Perioperative Mortality in New Zealand | Te Mate Whai Muri mai i te Poka ki Aotearoa

Eighth report of the Perioperative Mortality Review Committee | Te pūrongo tuawaru o te Komiti Arotake Mate Whai Muri mai i te Poka

Report to the Health Quality & Safety Commission New Zealand | He pūrongo ki a Kupu Taurangi Hauora o Aotearoa

December 2019 | Hakihea 2019

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Dedication to Dr Barry Norman Poata Smith, QSM | He kupu maumahara ki a Dr Barry Norman Poata Smith, QSM

E poroporoaki ana, hei tohu aroha hei maumahara ana ki a Dr Barry Norman Poata Smith

(Nō Te Rarawa, nō Ngāti Kahu)

The Perioperative Mortality Review Committee (the POMRC) acknowledges with sadness the passing of Dr Barry Norman Poata Smith QSM, who died earlier this year. He was a highly regarded and valued member of the POMRC, whose knowledge and intellectual prowess was sought after. His contribution to the POMRC's work was significant.

A gentle man of integrity and sound judgement, he will be remembered also for his great oratory skill and in his ability to share and teach. Barry included a music degree in his many academic achievements – he was an outstanding classical guitarist.

He was a friend to many and travelled the world as an esteemed scholar.

Though words cannot express adequately our heartfelt thanks and fond farewell to our dear friend, we hope the work of this report will allow and enable positive change to happen in the realm of health outcomes to the vulnerable, which Dr Smith actively pursued.

We miss him.

For all of these accomplishments Barry was first and foremost a loving husband and father.

Nā reira ki tōna hoa rangatira a Mary koutou ko ōu tamariki kāore e taea e te kupu te whakairo i te hohonutanga o ngā whakaaro aroha ki a koutou i te wehenga o te rangatira nei.

Nā reira e te rangatira, Barry, moe mai, moe mai, moe mai rā.

Acknowledgements | He mihi

The Perioperative Mortality Review Committee (the POMRC) would like to acknowledge:

- the whānau/families that have lost a loved one during or following surgery; we are committed to learning from their deaths to develop and implement solutions that will improve surgical health care in Aotearoa New Zealand
- the organisations and workplaces that have supported their staff to attend and participate in the POMRC
- the work of the staff within the Health Quality & Safety Commission, particularly Owen Ashwell (POMRC senior specialist advisor) and Dr Melanie Cheung (Ngāti Rangitihi) for developing the report
- Dr Phil Hider and Jonathan Williman for their epidemiological expertise
- technical advisory group members Dr Jason Gurney, Dr Jamie-Lee Rahiri, Dr Ahmed Barazanchi for their expertise on emergency laparotomy and Māori surgical outcomes
- the Ministry of Health for providing the baseline data for the analysis
- Ngā Pou Arawhenua (Māori members of the mortality review committees) for their support and advice
- Melissa Toohey from the Ministry of Health library and Isabelle Kwek from the University of Auckland for their support with the literature review
- representatives from Auckland District Health Board with whom we consulted on the report recommendations, particularly Dr Ben Griffiths and Dr Doug Campbell from Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement (ANZELA-QI) and Care Delivery in New Zealand for the Acute Abdomen (CADENZAA).

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Foreword by Chair of the Health Quality & Safety Commission | Kupu whakataki mai i te Heamana o te Kupu Taurangi Hauora o Aotearoa

As the Chair of the Health Quality & Safety Commission (the Commission), I am pleased to introduce the eighth annual report of the POMRC. This report presents data and information on perioperative mortality in Aotearoa New Zealand between 2012 and 2017. In particular, it focuses on mortality following emergency laparotomy outcomes for Māori.

Every year in Aotearoa New Zealand, more than 5,600 people are admitted to hospital for an emergency laparotomy. The POMRC found that out of those admitted for emergency laparotomy, incidence is 40.2% higher in Māori than non-Māori. There is evidence that the gap is widening. In reviewing emergency laparotomy, the POMRC found that compared with non-Māori, Māori:

- are younger
- reside in the most deprived neighbourhoods
- have more emergency laparotomies
- present to the emergency department more often
- have a higher burden of comorbidities, especially diabetes and smoking
- have higher severity of disease
- have a higher risk of complications following emergency laparotomy surgery
- have a higher mortality rate
- have a lower rate of colorectal cancer at the time of laparotomy, but are less likely to have localised cancer
- have some differences in the indications for laparotomy and procedures performed.

Large differences in socioeconomic deprivation and age at procedure between Māori and non-Māori reflect inequities in exposures and life opportunities that impact Māori health.

The take-home message for the POMRC's eighth report is that health equity gaps exist within our surgical systems between Māori and non-Māori. This is a timely finding given the Commission's recent report titled *A window on the quality of Aotearoa New Zealand's health care 2019: A view on Māori health equity*, which highlights several areas where change is needed in the health system (Health Quality & Safety Commission 2019).

I support the POMRC looking into surgical outcomes for Māori, and the work that has begun addressing inequity. This aligns with the Commission's strategic priority of 'Improving health equity'. The Commission is designing and implementing actions across our work programmes that will help us achieve it. Until recently, few quality improvement agencies – both here and overseas – have shown commitment to achieving health equity, and it is encouraging to see the POMRC take steps to highlight where inequities exist within surgical services.

This report showcases insights that will be important not only to those responsible for the funding and organisation of surgical services, but also to surgeons, anaesthetists and other clinicians who deliver these services, and to the patients and their families and whānau who depend upon them. It is also a challenge and a call to all hospitals to look at inequities in all aspects of surgery, the need to undergo further learning and development, and to put in concrete actions to improve and monitor in the future.

I would like to thank the Chair, Dr Tony Williams, and his team for their ongoing dedicated work on the POMRC.

Dr Dale Bramley
Chair, Health Quality & Safety Commission

Introduction by Chair of Perioperative Mortality Review Committee | Kupu arataki mai i te Komiti Arotake Mate Whai Muri mai i te Poka

This eighth report of the POMRC has the special topic of surgical outcomes for Māori, with a particular focus on acute laparotomy.

In our previous reports we have reported increased risk for Māori when they undergo surgery of all types. In our fourth report we noted that in some circumstances the death rate for Māori was double or triple that of non-Māori. Researchers who have studied and attempted to explain the increased death rate for Māori have indicated that at every step in a care pathway, Māori are more likely than non-Māori to experience delay or complication.

Acute laparotomy is a procedure required to deal with surgical emergencies, and it is known to be a procedure that is associated with high mortality. In studies undertaken overseas, the mortality in the 30 days following such a procedure may be between 10% and 30%. It is likely that the method by which cases are selected for inclusion in retrospective studies will have an important bearing on the recorded mortality rate. Several international projects are looking at outcomes from acute laparotomy, using audits to understand the risks accompanying emergency surgery and to try to reduce them. Patients requiring this type of urgent surgery are at risk of complications and providing good care to them is a measure of the ability of our hospitals to provide the complex care required.

Acute laparotomy is required due to a variety of problems. In general, the presentation is acute, and while some may potentially be prevented by early intervention, many are truly acute problems with no prior warnings. Because of these factors, the disparity of outcomes for Māori may not be as great as they may be in situations involving long and complicated care paths. In this sense we must remember that the sobering numbers we see in this report are by no means outliers, given the inequity of outcomes that occur in health care.

In the six years from 2012 to 2017 over 28,000 people underwent acute laparotomies in Aotearoa New Zealand. Of these, over 3,600 were Māori. About one in 20 people who require this procedure die within 30 days. In this report we have presented all our data when comparing Māori and non-Māori in age-adjusted form, due to the marked difference in age of the two populations. This adjustment is required to prevent differences being masked by the younger age of the Māori patient group, which has an important impact on raw mortality. In Aotearoa New Zealand hospitals, Māori admitted for acute laparotomy have about 60% greater mortality after adjustment for age. Some of this difference is explained by prehospital factors, which can be included in statistical models. Māori are also an order of magnitude more likely to live in the most economically deprived situations. They are more likely to suffer illnesses that increase the risk of dying after surgery. We have not included factors occurring after hospital admission in our explanatory models; the risk from some of these factors may be reduced by using the lessons drawn from overseas and from studies now underway in Aotearoa New Zealand.

