noted, equity in outcomes is at the forefront of the reform agenda in Aotearoa NZ.

Increasingly, healthcare systems and organisations are recognised as complex adaptive systems (CAS).[9] Effective leaders and leadership approaches at this level embrace complexity. The behaviours and actions characterising effective leadership in these environments are markedly different to simple or complicated domain leadership that are typically more familiar to doctors in leadership positions.

In health systems where doctors play active roles in governance and leadership at a whole of system level, as previously outlined, there is good evidence that system outcomes are enhanced.[3,5,10] An example of the interface of how this skill set and equity interface plays out almost every day is in deciding which health services are to be delivered and where. The passion and strength of argument employed by medical staff for their own patient's interests and their practice, often at incremental cost, are formidable. At times this demand almost overwhelms the system, and decisions are made using models such as garbage can decision making.[11] It will be almost impossible to build a system that identifies and assesses the rela-

tive merits of various new directions and demands in treatments and services without the involvement of people who not only will receive the service, but also of those who frame and drive the demand in the most visible manner.

If we are to deliver on the purpose of the healthcare system, engaging doctors as leaders or governors in the complex domain appears to be desirable. Whilst many would make this argument based on intuition or experience, what we know from evidence is that doctors need a different set of skills and knowledge when operating at a system or organisational level.[12] Empirically, this is difficult to refute given what is known about CAS and the operational characteristics these systems exhibit. Simple or complicated leadership approaches, knowledge, and applications generally do not work well in the complex domain.

Doctors as leaders or governors—how do we develop them?

Broadly, doctors may engage in leadership or governance at three levels: within their own specialty (e.g., Head of Department or Clinical Lead); at a sub-organisational or organisational level in their professional sphere (e.g., Chief Medical Officer or Medical Director); and at an inter-organisational or system level (e.g., Regional Lead). As we have previously outlined, the knowledge, content and capabilities required at each of these levels differ. If we accept that when doctors lead or govern at system or organisational levels they require different skill sets and knowledge to operate effectively, then it is important to understand how we train and develop doctors for these roles.[3,10]

For many doctors, progression in leadership does not necessarily follow a linear or structured pathway. It is important to acknowledge, however, the requirement for acquisition of practice capability whether the progression is linear through different levels or whether the path to leader or governor roles is more *ad hoc*.

Within the Aotearoa NZ context, in the absence of opportunities for a structured approach, a vacuum has developed. Within this vacuum, less structured approaches to entraining doctors into leadership have flourished. These approaches are sometimes more reflective of personality traits than a demonstrable body of knowledge and capability suited to the requirements of the role and the desired outcomes. Whilst there are examples where this less structured approach has worked well, this is inconsistent with standards across other specialties that have structured training requirements, and not consistent with the Medical Council of New Zealand's advice.

There is an existing pathway to expert medical practice in the field of medical leadership and management and an associated scope of practice set out in the regulatory framework that corresponds with this skill set across Australia and New Zealand. The Royal Australasian College of Medical Administrators (RACMA) is the College that manages this pathway and associated continuing professional development within this scope of practice.

Additionally, many opportunities outside of this formal pathway exist for training and experiential learning in leadership, management and governance. For example, clinicians have opportunities to develop skills through military environments, formal directorships where Institute of Directors requirements are in place, university or academic leadership environments, and/or increasingly commercial and industry environments. There are also a range of formal qualifications that offer learning in this domain for clinicians, including Masters in Business Administration, Masters in Health Management, and Masters in Leadership across a range of universities locally and internationally. Furthermore, the formal pathways that exist within leadership and management often have flexibility to recognise and accredit these training and experiential opportunities.

There are certain domains including financial management, system design and co-design; and operations management to name three, that are not explicitly taught in other medical specialty curricula. Some competencies in domains such as these are required in any leadership or governance function. We acknowledge that within many organisations and systems, partnership models where clinical leaders are paired with operations or general managers do exist and go some way to potentially cover for explicit knowledge in domains like this. However, it is not uncommon for leaders or governors to have stand-alone mandates that require competence in these domains.

Whilst there are specific domains or subjects that can be called out explicitly, the key principle is that the training and experience doctors have as they work to become specialist practitioners require and reinforce skills, knowledge, and patterns of practice that rely on simple or complicated paradigms for problem solving.[12] This is problematic when doctors are then called on to lead or govern in a CAS environment,[9] where we know different skill sets and knowledge are required to perform. In the absence of a structured approach or formal pathway as offered by RACMA, some thought must be given to how doctors acquire the skills they need at the different levels of leadership or governance, either as a part of their clinical career, or in developing a career in leadership. A useful output to sup-

port this process would be a framework to aid and guide development.

The framework below identifies buckets of skills and/or knowledge that doctors may need in leadership or governance capacities as they progress through their careers, or that would be beneficial in specific leadership or governance roles.[13] While a detailed review of specific knowledge and skills within these buckets is beyond the scope of this article, we see development and training across the relational (e.g., communication, meetings); operational (e.g., resource planning, contingency planning); and strategic (e.g., planning, needs assessments) as critical to enable progression through roles and functions.

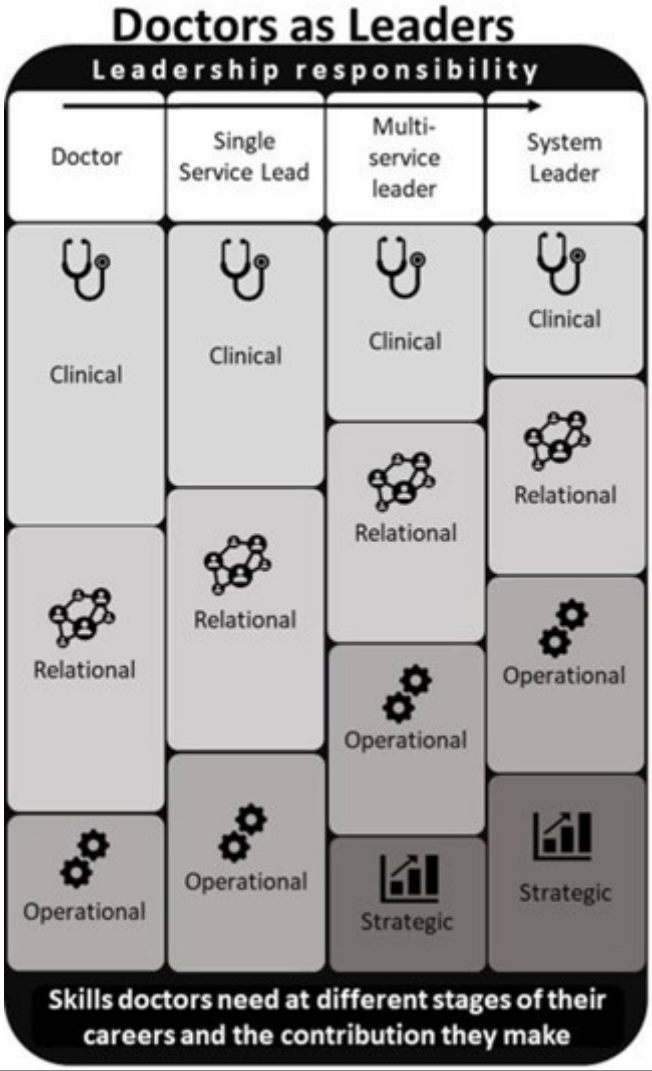
Verifying doctors as leaders and governors

The professional services a doctor can perform in Aotearoa NZ are defined by the scope of practice they are registered in.[14] Within these scopes, the Medical Council identifies what each scope of practice entails and the qualifications required for a doctor to attain registration in that particular scope.

At a clinical and departmental level, audit, quality assurance and quality improvement, are very often inherent within a scope of practice for multiple specialties. Leading these activities at a clinical or departmental level would fall within a defined scope of practice.

Within the context of a CAS, and when doctors operate as leaders or governors at a system or organisational level, the scope of these roles broadens. There is a strong argument that a clinical scope of practice does not adequately encapsulate the breadth of the leadership and administration tasks and knowledge required.[4] Additionally, there is arguably limited active management of the scope of practice where doctors are operating in a leadership or governance role at an organisational or system level. This approach is clearly at odds with the majority of specialty practices

Figure 1: Doctors as leaders / governors: skills framework.



for credentialing, and for managing specific scopes of practice. It is important to acknowledge the different standards that exist where doctors working at one-to-one patient level operate within tightly regulated guard-rails, whereas some operating at the system level do not have a similar level of regulation.

Given the inconsistencies and issues highlighted above, we see an opportunity to introduce a requirement for some form of credentialing for doctors to work within this domain. We believe this would again assist with further enhancing medical leader performance and consistency of performance across the system.

Strengthening and supporting pathways for doctors as leaders and governors

Doctors as leaders and governors can have a positive impact on overall health system performance. We must recognise this value and commit to measuring value and outcomes from these leadership approaches.

There are multiple pathways that exist today for doctors to build knowledge and skill in relation to complexity leadership. We need to enhance the flexibility and visibility of these pathways to ensure that individuals see them as viable, supported options to pursue. It is also critical that we increase competition for these pathways so that we can select the best candidates for these roles and positions. Many would argue that selection by default does not drive improved performance or outcomes. We have an opportunity to shift our thinking, our behaviours and actions to value these roles and opportunities which will lead to better outcomes for doctors in these roles, and also for the systems and organisations they serve.

Conclusion

The challenges and opportunities the health reforms present will require highly capable leadership and governance, at multiple levels. There is no doubt that a medical lens across these domains adds value and could ensure that we make advancements in key areas such as equity. Similarly, health systems anywhere, but particularly those that set out to deliver full coverage for their populations, have grappled for decades with rising costs and variation. Many have transitioned through several structures, and some have returned to previous structures in search of elusive solutions.

Doctors operating effectively as leaders or governors at a system level are part of the solution. We believe there are some key actions that can enhance the role doctors play as leaders and governors:

- Recognition that doctors leading or governing at different levels requires different skill sets and knowledge.
- Structured, supported and tested approaches to equip doctors with the skills and knowledge to perform in system level leader or governor roles.
- A framework that informs semi- or un-structured approaches for doctors whose careers evolve in such a way that a formal or structured award is not viable.
- A regulatory and credentialing framework that documents the capability and credentials of expert practitioners in the medical leadership or medical administration field.
- Measurement and monitoring of outcomes from practitioners that work in system level roles.

Leadership and governance are sometimes reduced to homilies that are as illuminating as they can be elusive. One of these is that leadership and governance can be summarised by the idea that we should work out what we are trying to do and then organise to do that. The steps that follow are then planning the work, working the plan, and managing the variances. Using this approach, it becomes obvious that if we are to assure ourselves and the public that we can supply doctors adequately trained in leadership and governance at all levels of endeavour, then there is a fair bit of organising to be done.

COMPETING INTERESTS
Nil.

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Trends in maxillofacial fractures in Otago-Southland, New Zealand: 2009 to 2020

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ABSTRACT

AIMS: Fractures to the maxillofacial region can have a serious impact on quality of life. The over-representation of males in the occurrence of almost all types and mechanisms of these injuries has tended to divert attention away from maxillofacial fractures in females. This study aimed to describe trends in maxillofacial trauma in a New Zealand tertiary trauma centre over a 12 year period, with a particular focus on gender differences.

METHOD: A retrospective audit was undertaken of records for maxillofacial fracture cases referred to Dunedin Hospital and Southland Hospital Maxillofacial Units during the period January 2009 to December 2020. Information on age, gender and ethnicity, aetiology, alcohol and/or drug involvement, fracture type, and management was obtained from the Southern District Health Board – Health Connect South Network.

RESULTS: Over the observation period, 1,561 patients presented for a total of 2,480 fractures. There was an increase in the proportion of fractures arising from falls and involving the orbit, while those due to interpersonal violence (IPV) or involving the mandible fell. Additionally, the proportion of cases treated conservatively rose, while the use of surgical fixation fell. While overall just over one in five patients were female, that proportion increased from one in six in 2009–2011 to one in four in 2018–2020. Fractures among females were due mainly to falls (55.6%) and road traffic accidents (23.2%), and frequently involved the orbit (46.3%). The proportion of presentations involving people aged 50 or older also increased over time.

CONCLUSIONS: A greater proportion of women are suffering from facial fractures in the past decade than they have previously. Public health interventions for those at risk and their families are necessary. Interventions should have a focus on preventing falls and domestic violence, with a particular focus on older people and Māori/Pasifika populations. Improved and continued monitoring of these changing patterns is important for addressing the issues they present to New Zealand.

Fractures to the maxillofacial region can have a serious impact on quality of life. Those suffering such trauma can experience severe morbidity, mortality, facial disfigurement, loss of function, psychological stress, and substantial financial costs.[1,2] Maxillofacial trauma places a serious burden on the New Zealand healthcare system.[3] The incidence of maxillofacial fractures and their associated costs have steadily increased over the last 11 years, to the point where the latter now exceed NZ$90 million annually.[4]

Historically, gender role differences have meant that males have disproportionately borne the burden of maxillofacial trauma, particularly that arising from road traffic accidents or workplace injuries.[5,6] In recent years, however, there have been indications that women's greater participation in traditionally male-only domains have also been reflected in changes in epidemiological patterns of maxillofacial trauma, as seen in Asia and South America.[7]

According to the United Nations, New Zealand ranks fourth in the world for gender equality, the only Asia–Pacific country in the top ten.[8] Recent reports demonstrate the gap in economic opportunity, educational attainment, and workforce opportunities in New Zealand is closing. The downward trends in road traffic accidents (RTA) and rise in interpersonal violence (IPV) and fall-related facial fractures seen in New Zealand are consistent with those in Europe.[9,7]

With major shifts in the role of females within our society we may see the gender gap within health patterns such as fracture presentations between males and females also draw closer.

This case series analysis describes sex differences in facial fracture occurrence by identifying trends in demographic characteristics, aetiology, distribution, and treatment of maxillofacial injuries in two New Zealand tertiary trauma centres over a 12 year period.

Methods

Data on consecutive patients presenting to Dunedin Hospital and Southland Hospital Maxillofacial Units

from January 2009 to December 2020 were collected. Information on age, sex and ethnicity, aetiology, alcohol and/or drug involvement, fracture type, and management was obtained from the Southern District Health Board – Health Connect South Network. Digitally recorded data were available only from 2009. The nature of the fractures was determined through available records and radiology reports. A report was obtained using search codes S02.1, S02.2, S02.3, S02.4, 2.60–69, S02.8 for facial fractures.

Patients whose fractures were confirmed on records were included, and those managed by the unit but with no reported fracture or with isolated soft tissue injuries were omitted from the current analysis. Those who had presented more than once during the observation period were treated as discrete cases. If aetiology had not been recorded, it was classified as unknown. Smaller ethnic groups (Māori, Pacific Island, Indian, Asian and Other ethnicity) were combined to make an "Other" ethnic category. Statistical analysis was undertaken using SPSS. Following the computation of descriptive statistics, comparisons were made using cross-tabulations and Chi-squared tests, with statistical significance set at $P<0.05$. All data used in this study had been de-identified and obtained from public records for audit purposes; as such, ethics approval was not required.

Results

There were 1,561 patients (with a total of 2,480 maxillofacial fractures), ranging in age from 1 to 97 years. While overall just over one in five were female, that proportion increased from one in six in 2009–2011 to one in four in 2018–2020 (Table 1). Males predominated in all age groups except for those aged 70+. Two thirds of cases were Pākehā. The lowest number of fractures was observed during spring, with the greatest number during winter; more fractures occurred during the autumn (March–May) and winter (June–August) seasons. Dunedin Hospital treated three quarters of the total number of cases, with its proportion rising steadily over the observation period.

Data on fracture aetiology, type and treatment are presented by period in Table 2. Across the observation period, there was an increase in the proportion of fractures arising from falls, while those due to interpersonal violence fell steadily. There was an increase in the proportion of cases treated conservatively, while the use of surgical fixation fell. There was an increase in the proportion of fractures involving the orbit and maxilla, in contrast to a marked decline in those involving the mandible. Alcohol was involved in a quarter of presentations overall. Despite the obvious impact of alcohol, there was no clear decrease or increase over the observation period.

Overall, orbital fractures were the most common (Table 3), accounting for almost a quarter of presentations. Falls were the most common reason for orbital fractures, involving one third, with interpersonal violence next, accounting for one quarter of orbital fractures. Just over half of the orbital fractures were managed conservatively. Maxilla-involved fractures were the second most common overall fracture type. Falls were, again, the most common reason for maxillary fractures, at one third. Interpersonal violence and road traffic accidents were next, each accounting for one fifth of maxillary fractures. Mandible fractures were the fourth most common fracture overall, and interpersonal violence accounted for almost one half of those. Surgical fixation was the most common treatment method overall. More than three quarters of mandibular fractures were managed surgically; by contrast, conservative management was particularly common for fractures of the skull, nose and orbit.

Māori/Pasifika individuals presented more due to IPV than any other aetiology (Table 4), representing a substantial proportion of total IPV-related maxillofacial fractures. Falls and IPV were the main causes among NZ Pākehā. A higher proportion of Māori/Pasifika presentations involved mandibular fractures or involved alcohol.

Data on sex differences by ethnicity, age group, season, location, alcohol involvement, and aetiology and fracture type are presented in Table 5. The proportion of females presenting with fractures was considerably higher in the older age groups, while males predominated in the younger age groups. A higher proportion of male fractures occurred during autumn (March–May) and during the summer (December–February) for females. The involvement of alcohol for females was one third of that for males. Falls and road traffic accidents were the most common cause for females fractures, whereas IPV and sport-related maxillofacial trauma were common for males.

Discussion

This case series analysis describes the changing trends in demographic characteristics, aetiology, distribution, and treatment of maxillofacial injuries managed in a New Zealand tertiary trauma centre over a 12 year period, with particular attention to sex differences. Our principal findings are largely consistent with emerging trends from studies in New Zealand[1,3,4,10,11] and in Europe.[7,6,9] Although just over one in five cases were female, that proportion increased from one in six in 2009–2011 to one in four in 2018–2020.

Table 1: Number of maxillofacial fracture cases for the periods 2009–2011, 2012–2014, 2015–2017 and 2018-2020 by demographic characteristics, season and location of treatment (brackets contain column percentages unless otherwise indicated).

	2009–2011	2012–2014	2015–2017	2018–2020	Total
Sex					
Male	303 (83.0)	313 (80.7)	288 (73.1)	307 (74.2)[a]	1,211 (77.6)
Female	62 (17.0)	75 (19.3)	106 (26.9)	107 (25.8)	350 (22.4)
Age group (years)					
0–19	77 (21.1)	68 (17.5)	57 (14.5)	57 (13.8)[a]	259 (16.6)
20–29	138 (37.8)	129 (33.2)	123 (31.2)	126 (30.4)	516 (33.1)
30–39	43 (11.8)	57 (14.7)	55 (14.0)	50 (12.1)	205 (13.1)
40–49	37 (10.1)	43 (11.1)	29 (7.4)	39 (9.4)	148 (9.5)
50–69	42 (11.5)	48 (12.4)	62 (15.7)	69 (16.7)	221 (14.2)
70+	28 (7.7)	43 (11.1)	68 (17.3)	73 (17.6)	212 (13.6)
Season					
Summer	95 (26.0)	93 (24.0)	98 (24.9)	92 (22.2)[b]	378 (24.2)
Autumn	110 (30.1)	102 (26.3)	117 (29.7)	86 (20.8)	415 (26.2)
Winter	78 (21.4)	108 (27.8)	95 (21.4)	125 (30.2)	406 (26.0)
Spring	82 (22.5)	85 (21.9)	84 (21.3)	111 (26.8)	362 (23.2)
Ethnicity[c]					
Pākehā	257 (73.0)	263 (69.6)	270 (68.9)	281 (68.2)	1,021 (69.8)
Other	95 (27.0)	115 (30.4)	112 (31.1)	131 (31.8)	463 (30.2)
DHB Location					
Dunedin	256 (70.1)	281 (72.4)	294 (74.6)	329 (79.5)[d]	1,160 (74.3)
Southland	109 (29.9)	107 (27.6)	100 (25.4)	85 (20.5)	401 (25.7)
All combined	365 (23.4)	388 (24.9)	394(25.2)	414 (26.5)	1,561 (100.0)

[a]P<0.001
[b]P<0.005
[c]27 patients had missing ethnicity data
[d]P<0.05

Table 2: Number of maxillofacial fracture cases for the periods 2009–2011, 2012– 2014, 2015–2017 and 2018-2020 by fracture aetiology, treatment, type and alcohol involvement (brackets contain column percentages unless otherwise indicated).