I would like to thank all the members of the POMRC for embracing this topic and working together to produce a report that allows us all to acknowledge that surgical outcomes for Māori are much worse than for non-Māori. This is a situation that will require the collective effort of the whole health system to redress. Many of the causes of these inequities have their genesis outside the hospital, and as practitioners we may feel that there is little we can do. I think we must all reflect on our own practice, because treating people as we always have done will lead to the results we have always seen. It will take a host of small changes to begin to improve things, and we all have some part to play.

Dr Tony Williams
Chair, Perioperative Mortality Review Committee

Introduction by consumer representatives | Kupu arataki mai i ngā māngai kiritaki

Supporting the best health outcomes for Māori and their whānau

Rob Vigor-Brown and Sheldon Ngatai

> **He aha te mea nui o te ao**
> **He tāngata, he tāngata, he tāngata**
> *What is the most important thing in the world?*
> *It is people, it is people, it is people.*

The present statistics of Māori health mortality in relation to emergency laparotomies makes for a heart-breaking read.

To address and change the appalling statistics for Māori health outcomes and implement changes within the health system, the system needs to be making sure it is doing everything it possibly can to promote culturally safe care at all levels, particularly the workforce.

Clinicians and health care organisations need to listen and respond to the needs of Māori and their whānau. Our focus must be to achieve equitable health outcomes and support overall wellbeing for Māori and among groups of people and populations who are experiencing unsatisfactory health outcomes, and whose aspirations for their own lives is not being heard.

It is the hope of the consumer representation on the POMRC to ensure the voice of consumers, Māori patients and their whānau is heard and acted upon, and to provide you, the clinician, or as a patient with your whānau, the best health outcomes and experience.

What does this mean to you as a clinician?

As with previous POMRC reports, it has been identified that the support of whānau at the hospital during the perioperative stage is vitally important.

In your role as a health care professional, when providing care to Māori patients and their whānau:

- listen carefully to whānau and understand what is important to them
- reflect and be self-aware of any biases, attitudes, assumptions, stereotypes and prejudices that may be contributing to a lower quality of health care for Māori, and that may be within the policies and procedures in place across your health organisation that may be further perpetuating inequitable health outcomes for Māori
- commit to establishing, maintaining and enhancing your cultural competence to provide culturally safe care
- better understand the experience within the health system for Māori, including:
  - acknowledging a differing world view from your own and te ao Māori (Māori world view), including its tikanga, cultural practices and protocols

- – gaining an awareness of the experience of colonisation and its influences on health and illness for Māori and its ongoing effects
- provide the highest level of care by making senior clinicians available for procedures
- continue to check in with the patient and their whānau, acknowledge their concerns and answer their questions – whānau know best
- acknowledge hauora (overall physical, mental, emotional, environmental and spiritual health) and make available Māori health pastoral care from within the hospital to provide additional support to your patients and their whānau during consultations with clinicians.

What does this mean for patients and their whānau?

We know that patients and their whānau have an extremely important role to play in supporting the overall health – hauora – of their family member.

Patients and whānau can expect that to be:

- listened to without judgement
- included in management of their own health care
- provided answers to their questions and concerns for themselves and whānau members.

Patients and whānau can advocate for:

- a proactive health care management plan to meet the needs of patients and whānau
- an assessment before the surgery of the risks of the surgery and any risk of death
- surgery to be offered within an appropriate timeframe
- both a consultant surgeon and consultant anaesthetist to provide input prior to surgery
- a senior clinician to be present during the operation, especially if the patient is high risk
- the admission to a critical care facility following surgery (noting that there is a high risk of severe infection, and intravenous antibiotics need to be given within 60 minutes of diagnosis)
- patients and whānau to be given the opportunity to discuss appropriate goals of care.

Mauri ora.

Rob Vigor-Brown   Sheldon Ngatai

Emergency laparotomy outcomes for Māori – infographic | Ngā putanga hahae puku ohotata mō Ngāi Māori – he hoahoa

Differences in patient health and perioperative mortality between Māori and non-Māori show the current system creates and maintains health inequity.

Distribution of patients undergoing emergency laparotomy by age
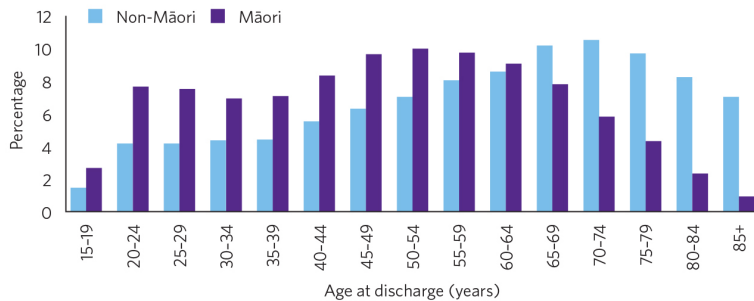
Non-Māori ■ Māori

Percentage (y-axis: 0 to 12)
Age at discharge (years): 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, 85+

The average age of Māori having emergency laparotomies is 10 years younger than non-Māori.

Māori are dying at higher rates and at much younger ages than non-Māori **following emergency laparotomy.**

Māori are over-represented and dying at much higher rates in the **highest socioeconomic deprived areas.**

Māori are dying at higher rates with a **higher burden of comorbidities, including diabetes.**

Māori have a **higher burden of disease**, which correlates to higher mortality.

Even at younger ages, Māori have a higher mortality rate, demonstrating a higher burden of disease at younger ages in Māori.

Multivariate analysis shows the percentage increased mortality from each factor: **15% socioeconomic deprivation, 18% comorbidities, 9% complications** and **11% racial disparities.**

Recommendations from the POMRC include:

Improvements to Māori surgical outcomes

All surgical departments to commit to achieving equitable outcomes for Māori, and honouring Te Tiriti o Waitangi.

All surgical departments to review Māori mortality and morbidity outcomes and, where inequities exist, consider all aspects of the surgical pathway that may contribute to these inequities.

All surgical staff to undertake training on Te Tiriti o Waitangi, cultural safety and competency.

Improvements to surgical care

Emergency laparotomy patients and their whānau should be given the opportunity to discuss appropriate goals of care.
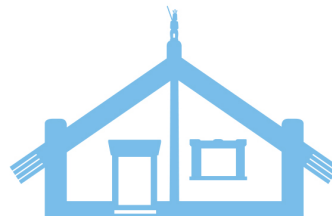
Executive summary | Whakarāpopototanga matua

For the eighth Perioperative Mortality Review Committee (POMRC) report, we took a systems-level view of health equity focusing on whether emergency laparotomy surgical systems were equitable between Māori and non-Māori.

The development of this report and its prioritised focus on Māori mortality has been a journey of reflection and required a change in focus for many of our POMRC members. We wanted to challenge ourselves to understand the persistent inequities that exist for Māori in our health system and the many components that exist within Aotearoa New Zealand that have led to these poorer health outcomes.

This is timely given the Health Quality & Safety Commission's recent report *A window on the quality of Aotearoa New Zealand's health care 2019: A view on Māori health equity*, which highlights several areas where change is needed in the health system (Health Quality & Safety Commission 2019).

Key findings

The key findings from the POMRC's analysis are set out below. All findings relate to emergency laparotomy operations in Aotearoa New Zealand between 1 January 2012 and 31 December 2017. All mortality findings report 30-day aged-adjusted emergency laparotomy mortality rates.

Between 2012 and 2017, there were 28,481 admissions for emergency laparotomy and 1,566 deaths (5.5% of admissions). Age-standardised emergency laparotomy incidence is 40.2% higher in Māori than in non-Māori (eg, 71.6 per 100,000 in Māori compared with 52.9 per 100,000 in non-Māori). Furthermore, there is evidence that the gap in rates of emergency laparotomy surgery is widening over the time period of the report.

The epidemiology of Māori having emergency laparotomy operations

In comparison to non-Māori having emergency laparotomies, Māori:

- are younger
- reside in the most deprived neighbourhoods
- have more emergency laparotomies
- present to the emergency department more often
- have a higher burden of comorbidities, especially diabetes and smoking
- have higher severity of disease
- have a higher risk of complications following emergency laparotomy surgery
- have a higher mortality rate
- have a lower rate of colorectal cancer at the time of laparotomy, but are less likely to have localised cancer
- have some differences in the indications for laparotomy and procedures performed.

Emergency laparotomy mortality as a measure of health equity

A systems-level view of health equity involves thinking about how systems create and maintain health equity and inequity. We wanted to know if surgical systems in Aotearoa New Zealand were equitable between Māori and non-Māori. We found that Māori have an overall 30-day emergency laparotomy mortality rate of 8.8% compared with 5.5% in non-Māori.

We analysed the emergency laparotomy mortality data to identify inequities that might exist in surgical health between Māori and non-Māori at three different levels:

1. inequities in exposures and life opportunities that impact on a person's health
2. inequities in the ability to access appropriate health care
3. inequities in the quality of care delivered.

Inequities in exposures and life opportunities contribute to higher mortality at younger ages in Māori

Large differences in socioeconomic deprivation and age at procedure between Māori and non-Māori reflect inequities in exposures and life opportunities that impact Māori health.

- Half of all Māori that had emergency laparotomies live in the most socioeconomically deprived areas (lowest NZDep2013[1] quintile) and have 57% higher mortality than non-Māori living in the same areas. In the multivariable model, socioeconomic deprivation accounts for 25% of the excess mortality in Māori, indicating there are larger systemic issues that need to be addressed.

- The average age of Māori having emergency laparotomies is 10 years younger than non-Māori. Even at young ages, Māori have a higher mortality rate, demonstrating a higher burden of disease at younger ages in Māori.

- In an equitable system, Māori and non-Māori would have the same socioeconomic privileges and die at similar ages. In the absence of this equity, Māori who live in the most socioeconomically deprived areas and/or are aged 40 and over having emergency laparotomies should be considered high-risk patients, and they should receive the care they need to ensure they have equitable outcomes to non-Māori.

Inequities in access to health care contribute to higher Māori mortality

Large differences in access to elective surgery, access to primary care, emergency department (ED) attendance and Charlson Comorbidity Index (CCI) scores between Māori and non-Māori reflect inequities in access to health care, particularly the ability to financially and physically access appropriate health care. In an equitable system, Māori and non-Māori would have the same access to elective surgery, and Māori would not need to go to the ED more often.

- Māori have 21% more emergency laparotomy operations than non-Māori, indicating that Māori have reduced timely access to elective abdominal surgery. This is an issue because

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[1] The New Zealand Index of Deprivation (NZDep2013) is an area-based measure of socioeconomic deprivation using variables from the Census of Population and Dwellings 2013.

emergency surgery is an independent risk factor for death and likely contributes to increased mortality.

- In the 90 days prior to having an emergency laparotomy, Māori are 40% more likely to have presented to the ED. In the group of patients who had been to the ED, Māori had a 71% higher mortality rate than non-Māori after an emergency laparotomy.

- Māori have an overall higher burden of comorbidity. The most common comorbidities are diabetes, smoking, and cancer. In the multivariable model, comorbidities account for 25% of the excess mortality in Māori compared with non-Māori.

Therefore, in the absence of equity, Māori (1) with diabetes and (2) with a > 3 weighted CCI score should be considered high-risk patients and receive the care they need to ensure they have equitable outcomes to non-Māori.

Inequities in quality of care

We do not have enough information in our data set to ascertain whether Māori are dying at a higher rate because of the quality of health care they receive. Moreover, the Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement (ANZELA-QI) project will be thoroughly investigating emergency laparotomy quality of care.

In an equitable system, Māori and non-Māori would receive the same quality of care. The presence of higher rates of postoperative complications in Māori compared with non-Māori suggests there may be differences in the quality of care received.

Conclusions

Differences in patient health and perioperative mortality between Māori and non-Māori show that the current system creates and maintains health inequity, with a strong correlation between mortality and deprivation.

Changes to the health system are required, as well as necessary wider societal changes to address these inequities. The higher burden of comorbidity amongst Māori needs to be addressed, as higher burden of comorbidity is likely contributing towards Māori having emergency laparotomies younger than non-Māori.

Māori are presenting to their GPs and the ED more often than non-Māori yet have a higher mortality rate.

As health professionals we must all implement the changes necessary to better meet the needs of Māori within the health system. It is the POMRC's aim to drive change in the health system to achieve equity in the surgical health outcomes for Māori. This requires ongoing and substantially improved culturally-safe dialogue and communication from clinicians, alongside their patients and whānau, so that all are connecting throughout the patient's journey to wellness.

We have developed recommendations from our findings to address many of the changes we believe will drive change within surgical care, the health system and overall improvements in care.

Eighth POMRC report recommendations | Ngā whakahau o te pūrongo POMRC tuawaru

The following recommendations were informed by data presented in this report, and a review of the international literature.

Improvements to Māori surgical outcomes

Recommendation 1: All surgical departments should commit to having equitable outcomes for Māori, consistent with Te Tiriti o Waitangi.

> *Rationale:* The Waitangi Tribunal Wai 2575 Health Services and Outcomes Kaupapa Inquiry report, *Hauora,* revealed significant differences throughout the health system that need to be addressed. Our report has shown that ethnic inequities (socioeconomic deprivation, comorbidities, complications, and access to elective laparotomies) account for large differences in mortality. These can only be addressed by breaking down racism that is inherent in the system.

Recommendation 2: All surgical departments should review Māori mortality and morbidity outcomes. Where inequities exist, they should consider all aspects of the surgical pathway that may contribute to these inequities.

> *Rationale:* The POMRC recognises that all future hospital protocols need to address differences in socioeconomic deprivation, comorbidities and complications between Māori and non-Māori to ensure outcomes are equitable for all.

Recommendation 3: All surgical staff should undertake training on Te Tiriti o Waitangi, cultural safety and competency.

> *Rationale:* The POMRC endorses the Medical Council of New Zealand (MCNZ) revised statement and resource on cultural safety released on 22 November 2019: *He Ara Hauora Māori: A Pathway to Māori Health Equity* (MCNZ 2019).

Recommendation 4: All hospitals should collect high-quality ethnicity data.

> *Rationale:* High-quality ethnicity data is needed to monitor equity for the health and disability sector.

Recommendation 5: All hospitals should review Māori mortality surgical outcomes within their catchment and be proactive in addressing any differences in access to, and/or quality of, health care between Māori and non-Māori.

> *Rationale:* Our report has shown that ethnic inequities account for large differences in mortality. All hospitals need to implement the changes that are necessary to better meet the needs of Māori and address the inequities identified in this report.

Recommendation 6: When planning care for emergency laparotomy patients, staff should take into account that Māori have high rates of comorbidity, complications and mortality from 40 years of age onwards.

> *Rationale:* Proactive management plans should be in place for all Māori patients undergoing an emergency laparotomy. The plans should consider age, comorbidities (especially diabetes) and prevention of complications associated with higher mortality (heart failure, severe sepsis, renal failure and pneumonia). For example, Māori patients may require admission to high dependency units or intensive care units at a younger age than their non-Māori counterparts if we are to achieve equity in health outcomes.

Further research and research funding

Recommendation 7: Research institutes should investigate further the factors that contribute to significantly higher Māori mortality in surgery.

> *Rationale:* The majority of perioperative mortality research that has been done with an equity focus has been on heart and cancer operations. The POMRC is interested in seeing more equity research done on other types of surgery.

Recommendation 8: Research institutes should investigate further into why the surgical care system disadvantages Māori, and how this can be rectified.

> *Rationale:* Every surgical study that is focused on equity has shown Māori have higher mortality regardless of the operation studied, indicating the system is not equitable. But little research has been conducted on how this should be addressed. Focus needs to be on how the system can be changed to achieve equity for Māori.

Improvements to surgical care

Recommendation 9: Clinicians should give emergency laparotomy patients and their whānau the opportunity to discuss appropriate goals of care.

> *Rationale:* Clinicians should make patients aware of the likely impacts of their surgery and should give patients the opportunity to discuss their goals and wishes, and to make plans for their life after surgery.

Recommendation 10: The POMRC endorses all National Emergency Laparotomy Audit (NELA) recommendations. NELA aims to improve the quality of care for patients undergoing emergency laparotomy by providing high-quality comparative data from all providers of emergency laparotomy.

A. All patients presenting to hospital requiring an emergency laparotomy should be offered surgery within an appropriate timeframe.

B. All patients presenting to hospital requiring an emergency laparotomy should receive input from a consultant surgeon and a consultant anaesthetist prior to surgery.

C. All patients presenting to hospital requiring an emergency laparotomy should be assessed for risk of death before surgery.

D. A consultant should be present during surgery for high-risk patients undergoing emergency laparotomy surgery.

E. The highest-risk patients should be admitted to critical care following emergency laparotomy surgery. Highest-risk patients include those with high American Society of Anesthesiologists (ASA) scores, significant comorbidities, high deprivation, complicated diabetes, and higher risk of sepsis (which are likely to be experienced disproportionately by Māori, and put Māori at higher risk).