	2009–2011	2012–2014	2015–2017	2018-2020	Total
Aetiology					
IPVa	129 (35.3)	125 (32.2)	103 (26.1)	102 (24.6)[c]	459 (29.4)
RTAb	65 (17.8)	57 (14.7)	72 (18.3)	71 (17.1)	265 (17.0)
Falls	80 (21.9)	100 (25.8)	128 (32.5)	142 (34.3)	450 (28.8)
Sport	48 (13.2)	61 (15.7)	57 (14.5)	64 (15.5)	230 (14.7)
Other/Unknown	43 (11.8)	45 (11.6)	34 (8.6)	35 (8.5)	157 (10.1)
Treatment					
Conservative	134 (37.3)	157 (40.5)	209 (53.0)	209 (50.7)[d]	709 (45.7)
Surgical fixation	211 (55.4)	215 (55.4)	166 (42.1)	174 (42.2)[d]	766 (49.3)
Other	9 (2.5)	13 (3.4)	12 (3.0)	25 (6.1)	59 (3.8)
Died from injuries	5 (1.4)	3 (0.8)	7 (1.8)	4 (1.0)	19 (1.2)
Fracture type					
Mandible	128 (35.1)	123 (31.7)	101 (25.6)	96 (23.2)[d]	448 (17.8)
Maxilla	118 (32.3)	123 (31.7)	142 (36.0)	166 (40.1)[c]	549 (21.9)
Orbit	121 (33.2)	151 (38.9)	176 (44.7)	161 (38.9)[c]	609 (24.3)
Zygoma	127 (34.8)	138 (35.6)	139 (35.3)	141 (34.1)	545 (21.7)
Frontal	12 (3.3)	18 (4.6)	17 (4.3)	30 (7.2)	77 (3.1)
Dentoalveolar	5 (1.4)	11 (2.8)	10 (2.5)	16 (3.9)	42 (1.7)
Other	50 (13.7)	54 (14.0)	56 (14.2)	81 (19.6)	241 (10.0)
Alcohol involvement	84 (23.0)	108 (27.8)	92 (23.4)	101 (24.4)	385 (24.7)

Eight patients had missing treatment data; fracture totals do not sum to 1,561 because some individuals experienced more than one type of injury.
[a]Interpersonal violence;
[b]Road traffic accident.
[c]P<0.05
[d]P<0.001

Table 3: Type of maxillofacial fractures by fracture aetiology and treatment (brackets contain column percentages unless otherwise indicated).

	Mandible	Maxilla	Orbit	Zygoma	Frontal	Alveolar	Skull	Nose	Total
Aetiology									
IPV	209 (47.8)[a]	114 (21.0)	147 (24.3)[a]	125 (23.3)	7 (9.1)	7 (17.1)	5 (6.7)	51 (30.7)	665 (26.8)
RTA	59 (13.5)	121 (22.2)[a]	118 (19.5)	105 (19.6)	24 (31.2)[a]	13 (31.7)	25 (33.3)[a]	34 (20.5)	499 (19.7)
Falls	74 (16.9)	181 (33.3)	198 (32.8)	160 (29.9)	29 (37.7)	11 (26.8)	36 (48.0)[a]	50 (30.1)	739 (29.8)
Sport	70 (16.0)	75 (13.8)	82 (13.6)	96 (17.9)	8 (10.4)	6 (14.6)	4 (5.3)	12 (7.2)	353 (14.2)
Other	17 (3.9)	49 (9.0)	56 (9.3)	47 (8.8)	9 (11.7)	4 (9.8)	5 (6.7)	17 (10.2)	204 (8.2)
Unknown	8 (1.8)[a]	4 (0.7)	3 (0.5)	3 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.2)	20 (0.8)
Treatment									
Conservative	86 (19.2)	271 (49.7)	329 (54.5)[a]	201 (37.1)	38 (49.4)	10 (23.8)	53 (70.7)[a]	105 (64.4)[a]	1,093 (43.9)
Surgical	347 (77.5)[a]	254 (46.6)	255 (42.2)	321 (59.2)[a]	34 (44.2)	9 (21.4)	10 (13.3)	48 (29.4)	1,278 (51.4)
Other	15 (3.3)	11 (2.0)	10 (1.7)	8 (1.5)	1 (1.3)	23 (54.8)[a]	1 (1.3)	9 (5.5)	78 (3.1)
Injury death	0 (0.0)	9 (1.7)	10 (1.7)	12 (2.2)	4 (5.2)[a]	0 (0.0)	11 (14.7)[a]	1 (0.6)	39 (1.6)
Row total	437 (17.6)	544 (21.9)	604 (24.3)	536 (21.6)	77 (3.1)	41 (1.7)	75 (3.0)	166 (6.7)	2,480 (100.0)

Missing aetiology data in 25 patients and missing treatment data eight patients.
Totals do not sum to 1,561 because some individuals experienced more than one type of injury.
[a]P<0.00

Table 4: Ethnicity of maxillofacial fracture cases by aetiology, type and alcohol involvement (brackets contain column percentages, unless otherwise indicated).

	Pākehā	Māori/Pasifika	Other
Aetiology			
IPV	303 (28.3)	122 (44.9)[a]	32 (16.8)
RTA	171 (16.0)	41 (15.1)	50 (18.4)
Falls	340 (31.7)	41 (15.1)	54 (28.3)
Sport	137 (12.8)	50 (18.4)	42 (22.0)
Other/Unknown	120 (11.2)	18 (6.6)	16 (8.4)
Fracture type			
Mandible	289 (27.0)	99 (36.4)[b]	55 (28.8)
Maxilla	377 (35.2)	87 (32.0)	73 (38.2)
Orbit	431 (40.2)	96 (35.3)	69 (36.1)
Zygoma	371 (34.6)	86 (31.6)	76 (39.8)
Dentoalveolar	31 (2.9)	5 (1.8)	6 (3.1)
Frontal	48 (4.5)	12 (4.4)	14 (7.3)
Alcohol involvement	242 (22.6)	103 (37.9)[b]	36 (18.8)

"Other" has been collapsed to include only Indian, Asian and Other ethnic groups.
[a]P<0.001
[b]P<0.0

Table 5: Sex of maxillofacial fracture cases by ethnicity, age group, season, location, alcohol involvement, aetiology and fracture type (brackets contain row percentages).

	Male	Female
Ethnicity		
Pākehā	834 (77.9)	237 (22.1)
Non-Pākehā	360 (77.8)	103 (22.1)
Age group (years)		
0–19	214 (82.6)[a]	45 (17.4)
20–29	453 (87.8)[a]	63 (12.2)
30–39	176 (85.9)[a]	29 (14.1)
40–49	126 (85.1)	22 (14.9)
50–69	158 (71.5)	63 (28.5)
70+	84 (39.6)	128 (60.4)[a]
Season		
Summer	271 (71.7)	107 (28.3)
Autumn	341 (82.2)[b]	74 (17.8)
Winter	316 (77.8)	90 (22.2)
Spring	283 (78.2)	79 (21.8)
Location		
Dunedin	902 (77.8)	258 (22.2)
Southland	309 (77.1)	92 (22.9)
Alcohol involvement	347 (90.1)[a]	38 (9.9)
Aetiology		
IPV	426 (92.8)[a]	33 (7.2)
RTA	184 (69.4)	81 (30.6)[a]
Falls	256 (56.9)	194 (43.1)[a]
Sport	216 (93.9)[a]	14 (6.1)
Other/Unknown	105 (79.5)	27 (20.5)
Fracture type		
Mandible	385 (85.9)[a]	63 (14.1)
Maxilla	415 (75.6)	134 (24.4)
Orbit	447 (73.4)	162 (26.6)[a]
Zygoma	436 (80.0)	109 (20.0)
Dentoalveolar	32 (76.2)	10 (23.8)
Skull	57 (76.0)	18 (24.0)

Table 5 (continued): Sex of maxillofacial fracture cases by ethnicity, age group, season, location, alcohol involvement, aetiology and fracture type (brackets contain row percentages).

	Male	Female
Nose	121 (72.9)	25 (27.1)
Frontal	65 (84.4)	12 (15.6)
No. of sites fractured		
Single	711 (77.1)	211 (22.9)
Two	253 (77.1)	75 (22.9)
Three or more	247 (79.4)	64 (20.6)

[a]P<0.001
[b]P<0.005

Earlier New Zealand studies (1989–2013)[3,7,11] identified an incidence ratio of one in six and one in five for female facial fractures. A more recent analysis of case data collected from 2013– 2017[4] identified an incidence ratio similar to the current study's one in four. All of these studies showed a greater proportion of female fracture presentations over time, with the trend most apparent in the Waikato analysis by Moore et al.[11]

Males predominated in all age groups except for those aged 70+. Fractures of the orbit were more common for females, while mandibular fractures were the most common type observed among males. Across the observation period, there was an increase in the proportion of fractures treated conservatively and those arising from falls, while there were decreases in those managed with surgical fixation or due to interpersonal violence. The orbit was the most common fracture type and most frequently treated conservatively. Māori/Pasifika individuals presented more due to IPV than any other aetiology, and alcohol involvement was common in those cases. Falls and road traffic accidents were the most common fracture cause for females, whereas IPV and sports were more common for males.

There are some methodological issues to be taken into account before considering the study findings. First, the sample was restricted to the Southern health district, which has a smaller catchment population than those examined in previous studies (as well as being ethnically distinct),[1,3,4,10] and so the salience of the findings for other locations may be limited. Second, analyses of routinely collected data such as these invariably involve missing information, and that was indeed the case, with missing ethnicity and treatment data noted as a consequence of imperfect data entry in the Health Connect South Network. Fortunately, these were low in number and unlikely to have affected the findings. Conversely, strengths of the study include the length of the observation period and the range of data collected for each patient.

Turning to the findings, improved diagnosis may have contributed to the rising number of facial fractures detected in this study, possibly from un-displaced fractures in locations such as the orbit or maxilla. A higher proportion of computed tomography scans are being undertaken in New Zealand emergency departments,[12] and our observed increase in the proportion of cases treated conservatively, such as the orbit, suggests the un-displaced nature of some of these fractures,[7] along with the fact that a proportion of those may hitherto have gone undiagnosed.