F. All patients at high risk of sepsis should receive high-dose intravenous antibiotic administration within the recommended 60 minutes of diagnosis.

Recommendation 11: The POMRC endorses quality improvement in emergency laparotomy undertaken by the Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement (ANZELA-QI) project. The POMRC recommends that ethnicity is recorded as part of the project criteria, and that ANZELA-QI develops Te Tiriti o Waitangi, cultural safety and competency training as a component of quality improvements.

> *Rationale:* The Royal Australasian College of Surgeons (RACS) and the Australian and New Zealand College of Anaesthetists (ANZCA) have committed to supporting the bi-national, bi-college ANZELA-QI project. The POMRC fully supports this project.

Introduction | Kupu arataki

The development of the eighth Perioperative Mortality Review Committee (POMRC) report and its prioritised focus on Māori mortality has been a journey of reflection and required a change in focus for many of our POMRC members. We wanted to challenge ourselves to understand the persistent inequities that exist for Māori in our health system that have resulted in poorer health outcomes for Māori.

The recent Waitangi Tribunal Wai 2575 Health Services and Outcomes Kaupapa Inquiry report, *Hauora,* highlighted the institutionalised racism embedded in the Aotearoa New Zealand health system (Waitangi Tribunal 2019). They found that despite significant persisting inequities in our health system, Māori health outcomes are not being systematically measured and reported on.

With awareness of the Tribunal's findings and a commitment to ensuring the rights of Māori to equitable health outcomes, the POMRC has chosen to consider how we can contribute to improving health sector performance in terms of surgical health for Māori and gain a better understanding about the factors/pathways within surgical systems that impact on equity for Māori.

Introduced in the seventh POMRC report, patient stories have again been included within this report. The purpose of these stories is to help bring the data to life in order to demonstrate the value of the experience of the patient within the health system and the voice of whānau. These stories are based on a combination of patient interviews and relevant patient experiences. Considerations have been included following the stories as to how care could have been improved in these clinical situations, which we hope will provide stimulus for discussion and action on how best to address these care components. The POMRC is very grateful to the patients and clinicians who helped provide information in the formation of these patient stories.

The POMRC terms of reference

The POMRC is a statutory committee that reviews and reports on perioperative deaths in Aotearoa New Zealand. The aim of the POMRC is to reduce complications and death after surgery, and to continually improve surgical health care in Aotearoa New Zealand.

The POMRC defines 'perioperative death' as death that occurs:

- during surgery
- within 30 days of surgery
- more than 30 days after surgery but before discharge from hospital
- while under the care of a surgeon in a hospital, even if surgery was not undertaken.

For the purposes of the POMRC's definition of perioperative death, an operation (or operative procedure) refers to any procedure requiring sedation or anaesthetic (local, regional or general). This includes a wide range of procedures for the diagnosis and treatment of medical conditions. These procedures are usually carried out in operating theatres but may also occur in endoscopy or radiology suites or minor operating theatres. They include gastroscopy, colonoscopy, excision and biopsy of skin lesions, and cardiac and vascular angiographic procedures.

Understanding perioperative mortality following emergency laparotomy surgery

For this report, the POMRC examined perioperative mortality in New Zealand following emergency laparotomy operations. These are recorded in one of two ways: either as emergency operations using the emergency suffix in the American Society of Anesthesiologists (ASA) score, or as acute laparotomies in the National Minimum Dataset (NMDS) because the admission was organised on the day of presentation and not pre-arranged. Patients who met either definition are included as emergency laparotomies in the report. See Appendix 1 for details.

The POMRC chose emergency laparotomy as a special topic this year. Emergency laparotomy is a surgical operation that involves an incision into the abdomen. It incorporates a large group of non-elective, non-trauma-related, open (+/− laparoscopic) surgical procedures on the gastrointestinal tract, excluding appendicectomy, cholecystectomy and trauma (Densham 2016). They are often performed on people with severe abdominal pain to find out and treat the cause of their pain. Many people undergo emergency laparotomies, including a large number of Māori. As well as affecting a large group of people, it is one of the highest-risk surgical procedures, with a relatively high 30-day mortality rate of between 6.6% and 21.8% (Al-Temimi et al 2012; Saunders et al 2012; Broughton et al 2017; Tengberg et al 2017; NELA Project Team 2018).

Some examples regarding the kind of cases that are included in our analysis and which cover the bases/spectrum of presentations follow:

- Example case 1: Patient presents extremely unwell with unexplained infection or bowel obstruction and needs an emergency exploratory laparotomy.

- Example case 2: Surgery starts as a less invasive procedure (perhaps a laparoscopic procedure) but needs to be converted to an open procedure for technical reasons to complete the surgery. An example might be a laparoscopic anterior resection surgery that is converted to open surgery to improve surgical exposure and allow completion of surgery.

- Example case 3: During a surgical procedure a complication occurs, such as unintended bleeding or intestinal perforation, which necessitates converting to laparotomy to manage the complication and complete the surgery.

It is important to note that the data excludes the typical cases of appendix or gall bladder removal where the diagnosis is known prior to surgery.

Emergency laparotomy patients have considerable variation in clinical presentation, underlying pathology, anatomical site of surgery, and perioperative management (Broughton et al 2019). Both emergency and elective laparotomies are performed in all district health boards (DHBs). Moreover, changes in perioperative care can potentially have large impacts on survival rates. For example, changes made to the National Emergency Laparotomy Audit (NELA) in England and Wales over a four-year period equated to 700 fewer patients dying a year (NELA Project Team 2018).

The Royal Australasian College of Surgeons (RACS) and the Australian and New Zealand College of Anaesthetists (ANZCA) are undertaking the Australian and New Zealand Emergency Laparotomy Audit Quality Improvement (ANZELA-QI) project, which will impact the comparability of future data with previous data. Therefore, this is the last year we could undertake a retrospective analysis before the data was modified as a result of the audit.

Towards equity

Māori rights to collective self-determination are affirmed in the articles of Te Tiriti o Waitangi and recognised in policy today as inclusive of the rights to health care provision and to equitable health outcomes (Health Quality & Safety Commission 2019). Arising from the process of colonisation, the New Zealand health system has generated and continues to reinforce inequities in health outcomes between Māori and non-Māori. This is evidenced by documented inequities in life expectancy and mortality and significant morbidity differences for both infectious and chronic disease (Health Quality & Safety Commission 2019).

The health system's failure to meet the rights of Māori has been described as institutional racism (Came 2014). Racism is a modifiable determinant of health (Paradies et al 2015), which has been shown in overseas studies to impact on physical health (Krieger et al 1993; Krieger 2003) and, in Aotearoa New Zealand studies, to lead to poorer health outcomes in Māori (Harris et al 2006; Harris et al 2012; Harris et al 2013). Institutional racism is a systemic pathway to inequity (Ministry of Health 2010) that occurs and continues because people at all levels of the system make decisions that disadvantage one group in relation to another (Health Quality & Safety Commission 2019). Institutional racism is also evidenced by differential access to health care, and differences in the quality of care for indigenous peoples, which have been extensively documented internationally (Tavella et al 2016; Keddis et al 2018; Coombes et al 2018) as well as here in Aotearoa New Zealand (Hill et al 2010; Hill et al 2013).

The Waitangi Tribunal Wai 2575 Health Services and Outcomes Kaupapa Inquiry report, *Hauora*, identified that the Crown **does not**:

1. collect sufficient qualitative and quantitative data to fully inform itself about how the health care sector is performing in relation to Māori health
2. use the data it does collect effectively
3. make the data easily accessible to and understandable by the public (Waitangi Tribunal 2019).

Research into health equity suggests that fragmented approaches have failed and will continue to fail; efforts need to be sustained, systematic and multileveled to be successful (Came et al 2016). Inequity is a system-wide problem (Blackman et al 2011), and there is a recognised need for better methods to produce evidence about such complex policy challenges (Blackman 2012). We use a framework of a systems-level view of health equity focused on three levels, although there is insufficient data to examine each in depth:

1. inequities in exposures and life opportunities that impact on a person's health
2. inequities in the ability to access appropriate health care
3. inequities in the quality of care delivered.