The observed seasonal variations may in part have been due to hazardous road conditions or contact sports such as rugby seen during autumn–winter.[13] Globally, a higher incidence of sport-related facial injuries occurs in regions with higher participation in heavy contact sports such as rugby.[14] Although ball sports such as football and field hockey contribute more to female facial fractures in European countries,[15] this was not seen in the current study. Female fractures were more common during the summer months, and it is likely that an increase in social and outdoor activities and domestic tourism due to more favourable weather may be the cause of this.[9]

There were noteworthy trends in aetiology, with the contribution from interpersonal violence falling steadily over the observation period (from one in three to one in four), and an increase in the proportion of fractures arising from falls (from one in five to one in three). Part of the latter increase can be ascribed to demographic changes, with a steady increase in the older population meaning an absolute increase in the number at risk, over and above any possible changes in the acknowledged risk factors for

falls among older people.[16] As for the former, we are unable to identify any reason for that, other than perhaps ongoing changes in societal attitudes to assault (see below).

The most striking sex differences were in respect of fracture aetiology.[7] One analysis into road traffic accidents reported higher scores for driver aggression and thrill-seeking behaviour in males than in females.[17] Our findings may indicate that females may not be immune to such behaviours. Road-traffic accidents contributed to a substantial proportion of their facial fractures, and that may reflect hazardous driving behaviour. Within the rise in fall-related fractures among females, it is possible that aetiology may have been incorrectly recorded. The actual aetiology could have involved assault, given that violence against women can generate fear, shame, and low self-esteem which may influence their decision to report violence.[6,18] IPV-related facial trauma affecting females is mainly due to domestic violence (apparent in more than two thirds of cases).[19] Notably, the lifetime prevalence of domestic violence for NZ Māori females is three times that of their non-Māori counterparts.[19] Campaigns against interpersonal violence in New Zealand are therefore directed towards domestic violence, focusing on intimate partner and family/whānau relationships.

Falls impacted older females than males of any age, but most significantly among those aged 70 or older. The increase in female participation in traditionally male-only domains (such as driving, endurance sports, economic outdoor labour)[8] in the later stages of life will likely elevate their susceptibility to falls. Most fall-related fractures also occur at home,[21] and the likelihood of living alone increases with age, more commonly among females.[22] The increase in fractures involving older females is likely to have arisen from several factors: (1) the absolute increase in the number of older females (population at risk); (2) those females living longer (more time at risk); and (3) falls risk factors (such as polypharmacy, multimorbidity, disorientation and cognitive decline) becoming more operative with the increase in longevity.[16] Our ageing population, which is expected to increase by 75% over the next 30 years,[23] will put further pressure on the New Zealand health system. Prevention of domestic falls (especially among older females) should be emphasised. Fall prevention programs are available through most New Zealand DHBs and community health providers can also be useful in this respect.

Tong et al. (2010) reported that approximately 75% of facial fractures in the Otago Region between 2000 and 2005 involved alcohol; by contrast, it was involved in only 25% in the current study.[24] This apparent decrease may reflect ongoing reductions in hazardous drinking causing fractures in the region or perhaps errors in recording of alcohol involvement at the time of presentation to the emergency department. Currently, the Dunedin Emergency Department information system prevents discharging patients without recording essential data (such as smoking status and alcohol involvement). The impact of alcohol may be more serious due to the higher proportion requiring surgery, as seen with facial fractures from alcohol-related falls.[25,26] The involvement of alcohol in females' fractures in this study was only minor; however, at one point in New Zealand, peak injury rates for both sexes coincided with the legal purchasing age for alcohol.[1] It was a concern for young women, who were increasingly involved in alcohol-related road traffic accidents.[10] Drinking daily, however, increases with age and people aged 70+ are the most likely to drink daily.[27] Daily drinking is far more hazardous than episodic or binge drinking for health.[28] Daily impairment due to alcohol may alter behaviour that further increases the risk of fall, RTA or IPV related fractures. In the Middle East, where religious beliefs and the prohibition of alcohol have a significant impact on social activities, there is a less distinct association between alcohol abuse and facial fractures.[29] Alcohol-related facial trauma may be reducible through further restrictions to the legal purchasing age for alcohol, along with raising public awareness of the issues.

These changing trends in maxillofacial trauma among females highlight a risk for the health system and a need for intervention in this area. Women tend to use more services and healthcare funding than men;[30] the additional costs for care of facial trauma will only further increase their share of the burden on the health system. Screening tools for fracture risks at women's health clinics could be useful to identify specific needs for intervention. Interventions should focus on falls and interpersonal violence prevention, accounting for factors such as ageing and alcohol consumption, particularly within NZ Māori/Pasifika populations.

Further studies are necessary to investigate the accuracy of recording of falls as an aetiology in women presenting with facial fractures. Future studies would also benefit from more accurate information on the level and timing of alcohol intake at presentation, in order to improve the comparability of studies and to aid ongoing activities to reduce substance use.

Conclusion

Numbers of maxillofacial fractures continue to rise steadily, and a greater proportion of women are suffering from facial fractures than in previous decades. New Zealand needs a greater focus on falls prevention, along with measures to reduce interpersonal and domestic violence. Improving the recording of alcohol involvement would enable better insight into the health behaviours of those involved.

COMPETING INTERESTS
Nil.

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A red scaly patch diagnosed as hypomelanotic melanoma

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ABSTRACT

Early detection of melanoma is important and the diagnosis of amelanotic/hypomelanotic melanoma (AHM) is challenging. Nevertheless, dermatoscopy has been shown to improve diagnostic accuracy for non-pigmented skin lesions as well as pigmented lesions, and several algorithms for cutaneous neoplasms evaluation are available. We present a hypomelanotic melanoma detected on an asymptomatic patient at routine skin examination utilising a dermatoscopic decision algorithm. General practitioners, also known as primary care practitioners, are likely to be the first practitioners to encounter a skin cancer on a patient with further necessary actions.

An asymptomatic 70-year-old male bus driver with phototype-2 skin was offered a total body skin examination following treatment of two keratinocyte carcinomas of the face. He had a history of a targeted skin examination of a leg elsewhere, two years previously, and had no significant co-morbidities.

Examination discovered an ordinary scaly dermatosis-like erythematous patch, but it was solitary, measuring 14mmx10mm with no clinically evident pigment, on the abdomen in the context of surrounding angiomas together with some naevi and seborrhoeic keratoses (Figure 1). Dermatoscopically (Figure 2), it was not possible to render a confident diagnosis of any common benign lesion (naevus, benign keratinocytic lesion, haemangioma, dermatofibroma or dermatosis) by pattern recognition. Although there was very subtle structureless brown pigmentation visible dermatoscopically on one section of the periphery, the lesion was regarded as essentially amelanotic, and was assessed by the "prediction without pigment" decision algorithm (Figure 3).[1,2] There was no evidence of ulceration (the first assessment in the algorithm) but white clues (polarising-specific white lines) and also polymorphous vessels with patterns of both linear and dot were present. According to "prediction without pigment", any of these described features in a lesion of concern, mandate histological assessment. An excisional biopsy with 2mm peripheral margins undermined in the fat layer was performed as per published guidelines.[3,4] Specifically, a polymorphous vessel pattern including both linear-irregular vessels, along with a pattern of dot vessels in the background of milky red, pointed to melanoma as a possible diagnosis.[2]

Dermatopathological examination revealed an invasive superficial spreading melanoma, Clark level IV, Breslow thickness 1.5mm. The patient was referred to a tertiary facility for further management.

Discussion

Amelanotic/hypomelanotic melanoma (AHM) is descriptive term for melanomas, in which amelanotic means absence of melanin and hypomelanotic melanoma implies low levels of melanin that may extend to the entire lesion. In addition, a partially pigmented melanoma has pigmentation occupying less than 25% of the lesion.[5,6] The prevalence of AHM is estimated to be 2–8% of all melanomas.[6,7] AHM can present with wide range of deceptive appearances such as of inflammatory dermatoses and various skin neoplasms (see Box 1), and therefore, it is called sometimes "the great masquerader".[7] As a result, it poses diagnostic challenges, typically, as in the current case, with delayed presentation, diagnosis and treatment.[5–7]

The current case demonstrated some unexpected features such as the presence of scales while other features such as location in a sun-protected area were typical for superficial spreading melanoma. Being hypopigmented, the lesion did not fulfil the criteria of ABCD (asymmetry, border, colour, and diameter) apart from being greater than 6mm in diameter, or the EFG criteria (elevated, firm and growing). However, dermatoscopic features of white lines and polymorphous vessels (including both linear and dot patterns) on a background of structureless milky red, led for suspicion, as specified in several publications,[2,5–7] although they are not pathognomonic signs for AHM.[8] While there is lack of well-established criteria to detect AHM early, it would be prudent to have a low

threshold for biopsy of hypopigmented lesions when a confident specific benign diagnosis cannot be made by dermatoscopic pattern recognition. This case also highlighted the important tool of the dermatoscope (dermoscope, surface microscope, epiluminescence microscope) and the utility of decision-making algorithms in early detection of skin cancers including difficult AHMs, and the minimisation of unnecessary biopsies of benign lesions.

A variety of algorithms to assist in the diagnosis of pigmented malignancies have been published, but one of relevancies to the current case is a decision algorithm designed specifically for non-pigmented lesions, "prediction without pigment" (Figure 3). For overview and details of this method, we recommend this resource: https://dermoscopedia.org/Prediction_without_Pigment.

Despite no evidence base for mass skin cancer screening, in general, people with high risks of developing melanoma and non-melanoma skin cancers should be encouraged to perform 3–4 monthly self skin check with 12 monthly full skin examination by a trained professional.[9] Risk factors for skin cancers include skin phototype 1 and 2, past and family history of skin cancers, multiple naevi (>100) or large/atypical naevi (>5), solar keratosis (>20), immunocompromised patients and occupations with high UV index exposure.[9–11] In terms of screening age, there are no universally defined guidelines. Generally, skin cancer is rare in younger age, and a US study (2017) recommended risk-stratified screening for persons aged 35 to 70 years.[12] Recommendations are not prescriptive, and the clinician should exercise discretion and regular screening should be offered routinely to those with a history of previous skin malignancy and no patient requesting a skin examination should be denied.

The ideal method of biopsy for a suspected melanoma is a complete excision with 2mm peripheral margin including fat layer in order to avoid a false negative report, as specified in the Australia and New Zealand guidelines.[3,4] Sometimes, partial biopsy (punch, shave or incisional biopsy) may be employed for larger lesions, those on acral sites or other difficult locations where an excisional biopsy may have unwanted functional or cosmetic outcomes, or in patients with significant comorbidities.[3,4]

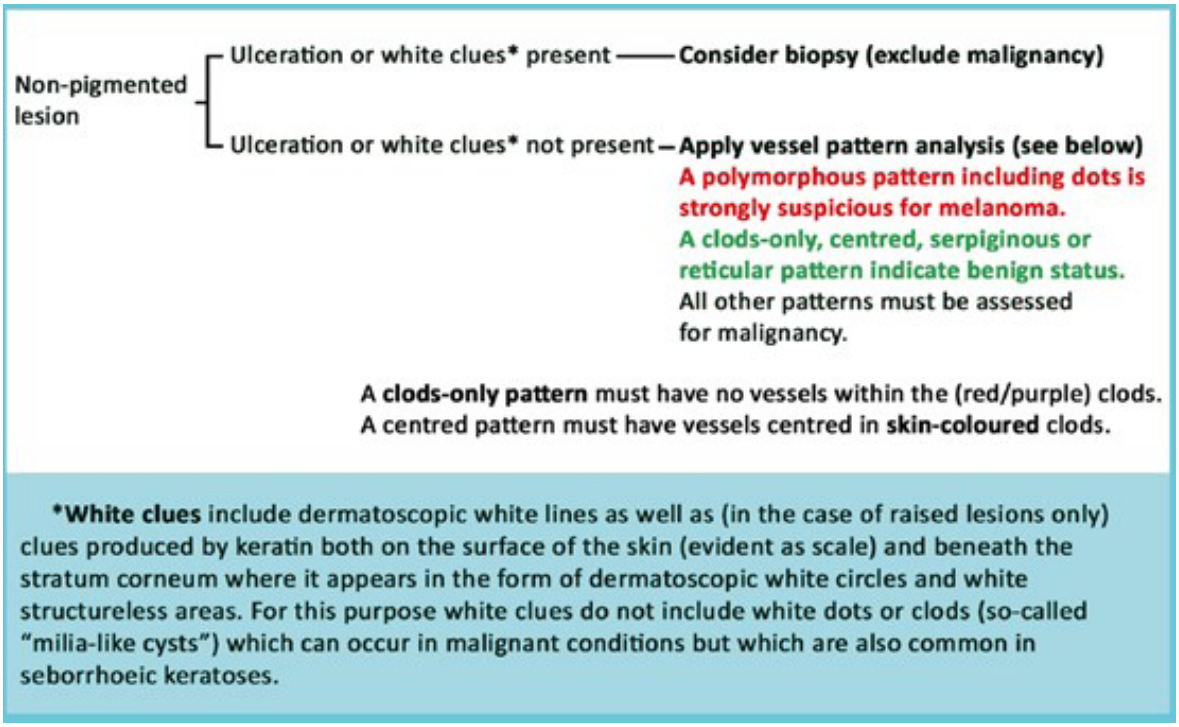
Summary lessons or key points:

- AHM can present with scaly dermatosis-like erythematous patch or plaque, in addition to nodular appearance with or without ulceration, but an unusual solitary lesion should draw a proper evaluation with histology assessment.
- Diagnosis of AHM remains challenging, and late presentation and misdiagnosis are not uncommon.
- Dermatoscopic polarising-specific white lines and polymorphous vessels including both linear and dot patterns on the background of milky red, are helpful for suspicion of melanoma.

Figure 1: A red patch of abdomen wall.

Figure 2: Non-compressed polarised dermatoscopic features prior alcohol swab emersion. Black arrows=scales; Black circles=linear-irregular and hairpin vessels; Yellow rectangles=dotted and comma vessels.

Figure 3: Prediction without pigment: a decision algorithm.



Adapted from "Dermatoscopy and Skin Cancer: a handbook for hunters of skin cancer and melanoma" Rosendahl and Marozava. 2019. Scion publishing (used with permission).

Box 1: Conditions which can mimic amelanotic/hypomelanotic melanoma.

Benign conditions:	**Malignant conditions:**
• Naevus	• Basal cell carcinoma
• Angioma	• Bowen's disease
• Dermatofibroma	• Squamous cell carcinoma
• Pyogenic granuloma	• Keratoacanthoma
• Seborrhoeic keratosis	• Merkel cell carcinoma, etc.
• Actinic keratosis	
• Wart	
• Inflammatory dermatosis, etc.	

COMPETING INTERESTS
The authors have no conflicts of interest. Cliff Rosendahl is a co-author of "Dermatoscopy and Skin Cancer: a handbook for hunters of skin cancer and melanoma" for which he receives royalties.

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The first Aotearoa New Zealand case of NUDT15-variant-related thiopurine-induced myelotoxicity

Ho Nam Lee, Steven Leslie Ding

ABSTRACT

A 37-year-old Han Chinese man, with a history of severe ulcerative colitis with incomplete response to oral glucocorticoids, was commenced on azathioprine [AZA] 200mg once a day. His pre-treatment thiopurine S-methyltransferase [TPMT] levels were in the normal range. Eleven days later he developed symptoms of stomatitis and gingivitis. Chinese herbal medications were taken in an attempt to treat these symptoms. He presented to the emergency department with this, with normal vital signs. A full blood count five days post-onset of symptoms showed pancytopenia with an absolute neutrophil count [ANC] of 0.0x10(9)/l, C-reactive protein was 120 mg/L. Initial chest radiograph, urinalysis and peripheral blood cultures were unremarkable and he was commenced on broad spectrum antibiotics and granulocyte colony stimulating factor [G-CSF]. He remained an inpatient under the gastroenterology team for 16 days and developed infectious complications of herpes simplex stomatitis, oral candidiasis, dental abscess, and scalp abscess. On day 16 his ANC recovered to 1.0x10(9)/L and was discharged from the hospital. He underwent nudix hydrolase 15 [NUDT15] genotyping and was found to have homozygosity for the variant NUDT15:c.415C>T. This case demonstrates the importance of pre-treatment testing for NUDT15 genetic variants, to predict the risk of severe leucopaenia, particularly in a patient of East Asian ethnicity.

Thiopurines, such as azathioprine, 6-mercaptopurine, 6-tioguanine, are used commonly as steroid sparing agents and immuno-supressants for many auto-inflammatory conditions such as inflammatory bowel disease [IBD], anti-neutrophil cytoplasmic antibody [ANCA] associated vasculitides, rheumatic conditions, and solid organ transplantation.

Their side effects include gastrointestinal symptoms, acute pancreatitis, myelosuppression, and neoplasms. Patients are routinely screened for TPMT genetic polymorphisms prior to commencing therapy with azathioprine to predict the risk of severe myelosuppression and azathioprine intolerance. Recently, genetic testing for polymorphisms in the enzyme NUDT15 has attracted interest as another predictor of severe myelosuppression, especially in East Asian patients.

We describe the first case of severe myelotoxicity related to a NUDT15 genetic variant in Aotearoa New Zealand.

Case presentation

A 37-year-old Han Chinese gentleman with a recent diagnosis of severe ulcerative colitis with incomplete response to oral steroids was started on AZA 200mg once a day following normal TPMT serum levels as part of pre-treatment screening. Eleven days later he developed stomatitis with pain on chewing and swallowing. He also noticed alopecia, right post-auricular swelling, pain and serous discharge from the vertex of the scalp. He had ongoing diarrhoea, albeit improved with oral prednisone. He had no respiratory, genito-urinary, musculoskeletal, cutaneous, or B-symptoms. Chinese herbal medicines were commenced at this time by the patient for these symptoms. On day 16 post-commencement of AZA he obtained a blood test which revealed a new pancytopaenia with an ANC of 0.0x10(9)/L. He was contacted that night and in the absence of concerning symptoms, was advised to present to the emergency department at Christchurch Hospital the following day, to be seen by the gastroenterology team for assessment and treatment.

His vital signs were all within normal range and clinical examination revealed gingivitis and mucositis of the oral mucosal surface. There was no oral thrush. The right post-auricular area was indurated and tender to touch with no fluctuance or discharge.

Investigations

Upon admission the full blood count showed an ANC of 0.01x10(9)/L, with a total white blood cell count of 0.9x10(9)/L, a platelet count of 55x10(9)/L and a haemoglobin level of 108g/L. The mean cell volume was normal at 94fL. His mouth swab revealed presence of herpes simplex virus as well as growth of *Candida albicans*. Non-contrast computed tomography scan of the head did not reveal any evidence of mastoiditis or extra-axial collection. His chest radiograph did not show any evidence of a pneumonic

process. An orthopantomagram revealed periapical lucency about the mesial root of tooth 46 that could have represented an abscess. Faecal samples had no evidence of viral or bacterial infection. The urinalysis had no pyuria with white cells less than 10x10(6)/L and there was no growth on culture. Numerous pre-antibiotic peripheral blood cultures exhibited no growth. He was also negative for hepatitis A, B, C, and human immunodeficiency virus. Cytomegalovirus DNA in the plasma was also undetectable.

NUDT15 genotyping revealed that the patient was homozygous for the variant NUDT15:c.415C>T.

Progress and treatment

Broad spectrum intravenous antibiotics were commenced following peripheral blood culture collection upon admission. AZA was ceased at admission while daily subcutaneous G-CSF 300mcg, oral fluconazole 50mg and 8-hourly intravenous acyclovir 800mg initiated. Dental extraction of infected tooth 46 under local anaesthetic by the dental team was completed, which was uneventful.

Due to ongoing pain in the temporo-occipital region of the scalp an ultrasound scan was performed which showed a small, complex soft tissue fluid collection measuring 23mm in length and 4mm in depth. Ultrasound-guided aspirate of this scalp collection was performed with a gram stain showing numerous leucocytes with no organisms and no growth in culture.

A sample of the herbal medicines was taken for toxin analysis and was negative for heavy metals or active drugs. There was no evidence for interaction between these and AZA, nor alteration of TPMT activity or direct myelotoxicity.

He remained an inpatient for 17 days total, with daily monitoring of full blood counts and inflammatory markers (please see Table 1). G-CSF was continued until ANC was above 1.0x10(9)/L for two days. After cessation a reduction in ANC was observed the following day, however, this improved in the following days despite continued cessation of G-CSF.

He completed the full course of antibiotics and anti-fungals while an inpatient and was discharged from hospital with an ANC of 1.0x10(9)/L and a short course of oral acyclovir. Full blood count monitoring continued in the community which showed improving pancytopaenia (Table 2). Follow up in clinic three months following discharge from hospital confirmed that the patient was clinically well.