The POMRC supports transformational change within the current health system to improve Māori surgical health outcomes and endorses the vision of the Māori Health Action Plan 2016–18 developed by RACS (2016), which promotes action on equity, health workforce development and cultural safety (Rahiri et al 2018). We have also worked towards making the report understandable for the everyday public. We acknowledge there is a lack of available data on the surgical health of Māori and that further work on developing indicators of quality of surgical care is needed. The POMRC will:

- advocate for a continued focus on documenting and addressing disparities in surgical care and outcomes between Māori and non-Māori
- support the development of purposeful interventions aimed at improving equity in surgical care
- work in partnership with, for example, Te Ohu Rata o Aotearoa (Māori Medical Practitioners Association) to promote strategic efforts to increase the Māori medical workforce
- support specialist training/surgery pathways for that workforce.

Applying an equity lens to improve Māori surgical health

Aotearoa New Zealand has historically followed a 'one size fits all' approach to health care policy, service design and delivery based on Pākehā European norms and values, including fundamentally, the way in which 'health' itself is defined (Wilson and Barton 2012). A number of commentators have highlighted that narrow definitions of health may have particular implications for Indigenous peoples and minority populations who do not share the same norms and values, as well as having important implications in terms of funding, resourcing and location of services (Wilson et al 2018). Māori health discourses also recognise the pivotal role of environment and additional external influences that impact on health and wellbeing, such as socioeconomic oppression and racism (Robson 2004; Robson and Harris 2007).

Māori understandings of health and wellbeing extend beyond those of the physical, mental and emotional dimensions of the individual to recognise the importance of spiritual wellbeing and the central role of whānau (family) health as detailed in Durie's Te Whare Tapa Whā (the four cornerstones of Māori health) model, which describes four dimensions of Māori wellbeing: tinana (physical health), hinengaro (mental and emotional health), wairua (spiritual health) and whānau (family) (Durie 1994).

The Meihana multidimensional model of clinical practice (Pitama et al 2007) helps practitioners to understand causes of health inequities between Māori and non-Māori. This model integrates cultural competencies into clinical assessments and interventions with Māori and their whānau, extending Te Whare Tapa Whā to include two additional elements: taiao (the physical environment of the clinical service) and iwi katoa (societal structures that impact organisational capacity). The role of the clinician is to identify the patient's beliefs, values and experiences within a Māori context. This allows the clinical team to explore past and present influences and impacts of whānau, wairua, tinana, hinengaro, taiao and iwi katoa on the client's health and make appropriate treatment decisions accordingly.

In the context of this report, our approach is driven by the desire to improve Māori surgical care and outcomes. Currently, Māori have a higher prevalence of surgical disease, experience poorer access to surgical services, and are more likely to have worse postoperative outcomes than non-Māori (Rahiri et al 2018). We have chosen to use Te Pou, the Māori Responsiveness Rubric developed by Ngā Pou Arawhenua, the Māori members of the mortality review committees, as a guiding principle for this report to highlight and further our understanding about the range of factors impacting on equity in surgical outcomes for Māori. The four values of the rubric are:

- tika – getting the story and interpretation right
- manaakitanga – being culturally and socially responsible
- mana – advancing equity, self-determination and social justice
- mahi tahi – establishing relationships for positive change.

Tika (getting the story and the interpretation right)

This includes: performing regression modelling on the data to account for the age distribution differences between Māori and non-Māori populations; incorporating ASA and Charlson Comorbidity Index (CCI) scores into our analyses to better understand how severity of illness impacts Māori perioperative mortality; incorporating multiple Māori narratives into the report; and thinking about how our current surgical care system creates and maintains health equity and inequity.

Manaakitanga (being culturally and socially responsible)

Manaakitanga is about prioritising Māori expertise, wisdom and input. This POMRC report has been woven together by key Māori personnel in the POMRC, our technical advisory group, Ngā Pou Arawhenua, and the Health Quality & Safety Commission (the Commission). Collectively, our main focus is to understand and address the increased mortality rates seen in Māori who have undergone emergency laparotomies. We recognise and acknowledge the whānau and families who have lost loved ones following emergency laparotomies and are committed to improving the surgical care system.

Mana (advancing equity, self-determination and social justice)

The POMRC recognises that institutional racism is a systemic pathway to inequity (Paradies et al 2015). We highlight systemic factors that impact access to appropriate health care, and we have developed recommendations to address inequities in exposures and life opportunities that impact on a person's potential to experience optimum health. Addressing inequities will improve not only outcomes for Māori, but also the health of all New Zealanders.

Mahi tahi (establishing relationships for positive change)

The POMRC engaged with Ngā Pou Arawhenua throughout the development and writing of this report. Ngā Pou Arawhenua has significantly contributed to the ideas, methods, analysis, interpretation and recommendations contained in this report.

Patient story 1: Māori man in his 60s

I had a heart attack when I was doing some manual work. I saw my GP [general practice], but they kept sending me away with medication for a stomach ache. It wasn't until the fourth visit that they did some blood tests which showed I'd had a heart attack. They sent an ambulance around to my house to take me to the hospital. I self-discharged the next day because the heart attack had happened four days ago by that point.

I have a new GP that I go to now, which is much better. They treat me like a person. The previous GP felt like they just wanted my money – some of my mates felt this way as well.

I have had a few hospital admissions and required urgent surgery. My stomach aches turned out to be colorectal cancer. The hospital sometimes feels so rushed – they treat your condition or diagnosis and not who you are as a person. During the six weeks of radiation therapy when I drove back and forth to the hospital, I only saw one other Māori patient. It was good to connect with him, even though you don't want to see people in hospital.

That connection with people is very important. I would go outside the hospital for a cigarette and see other Māori patients, so we would all talk, and I'd get them coffees, we would all help each other out, roll cigarettes for those who couldn't. Even at 3 in the morning, it was good to have that social connection.

Even though I know smoking is bad for you, it is important that I can get out when I want. A smoking area is important. It would be good to have a communal space, or a TV or family room, some sort of focal point where you can connect with others.

I think all the doctors and nurses are caring, that they do their best. As a Māori patient I just want them to be honest, and to have respect. I would just like hospital staff to ask, 'Is there anything else we can help you with? Is there anything else that is worrying you?' And not just about the reason that they are there for. My great-grandfather signed Te Tiriti o Waitangi, but no one had ever really shown me much manaakitanga – the principle of reciprocity of kindness, respect and humanity. You just want to feel love, and some sort of connection. That is why I go outside, I find the camaraderie there. Not inside the hospital.

It did feel good when the anaesthetist shared my notes with another anaesthetist for one of my visits. Knowing that they had been in the same meeting, on how to improve my anaesthetic for the next time, that was awesome.

Aspects of care that could be improved

The patient experienced differential access to health care.

- It took four visits to the GP to get referred to specialist care.

The patient experienced differential quality of health care.

- He wanted to be treated like a whole person, not an illness (hauora Māori is holistic).

- He wanted staff to extend manaakitanga through being more friendly and caring. This would have put him more at ease in his surroundings (taha whānau, taha hinengaro).
- Feeling a sense of social connection was very important to the patient. He preferred to be outside because that is where he found a sense of community, especially with other Māori (taha whānau, taha hinengaro, taha wairua).

Ways that these could be addressed

Access to health care

The diagnosis of myocardial infarction needs to be considered in Māori at a younger age than in non-Māori due to their high incidence of ischemic heart disease and reduced life expectancy. The diagnosis of myocardial infarction is fraught and is sometimes misdiagnosed as indigestion. If the differential diagnosis includes myocardial infarction, then the appropriate tests such as electrocardiogram (ECG) and myocardial injury markers should be ordered to provide the appropriate level of care.

Quality of health care

Being a good clinician isn't just about diagnosing and treating. Most people are quite nervous in clinical settings, so being friendly can put them at ease. A little kindness goes a long way. Connection to place and people is very important to Māori, so providing opportunities for them to connect is an important part of holistic wellbeing.

The contribution of social determinants of health to Māori surgical outcomes

This report is the first study in Aotearoa New Zealand with an equity focus on emergency laparotomy perioperative mortality. Other surgical studies have shown that Māori have significantly higher rates of disease-specific and all-cause mortality with cancer, cardiac, kidney transplant and hip fracture surgery (Hill et al 2013; Chamberlain et al 2013; Swart et al 2013; Wang et al 2013; Sarfati et al 2014; Signal et al 2015; POMRC 2017, 2018). Overall, there is an acknowledged lack of studies investigating ethnic disparities in surgical care over the majority of surgical specialities (Rahiri et al 2018).

Increased mortality has been shown to be linked to inequities on multiple levels (Blakely et al 2000; Fawcett et al 2006; Robson and Harris 2007). Inequities in Māori perioperative mortality may be related to institutionalised racism, which has significant negative effects on health via differences in:

- environmental exposures and life opportunities
- access to health care
- quality of health care (Jones 2002).