Discussion

DNA variants in the TPMT gene have been described which can lead to a reduction in TPMT enzymatic activity and metabolism of thiopurines and their metabolites. As a result, life-threatening myelotoxicity can complicate thiopurine therapy. Ninety percent of Caucasians have high or normal TPMT activity, whereas 10% have intermediate activity and 0.3% have low or no detectable enzyme activity.[1–4] Inter-ethnic variations have been described with 5% of East Asians having intermediate enzyme activity and 0.12% having low or undetectable activity.[5]

Although the frequency of TPMT mutations is lower in East Asian populations the frequency of thiopurine-induced leucopaenia can be higher.[6–8] Genome wide association studies [GWAS] in IBD adult patients in Korea, and acute lymphocytic leukaemia paediatric patients in North America, has led to the discovery of genetic variations of the NUDT15 enzyme in patients with thiopurine-induced leucopaenia.[9,10] Subsequent retrospective studies in China and Japan have investigated NUDT15 genetic polymorphisms and its role in thiopurine-induced leucopaenia in IBD patients.

In contrast to TPMT mutations, NUDT15 mutations are found more commonly in East Asian patients than that of Caucasians. The incidence of NUDT15 allelic mutations in East Asian populations is between 8.5–16%.[11,12] In Caucasians it is less than 1%.[10] To date, there are no data in the literature regarding NUDT15 polymorphisms in the Māori and Pacific Island populations.

The Clinical Pharmacogenetics Implementation Consortium have released guidelines for thiopurine dosing based on NUDT15 genotypes.[13] For a NUDT15 intermediate metaboliser patient, AZA should be commenced at a starting dose of 30–80% of normal dose with regular monitoring. However, in a NUDT15 poor metaboliser, it is recommended that an alternative non-thiopurine immuno-suppressant should be considered for non-malignant conditions (such as IBD), while for malignant conditions a starting dose of 10% of normal dose is recommended.

Conclusion

This is the first case, in Aotearoa New Zealand, of severe thiopurine-induced leucopaenia associated with a patient who was found to be a NUDT15 poor metaboliser. We recommend pre-treatment genotype testing of TPMT in all patients. In addition, all East Asian patients are recommended to have NUDT15 genotype testing prior to initiation of a thiopurine to estimate the risk of myelosuppression. In the Caucasian population NUDT15 testing should be considered in patients who develop myelosuppression. Currently there is limited data in relation to the genotype and phenotype of NUDT15 polymorphisms in the Māori and Pacific Island populations and further studies in these ethnic groups would be beneficial.

Table 1: Full blood count monitoring during inpatient admission.

	Day prior to admission (D-1)	D0	D1	D3	D5	D7	D9	D11	D13 (G-CSF ceased)	D15
Haemoglobin (g/L)	109	108	96	97	88	93	81	76	95	97
Platelets (x10(9)/L)	76	55	30	22	42	59	67	64	77	69
White blood cells (x10(9)/L)	0.4	0.9	0.02	1.0	1.0	1.3	1.4	1.6	2.9	2.5
Neutrophils (x10(9)/L)	0.0	0.01	0.02	0.01	0.06	0.22	0.38	0.7	1.1	0.9

Table 2: Full blood count monitoring post discharge.

	Day 2 post discharge	Day 10 post discharge	One month post discharge	Two months post discharge	Three months post discharge
Haemoglobin (g/L)	88	89	100	121	126
Platelets (x10(9)/L)	91	188	247	133	102
White blood cells (x10(9)/L)	2.4	3.8	3.9	3.2	3.1
Neutrophils (x10(9)/L)	1.4	2.6	1.4	1.1	1.3

COMPETING INTERESTS
Nil.

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Current role of sentinel lymph node biopsy in early-stage melanoma

Gareth Rivalland, Rosalie Stephens, Michael McCrystal

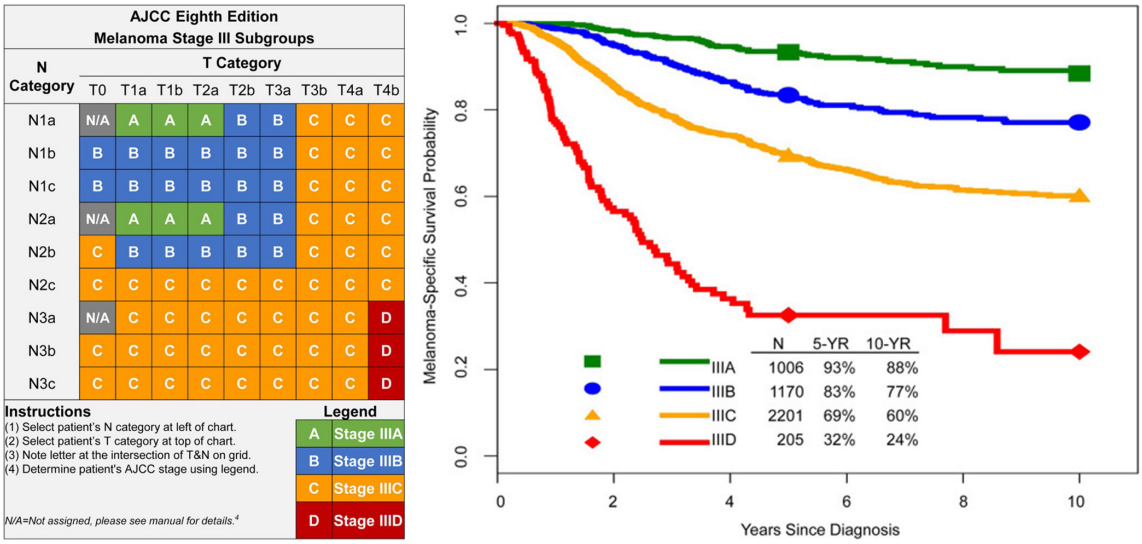
There has been significant evolution in the management of surgically resectable melanoma the past five years with the success of adjuvant therapy for stage 3, and more recently, high-risk stage 2 melanoma. In the context of these recent changes, the role of sentinel lymph node biopsy (SLNB), which has been debated for many years, has come under the spotlight again.

The issues underlying the differing opinions regarding SLNB are borne out in the MSLT-1 and MSLT-2 studies of SNLB and completion lymph node dissection (CLND).[1,2] The MSLT-1 trial found that, although a positive sentinel node was a poor prognostic sign, SLNB did not independently improve 10 year melanoma-specific survival. MSLT-1 did, however, confirm sentinel node status as the most important prognostic factor in intermediate-thickness melanomas,[1] and in patients without clinically detected lymph node involvement, it remains the best single predictor of melanoma-specific survival.[1,3]

The impact of nodal involvement is reflected in the eighth edition of the American Joint Committee on Cancer (AJCC) melanoma staging. In this most recent staging system, an accurate stage cannot be allocated to a patient with melanoma >1.0mm Breslow thickness in the absence of the results of SLNB assessing clinically occult nodal disease. A comparison of 10 year survival rates for stages IA and IIC is illustrative as survival was 93% and 39%, respectively, using the AJCC seventh edition (which did not require SLNB) compared to 98% and 75% with the eighth edition.[4,5] Accurate nodal staging offers improved prognostication within this heterogeneous group of patients. For instance, the presence of sentinel lymph micrometastases in a patient with a 2mm Breslow thickness ulcerated cutaneous melanoma decreases 10 year survival from 89% to 60%, mandating significant changes in follow-up and adjuvant treatment.

The subsequent MSLT-2 trial showed that completion lymph node dissection (CLND), following a positive sentinel lymph node, did not improve melanoma-specific survival. It was, however, associated

Figure 1



Note: AJCC 8th edition showing updated staging classification and melanoma specific survival based on Stage IIIA–D. Ref: Gershenwald et al. Melanoma Staging: AJCC 8th Edition *CA: A Cancer Journal for Clinicians* 2017:67(6):472–492[5]

with an increased rate of complications compared with ultrasound observation, especially lymphoedema which occurred in 24% versus 6%.[2] These trials show that, although SLNB does not have an independent therapeutic benefit in early-stage melanoma, it does provide vital prognostic information.

Recent trials of PD-1 inhibitor immunotherapy and BRAF/MEK tyrosine kinase inhibitors in stage 3 melanoma proved definitively the benefit of adjuvant therapy.[6,7] The KEYNOTE-054 and the CheckMate-238 trials showed that one year of adjuvant pembrolizumab and nivolumab significantly reduced relapse in stage 3 melanoma.[6,8] Inclusion in these trials was based on the AJCC staging and required lymph node metastasis. Adjuvant immunotherapy has become a cornerstone in the of treatment of early-stage disease as these trials show sustained benefit in relapse-free survival (RFS hazard ratio of 0.56). Adjuvant immunotherapy has become standard of care in Australia, USA, and Europe[9–12] for patients with stage 3B melanoma and above (assessed by SLNB status) but is still not funded by PHARMAC in New Zealand.

Furthermore, the recent KEYNOTE-716 trial in high-risk stage 2 melanoma (pT3b–pT4b) also showed a benefit in adjuvant therapy.[13] However, the absolute risk of disease recurrence was far less in stage 2 (16.9% at 12 months without treatment), compared with stage 3 disease (39.2% at 12 months without treatment). When weighing the relative benefits and risk of adjuvant therapy, SLNB provides fundamental prognostic information to inform patient and clinician choice.

One of the criticisms of SLNB is that it does not account for distant haematogenous spread, and is of limited utility. This is a valid critique, but there are no clinically validated prognostic risk models superior SLNB.[14] Until we have improved risk assessment tools, such as molecular assessment of the primary melanoma or composite tools (not currently available), validated in adjuvant clinical trials, it is our position that SLNB remains a critical element in the management of early-stage melanoma. The prognostic information SLNB provides allows patients and their doctors to make informed decisions about adjuvant therapy, especially given the current cost of adjuvant therapy in New Zealand.

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Nil.