More Māori live in neighbourhoods with higher deprivation than non-Māori, specifically the most deprived quintile (Grey et al 2016). Low income influences the care received and has been

linked to poor prognosis (Bowman et al 2010; Lee et al 2011; Lassiter et al 2017). Māori are known to have poorer survival following surgery for a range of conditions, including colon cancer and coronary artery bypass operations (Hill et al 2010; Wang et al 2013). The same phenomenon is observed in Aboriginal and Torres Strait Islanders undergoing coronary artery bypass surgery, and in First Nations patients following hip fracture (Kim et al 2011; Leslie et al 2013; Prahbu et al 2013). Māori in highly deprived circumstances have increased stressors across their lives, less ability to recover and less access to resources, including social support networks. Thus, inequities need to be improved in systems in addition to health, including housing, education and employment.

Additionally, Māori generally have a greater burden of preoperative comorbidities that have been shown to negatively impact surgical outcomes in colon, stomach, liver and rectal cancers (Chamberlain et al 2013; Wang et al 2013; Swart et al 2013; Sarfati et al 2014; Rahiri et al 2018). In their study on stomach and liver cancer, Sarfati et al (2014) identified that as comorbidity burden increased among Māori with stage I–III disease, the likelihood that the patient would receive curative surgery decreased threefold, and the risk of mortality increased by 44%. Many of the comorbidities experienced at high rates by Māori have been associated with increased stress and inflammation (Sotero 2006; Walters et al 2011). Chronic stress has been linked to impairment of the nervous system, the hypothalamic–pituitary–adrenal (HPA) axis, and the cardiovascular, metabolic and immune systems, which in turn contributes to diabetes, hypertension and cardiovascular disease (Brunello et al 2001; Schnurr and Green 2004; Lloyd et al 2005). Epigenetics has been implicated as the biological mechanism for how historical trauma physically manifests intergenerationally (Perroud et al 2011; Brockie et al 2013) and may be associated with poorer health outcomes.

Composite case: Acute laparotomy converted to open

Mr T, a 33-year-old Māori man, married with four young children, fit with nil previous medical history, presented to the emergency department (ED) with acute onset abdominal pain (day 1, Friday, 1130 hours). After some analgesia (paracetamol), his vital signs were stable, though his temperature was slightly elevated. A chest X-ray showed clear lungs. He was discharged home three and a half hours later with instructions to seek medical attention if severe pain or fevers develop. A script for antibiotics and analgesia was given.

The next day (day 2, Saturday) at midday he presented to the ED again. His wife recalls:

> 'He had had a terrible night – he was in a lot of pain. He was shaking with a fever, hot and cold.'

Six hours later he was admitted to the general surgical ward.

> 'They kept asking how many cigarettes he smoked and how much alcohol he drank. I lost count of how many times I told them that neither of us smoke or drink or take illicit drugs. I couldn't work out why they kept asking. They didn't seem to be listening to my reply.'

An abdominal ultrasound undertaken showed normal liver and gallbladder. No obvious cause was identified for Mr T's symptoms. While there was no evidence of acute cholecystitis, it was noted that the appendix was not visualised, with a comment made that this did not exclude the diagnosis of acute appendicitis. This ultrasound was not reviewed or acknowledged until the next day (day 3, morning rounds at 0930 hours).

On day 3 (Sunday) at 1730 hours an abdominal contrast computed tomography (CT) scan of the abdomen was performed. This showed free fluid in the presacral space. The right iliac fossa was dilated and fluid-filled, with the appendix measuring up to 11 mm. Perforated appendicitis with mild peritonitis and free fluid. The subsequent chest X-ray now revealed atelectasis on the right and left lower lung fields. This was not reviewed.

On day 5 (Tuesday) the abdominal contrast CT was acknowledged and reviewed at 1130 hours. Mr T was transferred to the operating theatre at 1730 hours (six hours later) with the problem described as a two-day history of vague upper and lower abdominal pain with intermittent pyrexia with right iliac fossa tenderness.

He was brought forward for laparoscopic appendicectomy, which proceeded to open in order to remove the perforated and gangrenous appendix and due to the inflammatory adhesions. A complete washout was performed, drain inserted and secured, and midline wound closed and skin stapled. Mr T was then transferred to the general surgical ward post-recovery, which was uneventful.

He was proceeding well in the first nine days of his recovery and was mobilising. However, on day 10 there was leakage from his wound sites, his temperature was rising, and he had developed a moist cough. His wife recalls:

> 'I kept saying that something was wrong, and I remember the doctors kept asking if my husband was a smoker. I kept having to tell them that "no" he doesn't smoke or drink or take illicit drugs.'

A chest X-ray showed pneumonia, and Mr T was becoming increasingly septic. Despite aggressive treatment he became progressively worse so that by day 14 his respiratory effort was increasing and the early warning score along with it. He suffered a cardiorespiratory arrest in the early hours of day 15 and was transferred to the intensive care unit for ventilation and vasopressor support.

On day 17 Mr T had his sedation stopped, and it was discovered that Mr T had suffered brain damage during the arrest. Despite Mr T's young age, he continued to deteriorate and died on the morning of day 19 with family present.

His case was reviewed by a multidisciplinary team at the hospital. They also deemed Mr T to be an 'atypical' presentation. Delays to diagnostic imagery intervention and subsequent review were identified as issues along with the escalation score procedure, which did not trigger an immediate review and appropriate response until the emergency management system was triggered at the time of the respiratory arrest.

Aspects of care that could be improved

Mr T and his whānau found staff repeatedly asking whether he smoked, drank alcohol and used recreational drugs offensive (how this impacted his care is outlined below). The whānau felt that staff did not listen to them.

His whānau's pleas for help were ignored – they felt he was deteriorating and did not know how to get help for him.

Ways that these could be addressed

- Clinicians need to be aware of their personal biases and stereotyping, which were felt by the whānau to have been a factor in what went wrong.

- The Code of Health and Disability Services Consumers' Rights states that patients must always be treated with respect and not discriminated against. Even if he did smoke, drink alcohol or use recreational drugs, the patient still has a right to be treated fairly and receive treatment in a timely fashion.

- Throughout his admission, Mr T's care was characterised by underassessment of the severity of his illness – both the initial appendicitis and his postoperative deterioration. His care was characterised by delays in diagnosis and in definitive treatment. Those who were caring for him did not appreciate the seriousness of his problems, and his death seems to have come after many opportunities to get his care back on course were lost.

- In summary – the lessons of the NELA are that proactive management and awareness of the significance of complications can prevent poorer outcomes. Postoperative

> surgical care needs to have a pathway for patients and whānau to escalate their
> concerns if they are worried.

Access to health care is another major systems issue which has critical implications for Māori. Rahiri et al's (2018) meta-analysis showed that regardless of disease or surgical procedure, Māori are less likely to receive best practice treatment interventions and surgical treatments. Māori are also more likely to experience delays between referral and seeing a specialist and have longer wait times on waiting lists (Hill et al 2013; Chamberlain et al 2013; Swart et al 2013; Wang et al 2013; Sarfati et al 2014; Signal et al 2015). Māori are more likely to experience a delay starting chemotherapy, more likely to die during the postoperative period (Hill et al 2013), and among those with stage IV disease, Māori are much less likely than non-Māori to be referred to palliative care (13% vs 40%) (Swart et al 2013). Poor access to health care was also associated with a 50% higher perioperative mortality rate in Māori having abdominal aortic aneurysm surgery compared with Pākehā, when adjusted for age, sex, and ASA and CCI scores (Nair et al 2012; POMRC 2017).

Reduced access to care means that Māori are more likely to have emergency operations, which are associated with higher mortality rates (Lassiter et al 2017; POMRC 2017). Consequently, Indigenous patients are more likely to experience postoperative complications (Lassiter et al 2017). Even for illnesses where Māori are under-represented, their mortality rate is still much higher than it is for non-Māori. For example, despite having 28% fewer hip fractures than non-Māori, Māori still had 65% higher age-adjusted 30-day mortality following hip fracture repair surgery than non-Māori (POMRC 2018). Comparisons of age-standardised mortality for previous POMRC reports show that Māori have considerably higher mortality for every procedure investigated by the POMRC (Table 1).

Table 1: Māori vs non-Māori age-standardised mortality ratios for POMRC tracking procedures (acute and elective), Aotearoa New Zealand 2012–17

	Time period	Crude mortality rate (%)	Age-standardised mortality ratio (SMR)	A-SMR 95% confidence interval (CI)
General anaesthetic or neuraxial anaesthesia	2 days	0.12	2.18	1.96–2.43
General anaesthetic or neuraxial anaesthesia	30 days	0.53	2.14	2.01–2.26
General anaesthetic or neuraxial anaesthesia	90 days	0.91	2.07	1.97–2.16
Abdominal aortic aneurysm repair	30 days	6.92	1.19	0.80–1.75
Abdominal aortic aneurysm repair	90 days	8.31	1.31	0.93–1.84
ASA 1 & 2	30 days	0.04	1.46	0.96–2.22
ASA 1 & 2	90 days	0.11	1.24	0.94–1.64
ASA 4 & 5	30 days	11.28	1.15	1.05–1.25
ASA 4 & 5	90 days	15.38	1.16	1.07–1.25
Coronary artery bypass graft	30 days	2.95	2.08	1.57–2.76
Coronary artery bypass graft	90 days	3.32	2.07	1.59–2.70
Cholecystectomy (gall bladder removal)	30 days	0.31	2.3	1.43–3.70
Cholecystectomy (gall bladder removal)	90 days	0.49	2.75	1.93–3.90
Colorectal resection	30 days	3.26	2.53	1.98–3.22
Colorectal resection	90 days	4.65	2.36	1.92–2.90
Hip arthroplasty	30 days	1.38	1.31	0.91–1.88
Hip arthroplasty	90 days	2.7	1.27	0.98–1.64
Percutaneous transluminal coronary angioplasty	30 days	1.91	1.73	1.36–2.21
Percutaneous transluminal coronary angioplasty	90 days	2.41	1.82	1.47–2.27

The above table shows there is increased mortality for Māori in almost all procedures we have studied. The excess mortality seen in emergency laparotomy is by no means large compared with other groups of surgical patients. The figures show the overall safety of surgery in Aotearoa New Zealand but the increase in mortality for Māori patients is system-wide.

Patient story 2: Whānau of Māori man in his 70s

We took him into the ED and he had a CT scan. The doctors arranged for a surgeon to come and talk to us. They told us he was really sick and needed an urgent operation. The surgeon asked about medical problems and medication but didn't ask anything about who he was or who we were other than that we were family. They didn't seem to care about what his role was within our whānau and hapū and where we were from. We were worried that if the surgeons didn't know who he was and didn't understand us, then they wouldn't be able to look after him properly in the theatre. It was really important to us that we felt that the surgeons cared about him.

There were only three of us there at the time and it was very stressful trying to get hold of the rest of the whānau.

They arranged for a kaumātua to come to meet with us, and we were able to go down to the theatre with him and do karakia there. That made us feel much better and more comfortable that he would be protected and looked after.

After the operation, he went to the intensive care unit. The surgeon didn't ring to tell us how the operation went, and we were waiting for ages to hear how he was. The nurses told us the surgeons were pleased with how things had gone and would see us tomorrow. We felt that they should have understood how concerned we were and rung us or come to talk to us about the operation. It made us feel really upset and unimportant, and it was hard to trust that they cared about us.

In the intensive care unit, only one of us could stay with him at a time. The ward rounds were huge, and the doctors were only concerned with his 'numbers' and the machines. No one seemed worried about his wairua or how our whānau was coping. They treated him like a medical problem and not a whole person. They didn't consider that we might be able to help make him better as well. We got that feeling that they thought he wouldn't make it and that we should expect him not to because he was old and had a few medical problems. They didn't understand that although he isn't employed, he does lots of important work for our whānau and marae, and that he was very much needed and loved.

Some of the staff could pronounce his name properly, but most didn't. One time we corrected someone who had mispronounced his name, and she just said that was how she said it, she couldn't pronounce Māori words. It made us feel angry and hurt. We didn't feel like it was a caring environment for him to be in. We realised he needed more medical care, but we felt it would be better for him if we could look after him at home.

Aspects of care that could be improved
The patient experienced differential quality of health care.

- Whānau were repeatedly offended by staff who had low cultural competency.
- Staff refused to try to pronounce Māori names and words.
- Whānau wanted:

- their loved one treated like a whole person, not a medical problem (Te Whare Tapa Whā)
- staff to value their loved one and understand that he was important to his whānau and hapū
- the surgeon to speak to them about how the surgery went
- to be acknowledged as important for their loved one's wellbeing (taha whānau)
- to be able to visit their loved one in intensive care together (taha hinengaro, taha wairua, taha whānau).

Ways that these could be addressed

Quality of health care

- Staff should have cultural safety and competency training.

- Staff should make an effort to pronounce people's names correctly and use Māori words like 'Kia ora!' (Hello!) 'Kei te pēhea koe?' (How are you?) 'Kia kaha!' (Be strong! – a common encouragement). This can really help put Māori at ease and make them feel more at home. Many Māori are uncomfortable in hospitals and associate death with hospitals. These little acts of kindness and familiarity by staff go a long way.

- Whānau are an important component of wellbeing for Māori. This is a component of the Meihana and Te Whare Tapa Whā models (see below).

- Communicating with the patient's whānau is important.

- There needs to be supportive care wrapped around the patient and their whānau. This relieves the nurses of a job where they are already stretched and under-resourced. The patient needed to be advised that there was a Māori health team and asked if he would like someone to meet with him. Not all Māori patients want this; it's important to ask first.

- When Māori have loved ones who are sick, we gather around not just to visit the sick person but also to awhi (physically comfort) and tautoko (support) each other.

- Also, if the surgery is risky, Māori want to be with their loved ones just in case they pass. Death is an extremely tapu (sacred and restricted) time, and it's especially important to Māori that people are not left on their own to die. Also, once a person has passed, it is our custom that they are not left alone. It is especially important for the women of the whānau to be with the tūpāpaku (deceased person's body).

Summary

Understanding and improving health for Māori is not just good for Māori, it is good for our nation as a whole. As Te Tiriti partners, it is a responsibility the Crown must address.

Institutional racism is a systemic pathway to inequity that has been shown to have a negative impact on Māori health. Māori generally have a greater burden of preoperative comorbidities than non-Māori, which negatively impact surgical outcomes.

Health care access is a major systems issue that has critical implications for Māori. Reduced access to care means that Māori are more likely than non-Māori to have emergency operations, which are associated with higher mortality. Māori are also less likely to receive best practice treatment interventions and surgical treatments, and more likely to experience postoperative complications.

Taking a systems-level view to investigate emergency laparotomy mortality data in terms of inequities in surgical health outcomes between Māori and non-Māori will provide much needed information on inequities in exposures and health opportunities, access to appropriate health care, and the quality of care delivered. This work provides an important opportunity for the POMRC to contribute to improving health sector performance in terms of surgical health for Māori and gaining a better understanding about the factors and pathways within surgical systems that impact on equity for Māori.

Inequities in the epidemiology of and mortality following emergency laparotomy operations | Ngā kore ōritenga ki te mātai tahumaero o ngā poka hahae puku ohotata me te matenga whai muri mai

This section uses information from the National Minimum Dataset (NMDS) and the National Mortality Collection (NMC) to describe people undergoing emergency laparotomy operations in New Zealand between 1 January 2012 and 31 December 2017. Detailed information about data sources and methods are presented in Appendix 1. To account for differences in the age distributions of the Māori and non-Māori populations, the data was age-standardised to the 2001 Māori resident population (Ministry of Health 2018) or adjusted for age using regression modelling.

Descriptive epidemiology

Between 2012 and 2017 there were 28,481 admissions for emergency laparotomy. Of these admissions, 12.5% were Māori, 5.5% were Pacific peoples, 6.2% were Asian, 0.9% were Middle Eastern, Latin American and African (MELAA) and 74.9% were New Zealand European (Pākehā). Since this report is focused on equity in surgical outcomes for Māori, all subsequent comparisons are between Māori (3,624) and non-Māori (24,456, comprising Pākehā, Pacific peoples, Asian and MELAA combined). People with missing ethnicity data (n=401) were excluded from the analysis.