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Medical Education

NZMJ editorial, June 1922

Professor Calmat-Jones, in another part of this number of the Journal, states that our editorial in the last issue indicates some degree of misconception about the proposed extension of the medical curriculum to six years, and he points out our error in supposing that the extra year is to be devoted to clinical work. Professor Calmat-Jones is right, and we are obliged to him for drawing attention to the misconception, but how did the misconception arise? By our confidence that the authorities in the Dunedin Medical School would pay heed to the recommendation of the New Zealand Branch of the B.M.A., which, when the matter was very properly referred to the Association by the University Senate, resolved "to support the proposal to extend the curriculum, with a recommendation that the additional time be devoted as far as possible to final examination subjects." The scheme as now finally adopted, was explained to the members of the Association, and met with no favour, and what is this scheme but, at the behest of the teachers of the immediate and first professional subjects, to add another year to the curriculum for their disposal except for a paltry three months that is given to the additional study of the subjects of the final examination. "The demand for lengthening the course does not come from the clinical teachers at all," is the candid admission of Professor Calmat-Jones. So to speak, the tail is wagging the dog, and as regards the result the B.M.A recommendation has had no effect. We have every respect for the expert knowledge of the Dean and Medical Faculty on questions of medical education, but apparently their control is limited by the demands of teachers who are not medical practitioners, and the opinion of the whole body of the profession, as expressed by the Medical Association, on the subject of medical education is entitled to respect only a little inferior to that due to the views of the Dean and Faculty. We make bold to say that the consensus of opinion of medical practitioners in New Zealand is that the graduates of the Otago Medical School have had quite enough lecturing and too little clinical experience, and yet under the new curriculum students are to submit to a further spoon-feeding, and so many lectures are to be stuffed into the sixth year that it will be impossible for students to leave Dunedin, and obtain clinical work and experience in larger hospitals in New Zealand elsewhere than in Dunedin. The hope of improvement as put forth in our last editorial is vain. The door at present is shut and belted in our faces.

Professor Calmat-Jones says "clinical teachers desire to see all students qualified at the earliest possible moment in order that they may do the kind of work implied in your article." Very well, why then add a sixth academic year; or if a sixth year is added, why devote it to anything but the kind of work implied in our article? The letter of Professor Calmat-Jones is really a strong indictment against what is being done in the new Dunedin scheme to the surprise and disappointment of the members of the meeting at Napier. Cannot the authorities at Dunedin arrange their curriculum so as to leave even six months clear for students to do ward work in other hospitals under the supervision of honorary staffs? Cannot these students be well employed in case-writing, writing commentaries, and having some responsibility put upon their shoulders instead of being stuffed like Strassburg geese? The Newcastle hospital is a clinical school for medical students of Sydney University where also both the Prince Alfred and Sydney hospitals are available for clinical instruction.

The professors and lecturers in the Dunedin, or as it may yet be called the New Zealand, Medical School, have had years of experience and success in medical teaching, and they may think it presumption for certain people to rush in where angels fear to tread, and the inferential rebuke is not wholly lost on us, but hear what the President of the Secondary Schools Association for New Zealand has to say: "Our aim must be to generate the faculties of self-reliance, of initiative, and of constructive thinking. We should welcome the dynamic principle in education, curb our undue lecturing and mothering propensities, equip our pupils with the tools of education—give them objectives, and let them go ahead." This opinion from a high authority

on education is not at all inconsistent with our own, or with the opinion of the Medical Association as clearly expressed at the Napier meeting, or with the views of a number of New Zealand medical men outside Dunedin who have recently sent their sons to study medicine at the British Medical Schools. If we are sunk in ignorance we are at least in some prospect of being buoyed up with hope, the hope that the Dunedin Medical School that has done well will yet do better by amending the new curriculum devised against the advice of the profession generally.

Abstracts for the 261st Otago Medical School Research Society Summer Student Speaker Awards, Wednesday 4 May 2022

The role of prolactin in the small intestine during pregnancy and lactation

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Pregnancy is a metabolically demanding state with many adaptations in maternal physiology required for optimal outcomes. Marked increases in the hormone prolactin (and placental lactogen) are characteristic of this state. Prolactin receptors (Prlr) are found throughout the body, including the small intestine (SI), where nutrients are absorbed. During pregnancy, mice increase their absorptive capacity for nutrients through morphological changes in the small intestine (SI), such as increased length of villi and length of SI, that results in increased total surface area. Combined with the hyperphagia of pregnancy/lactation, this means more energy consumed is absorbed. Based on this, we hypothesised that during pregnancy, Prlr contributes to pregnancy-induced adaptations in the SI and that failure of these adaptations leads to alterations in feeding behaviours.

Using a cage system that automatically monitors food intake, we assessed feeding patterns across pregnancy in transgenic mice with deletion of Prlr from the SI ($Prlr^{lox/lox}/Vil^{Cre}$). Both control (n=4) and $Prlr^{lox/lox}/Vil^{Cre}$ mice (n=10) showed pregnancy-induced increased food intake (mixed effects analysis: P=0.0058). However, pregnant $Prlr^{lox/lox}/Vil^{Cre}$ consumed more food in the dark phase (when mice typically consume most of their food) than pregnant controls (mixed effects analysis: P=0.0498). Interestingly, controls and $Prlr^{lox/lox}/Vil^{Cre}$ mice did not differ in bodyweight gain across pregnancy (mixed effects analysis: P=0.2448), suggesting that without Prlr function in the small intestine, presumably to drive changes in SI absorptive capacity, $Prlr^{lox/lox}/Vil^{Cre}$ must increase their food intake to meet the energy requirements of pregnancy.

Our results show that prolactin action in the small intestine during pregnancy leads to changes in feeding behaviours. This suggests that during pregnancy, prolactin acts within the small intestine to aid successful pregnancy by helping create a positive energy balance state.

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Reliability of remote gait and balance assessment of people with Parkinson's disease

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Parkinson's disease is a movement disorder that increases fall risk. Clinicians administer several validated gait and balance tests for people with Parkinson's disease in person. COVID-19 has reduced healthcare access, and this has disproportionately affected older populations. We tested the reliability of remote gait and balance assessments of people with Parkinson's disease using face-to-face as the comparator.

Fifteen people with Parkinson's disease (aged 57–82, 11 males) performed 14 tests of gait and balance twice: (i) face-to-face, and (ii) remotely, via videoconference between 7 and 14 days after. A trained physiotherapist rated participant performance. The tests included items from the Berg Balance Scale, Functional Gait Assessment, and the Timed-Up-And-Go. These assessments have been validated face-to-face for people with Parkinson's disease. The videoconference assessment was recorded. We compared face-to-face and live videoconference performance to obtain assessment reliability. The physiotherapist rated the recording at least two weeks after the live videoconference to obtain intra-rater reliability. A second rater assessed the recording, and we compared live and recorded telehealth assessments to obtain inter-rater reliability. Reliabil-

ity was measured using either intraclass correlation (ICC) two-way mixed with absolute agreement (continuous measures) or Fleiss multi-rater Kappa test (ordinal measures).

Most tests showed moderate to very good assessment reliability between face-to-face and live telehealth (ICC=0.5–1), between face-to-face and recorded telehealth (ICC=0.5–1) and good to very good inter-rater reliability between the recorded telehealth assessments (ICC=0.63–1). Reliability appeared to be higher in tests involving quantitative, rather than qualitative, measures of performance. A ceiling effect was noted in some tests where all participants completed tests with maximum scores in both face-to-face and remote assessments.

This study supports the feasibility of remote assessment in clinical practice for people with Parkinson's disease. Further research with a larger cohort and adjustment of the assessments to avoid ceiling effects is necessary.

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Exploring the awareness of people affected by Huntington's disease towards regenerative therapies

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Huntington's disease (HD) is a fatal neurodegenerative genetic disease that causes devastating changes to cognition, behaviour, and motor function. Currently, it is incurable, and medications manage symptoms with limited efficacy.

Recent focus has turned to the potential of regenerative therapies like gene silencing and stem cells to slow disease progression. These invasive therapies are ethically controversial, and knowledge of patients' attitudes towards them is limited. This study aimed to determine what New Zealanders affected by HD know about regenerative therapies, what they believe motivates researchers, and what should motivate them.

Adults diagnosed with HD, gene-positive pre-symptomatic, and at risk of HD were recruited by purposive sampling through social media, personal networks, and snowball sampling. Anonymous survey responses were collected using Qualtrics.

Fifteen responses were obtained. About half of study participants were female (n=8) and aged between 25–39 (n=7), with fewer respondents aged 40–4 (n=3) and 55–69 (n=4). Most respondents were gene-positive pre-symptomatic (n=10). Participants were predominantly NZ European (n=13), with one respondent identifying as Māori, and one as Pakistani.

Younger respondents were more aware of regenerative therapies than older. Respondents mainly sought information from HD support websites and social media. Awareness of stem cells (n=13) was higher than gene silencing (n=9); however, all participants who were aware of gene silencing knew about its application for HD.

Respondents ranked what they thought HD researcher motivations were using a rating scale (1=least, 5=most important). Importance rankings were comparable for researchers conducting stem cell vs gene therapy trials. While respondents believed researchers were motivated more by advancing science and helping patients than making money, they believed participant safety should be prioritised.

These findings highlight an opportunity for researchers to communicate to patients via support groups, and to emphasise the importance of participant safety in studies. This may increase recruitment and retention in clinical trials.

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Human neuronal models of Batten disease exhibit altered lysosome function and accumulation of alpha-synuclein protein

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Batten disease is a group of fatal genetic diseases that are the leading cause of neurodegeneration in children. This study focused on six forms of Batten disease, each caused by the mutation of a ceroid lipofuscinosis, neuronal (*CLN*) gene— which encode proteins involved in lysosome function. Mutations are expected to alter neuronal lysosome function and potentially global neuronal morphology. Accumulation of the protein alpha-synuclein, a hallmark of Parkinson's disease, is a neuronal phenotype identified in some forms of Batten disease. This study aimed to investigate the pathologies in human neuronal models of CLN2, 3, 5, 6, 10, and 12 Batten disease.

Using clustered regularly interspaced palindromic repeats inhibition (CRISPRi), the six *CLN* genes were inhibited in induced pluripotent stem cell (iPSC)-de-

rived human neuronal models of Batten disease. Lysosomal phenotypes were established via analysis of LysoTracker assays. Neuronal morphology was investigated by staining neurons for microtubule associated protein 2 (MAP2) and alpha-synuclein proteins via immunocytochemistry. Neurons were imaged via fluorescence microscopy and analysed with Fiji/ImageJ.

CLN2- and CLN3-inhibited neurons exhibited significantly reduced LysoTracker fluorescence compared to control neurons, indicating dysfunctional lysosomes (percentage of mean fluorescence intensity in CLN2-inhibited neurons compared to control: 78.18%±5.342, in CLN3-inhibited neurons compared to control: 84.47%±0.8065, control vs CLN2-inhibited and control vs CLN3-inhibited: $P<0.05$, unpaired t-test, n=3). MAP2 staining revealed possible morphological abnormalities in CLN2- and CLN3-inhibited neurons, which appear to have smaller dendrites and reduced MAP2 fluorescence (n=1, significance not determined). Significant accumulation of alpha-synuclein was revealed for the first time in CLN2-inhibited neurons (percentage of mean fluorescence intensity compared to control: 122.3%±5.783, control vs CLN2-inhibited: $P<0.05$, unpaired t-test, n=3).

Alpha-synuclein accumulation provides a possible pathogenic cause of CLN2 Batten disease— representing a potential treatment target. This project has extended our understanding of the neuronal anomalies in Batten disease.

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Lifestyle, social, and academic factors are associated with academic stress in Pasifika anatomy students

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Many Pasifika students in Aotearoa face challenges in their tertiary education experience. Here, we investigated how various factors are associated with academic stress of Pasifika students within the Anatomy Department.

Pasifika students at 200–300 levels were sent an online survey, consisting of validated questionnaires (Perceived Academic Stress, Social Provision Scale, Insomnia Severity Index, Godin-Shephard Leisure-time Physical Activity Questionnaire, Centrality Religiosity Scale) and questions developed by our team (e.g., social media use, who they go to for academic support, self-efficacy in passing anatomy papers). Academic stress was compared between genders, academic levels and sexual orientations. Multiple regressions were performed to determine the association between academic stress and the various lifestyle, social and academic factors.

Data from 57 participants are presented here. The average age of 41 participants was 21.1±1.6 years. Most represented ethnicities were Samoan (28.1%), Tongan (26.3%), and Fijian (24.6%). Participants' genders were men (35.1%), women (57.9%), and akava'ine (1.8%). Most participants had taken second (91.2%) or third year (47.4%) anatomy papers. Academic stress associated with academic expectations was higher in male students than female and akava'ine students ($t(52) = 2.15$, $P<0.05$), and was also higher in third year than second year students ($t(52)= -2.32$, $P<0.05$). Academic stress was comparable across all sexual orientation.

Elevated perceived academic stress was associated with lifestyle (exercise levels, insomnia severity, religiosity), social (low social provision, higher frequencies of posting on Twitter) and academic (low self-efficacy in passing anatomy papers, low academic support from friends) factors. A high proportion of participants had insomnia symptoms (73.7%) and social anxiety as an ethnic minority (30%).

Our findings highlight that social, lifestyle and academic factors influence academic stress in Pasifika students. These emphasise a need for institutions to enhancing support infrastructure that help mitigate academic stress faced by Pasifika students.

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Repairability of 3D-printed dentures

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Three-dimensionally (3D)-printed dentures are becoming more popular due to reduced waste during manufacturing. However, their repairability is still questionable. Various repair methods have been tested for conventionally processed dentures, but information is limited on whether the same principles apply to 3D-printed dentures. Therefore, the aim of this *in-vitro* study was to investigate the effects of different surface treatments: bur roughening (control), chemical primer application and sandblasting on the flexural strength (FS) of repaired

3D-printed denture bases under artificial ageing.

3D-printed resin samples (n=180) were thermocycled, simulating 12 months of clinical wear before fracture. A fracture line and repair areas were prepared, and samples were divided equally into three groups per surface treatment method. Samples were repaired using self-curing acrylic resin and each group was further divided into three different artificial ageing durations (immediate post-repair, additional 12 and 24 months post-repair) to measure the FS. Samples were also examined under scanning electron microscope (SEM) to analyse the crack propagation. Statistical analyses were carried out using two-way ANOVA and Tukey's post-hoc test with the significance set at $P<0.05$.

All groups showed a decrease in mean FS with increased ageing time. This was statistically significant for the control group when comparing immediate (106.43±14.22 MPa) with 24-month post-repair (90.24±11.19 MPa, $P=0.037$). The control group always reported the highest mean FS regardless of ageing time while sandblasting was least effective. This was statistically significant immediately post-repair (sandblasting: 85.80±24.38 MPa, $P=0.003$). SEM analysis showed that the failures were predominantly of cohesive nature.

Within the limitations of this *in-vitro* study, bur roughening of the fractured area was the most effective surface treatment method for repairing 3D-printed dentures. Different combination of repair methods such as metal/fibre meshes may also be included for future studies.

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Resistance and aerobic exercise of moderate or self-selected intensity is effective in reducing anxiety

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Current research regarding the anxiolytic effects of exercise has provided inconsistent effects. While physical activity (PA) and anxiety levels have largely shown an inverse relationship in population studies, the dose-response relationship is unknown. The purpose of this study was to complete a systematic review of studies which have investigated the effect of an exercise intervention on trait anxiety to gain insight into this relationship and the ideal PA prescription to reduce anxiety.

Trials were included if they contained an intervention longer than two weeks with anxiety as a primary outcome within a group of otherwise healthy adults (aged 18 to 45 years) with any level of anxiety. A total of 984 titles from SCOPUS, PsycINFO and PUBMED were screened with 43 trials included in the final review. These trials were examined regarding the structure of the intervention as well as the outcomes of the study.

Results showed that the majority (74%, n=32) of trials induced a reduction in anxiety symptoms, with both aerobic and resistance modalities being effective. Interventions were shown to be effective after as little as 2 weeks of intervention (n=5), although typically took place over 8 to 10 weeks (n=11). Effective frequencies were most commonly between 2 and 4 times a week (n=27), with most durations spanning 20–30 minutes per session (n=18). Effective interventions typically required a moderate intensity or higher (n=13) although self-selected intensities (n=7) were also shown to be effective.

These results can be used to inform interventions for those suffering from anxiety and its related symptoms. As these results largely mirror the current physical activity guidelines, this suggests that physical activity recommendations which follow the current guidelines may be expected to produce a decrease in anxiety.

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Smart watch integrated do-it-yourself continuous glucose monitoring (DIY-CGM) in adults with type 1 diabetes—a qualitative study

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This study explored experiences of adults with type 1 Diabetes (T1D) using a smartwatch integrated "Do-it-yourself" continuous glucose monitoring (DIY-CGM) system.

This qualitative study takes advantage of a funded

RCT investigating glycaemic control in adults living with T1D using DIY-CGM (MiaoMiao combined with Abbott Freestyle Libre). Convenience sampling was used to recruit participants. Semi-structured interviews investigated user experience with DIY-CGM. Key themes were identified using thematic analysis.

Interviews were conducted with 12 participants who had been using DIY-CGM for a minimum of one month. Participants noted a perception that DIY-CGM helped them improve their glycaemic control. Alarm and trend functionality were useful in allowing participants to avoid hypo/hyper-glycaemic events overnight and to better manage glucose levels after high carbohydrate meals. Smartwatch integration meant users could be alerted overnight without waking their partners. Barriers identified included signal loss during high-intensity exercise and alarm fatigue whilst using the smartwatch. Short battery life was also identified as a disadvantage of MiaoMiao use. Almost all participants intended to use DIY-CGM or upgrade to real-time continuous glucose monitoring (rtCGM) after the end of the trial.

DIY-CGM allowed the participants to harness the functionalities of real time CGM (rtCGM) that were important to their self-management priorities, namely alarms and trend information, without the expense of commercial rtCGM. Trend data appeared to inform behavioural changes, including the timing of pre-meal boluses. Glucose threshold alerts appeared valuable overnight. Participants identified a number of technical challenges with DIY-CGM use. Namely, the short battery life, limited compatibility with non-Android devices and Bluetooth connectivity issues. Smartwatch Bluetooth connectivity was reported to be particularly unreliable. Despite these inconveniences, DIY-CGM with support and training appears an affordable solution for people with T1D in countries that do not have universal funding for rtCGM technology.

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The relationship between secreted amyloid precursor protein alpha (sAPPα) and the cell surface expression of NMDA glutamate receptors

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Synaptic plasticity, the strengthening or weakening of neuronal connections influenced by neuronal activity, underpins memory, and involves changes in synaptic glutamate receptors. Our lab previously demonstrated that the memory-enhancing and neuroprotective neuromodulator, secreted amyloid precursor protein-alpha (sAPPα), induces the synthesis of amino-3-hydroxy-5-methyl4-isoxazole-propionic acid receptors and their movement to the neuronal surface. However, sAPPα's effect on N-methyl-d-aspartate receptors (NMDARs), which form calcium channels and are also crucial to synaptic plasticity remains unresolved. We hypothesised that sAPPα would also enhance total surface and synaptic NMDAR expression.

To examine sAPPα's effect on NMDAR expression we focused on the obligatory GluN1 subunit. Primary hippocampal cultures (DIV19-22), prepared from post-natal-day 0–1 Sprague-Dawley rats, were incubated with 1 nM sAPPα for 2 hours and labelled with primary antibodies targeting an extracellular GluN1 epitope, Synapsin-1 (synaptic-marker) and MAP2 (neuronal-marker). Fluorophore-conjugated secondary antibodies allowed signal visualization and imaging (≥30 cells/condition from three independent cultures). Corrected total cell fluorescence values were generated for soma and dendrites using ImageJ and averaged and converted to fold changes relative to non-treated controls. GluN1 colocalisation with Synapsin-1 was determined by Mander's overlap coefficient (MOC) generated using JACOP. Statistical significance determined using Mann–Whitney t-tests.

Unexpectedly, total GluN1 cell-surface fluorescence signal significantly decreased in response to sAPPα, in both dendrites (0.780±0.048 SEM; $P<0.0001$; $N_{dendrites}=168$) and soma (0.563±0.04 SEM; $P<0.0001$; $N_{soma}=75$). Additionally, sAPPα induced a significant reduction in colocalization between surface GluN1 and Synapsin-1 puncta. The mean MOC was 0.406±0.031 (SEM) for sAPPα-treated neurons, compared to 0.534±0.033 (SEM) for control ($N_{sAPPα}=48$, $N_{control}=66$, $P=0.0089$).

These results suggest sAPPα exerts its neuroprotective effects through mechanisms involving the withdrawal of NMDARs from the synapse, potentially preventing calcium-induced excitotoxicity. sAPPα's possible counteraction to aberrant calcium-influx by influencing NMDARs, positions sAPPα as a prospective neuroprotective agent for neurodegenerative disorders.

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