The median age among Māori undergoing emergency laparotomy was 50 years, compared with 62 years for non-Māori (Table 2). As shown in Figure 1, the age distribution of the Māori surgical population was considerably younger than non-Māori, reflecting a similar age difference in the whole population. A total of 13.4% of Māori emergency laparotomy patients were aged over 70 years, compared with 35.5% of non-Māori. The Māori and non-Māori surgical populations differed by deprivation level; 50.6% of Māori undergoing emergency laparotomies lived in the most deprived areas (New Zealand Index of Deprivation 2013 (NZDep2013) quintile 5), compared with 21.4% of non-Māori. This is mostly a reflection of the population distribution by deprivation. Based on the 2013 Census, 40% of Māori and 15% of non-Māori lived in the most deprived areas.

The overall age-standardised emergency laparotomy incidence for Māori was 71.7 per 100,000 (95% CI 69.2–74.1) compared with 52.8 per 100,000 in non-Māori (95% CI 52.0–53.7). This equates to Māori being 36% more likely to have an emergency laparotomy than non-Māori. In both Māori and non-Māori, women are about 20% more likely to have an emergency laparotomy than men; the female to male ratio is 1.27 in Māori and 1.20 in non-Māori. However, the inequity between Māori and non-Māori is present, and of similar magnitude, in men and women (Table 3). Similarly, for every age group from 20 to 79 years, the rates in Māori are higher than in non-Māori.

In each year, the age-standardised incidence rate was higher in Māori than non-Māori (Table 4). By 2017, Māori had a 54% higher rate of emergency laparotomy compared with non-Māori. The

age-adjusted Māori laparotomy incidence rates vary by DHB (Table 5 and Figure 2). Particularly high rates for Māori are seen in Lakes, Whanganui, Hawke's Bay and Counties Manukau. In all DHBs, the rate of surgery for Māori was higher than for non-Māori. The only exceptions were West Coast and South Canterbury, for which the rates are based on 8 and 16 cases respectively.

Māori have a higher burden of disease at the time of surgery compared with non-Māori, as measured by both ASA and CCI scores (Table 6 and Table 7). This higher burden is associated with poorer health outcomes and more complex clinical management. Details of the inequities in ASA score are shown in Table 6. Māori having surgery are less likely to be 'healthy or have mild systemic disease' (ASA 1 or 2) than non-Māori, but more likely to have an ASA score of 4 or 5, when compared with non-Māori. Details of the inequities in comorbidities are shown in Table 7. Using the overall CCI, Māori are 53% more likely than non-Māori to have a score of 3 or 4 (rate ratio (RR) 1.53; 95% CI 1.38–1.68), and 58% more likely than non-Māori to have weighted CCI scores of 5 or more (RR 1.58; 95% CI 1.4–1.71).

The most common comorbidities/pre-existing conditions in Māori were smoking (40.8%), complicated diabetes (15.1%), cancer (12.2%) and hypertension (11.9%) (Table 7). The comorbidities with the highest inequity, where the rate in Māori was over twice the rate in non-Māori, were smoking, diabetes, chronic obstructive pulmonary disease and renal disease. It is important to note that a large proportion of patients did not have known data on comorbidities, precluding the calculation of CCI score, so the reliability of this data is uncertain.

Looking specifically at colorectal cancer, 19.7% of Māori having emergency laparotomies have had a colorectal cancer diagnosis, compared with 27.5% in non-Māori (Table 8). Having accounted for age, the prevalence of colorectal cancer among people undergoing laparotomy is lower in Māori than non-Māori (prevalence odds ratio (OR) 0.90; 95% CI 0.80–1.00). Māori with colorectal cancer were more likely to have low grade (grade 1) disease, but the cancer was less likely to be localised (extent A) compared with non-Māori.

The indications for and procedures during emergency laparotomy differ for Māori and non-Māori. The most common indication for surgery in Māori and non-Māori was adhesive small bowel obstruction (Table 9). Māori were more likely to have a diagnosis of hernia, peritonitis and sepsis, and less likely to have had an emergency laparotomy for appendicitis. Among people having emergency laparotomy, the most common procedure was division of adhesions (Table 10). Drainage procedures and exploratory laparotomies were more common in Māori than non-Māori and colectomies were less common.

Mortality

Among the 28,481 people admitted for emergency laparotomy, there were 1,566 deaths (5.5%). Māori have an overall 30-day age-adjusted mortality from emergency laparotomy of 8.8%, compared with 5.5% in non-Māori. Having accounted for age, this equates to 51% higher 30-day mortality (RR 1.51; 95% CI 1.19–1.92). We also looked at 90-day mortality data and found Māori have an overall 90-day age-adjusted mortality from emergency laparotomy of 12.7%,

compared with 8.4% in non-Māori. Further analysis of 90-day mortality factors showed similar patterns to those found for the 30-day mortality data, so only the latter are presented.

Age-specific mortality rates are shown in Table 11. Mortality rates increase as age increases. However, in every age group decade from 40 to 79 years, Māori mortality rates are higher than non-Māori. Mortality rates according to deprivation level are shown in Table 12. Increasing proportions of patients died with increasing deprivation levels. At each level of deprivation, Māori mortality rates are higher than non-Māori. Since 50.6% of Māori live in NZDep2013 quintile 5 compared with only 21.4% of non-Māori, socioeconomic deprivation has a large impact on mortality. Even when both age and deprivation are adjusted for, Māori still have 47% higher overall 30-day mortality for emergency laparotomies than non-Māori (OR 1.47; 95% CI 1.26–1.72). No significant differences were observed in Māori mortality between DHBs (see Appendix 3).

We developed a multivariable model of 30-day mortality following emergency laparotomy comparing Māori with non-Māori (Table 13). This model allows the sequential adding of variables to investigate the role that one or more factors play in explaining the inequities in mortality. When age and sex are adjusted for, Māori have 64% higher overall 30-day mortality than non-Māori. Adjusting for socioeconomic deprivation reduced the excess mortality to 48%; that is, deprivation explained 25% of the excess mortality. Additionally, adjusting for comorbidities and health care access reduced the excess mortality to 23%. There remained a 22% higher mortality in Māori compared with non-Māori that could not be explained by factors that we adjusted for, including selected complications.

Framework for analysis of inequity in mortality between Māori and non-Māori

Inequities in socioeconomic deprivation and opportunities for health contribute to inequity in mortality

As noted above, Māori are more likely to be exposed to detrimental effects of living in areas of deprivation, and this socioeconomic deprivation is related to mortality (Table 12), which results in deprivation having a large impact on mortality in Māori. However, as noted above, this explains only part of the inequities in mortality experienced by Māori.

Higher levels of comorbidities (as measured by the CCI) and having had diabetes or colorectal cancer were associated with higher levels of mortality (Table 14). Among people with a specific level of comorbidity, the inequity in mortality persisted. Having adjusted for each comorbidity separately, the same inequity persisted. The results show that the presence of comorbidities individually does not explain the mortality inequities between Māori and non-Māori. However, the combination of more than one comorbidity has a greater effect on Māori than non-Māori. For example, when Māori have both diabetes and a weighted CCI score of 3–4, 30-day age-adjusted mortality increases to 111%. When Māori have both diabetes and a weighted CCI score of > 5, 30-day age-adjusted mortality goes up 168% compared with non-Māori with the same conditions. Furthermore, the higher level of comorbidities in Māori (Table 7) means that

the impact of the association between comorbidity and mortality will be greater for Māori than for non-Māori.

Inequities in access to health care contribute to higher Māori mortality

To investigate access to care, we used as a marker the use of health services (general practice and ED visits) prior to surgery.

A total of 4.7% of Māori and 4.6% of non-Māori visited their general practitioner (GP) in the 90 days prior to admission for emergency laparotomy surgery (Table 15). Having accounted for age, Māori were 20% more likely to have visited their GP than non-Māori. Of those who visited their GP, Māori were younger than non-Māori and had slightly more comorbidities on average (data not shown). In the 90 days prior to surgery, Māori were 40% more likely to attend the ED than non-Māori. When the number of ED visits were considered, Māori were 32% more likely to visit once and 53% more likely to visit two or more times than non-Māori. We also looked at whether the people going to the ED were the same as those going to their GPs, but this was not the case.

Among Māori, there was a higher mortality rate among people who had had some contact with the health system in the 90 days prior to surgery compared with those who did not (Table 16). For example, among Māori, 5.8% of people who had seen a GP died, compared with 3.7% who did not. This was not seen among non-Māori. This suggests that Māori who are accessing primary health care are likely to be more ill than those not accessing care, whereas for non-Māori, accessing care did not appear to be related to significant illness (as measured by mortality risk). Thus, we can see that there are inequities in access to primary health care. The inequities in accessing primary care appeared to result in higher inequities in mortality; these differences could have been due to chance. What was clear from the data was that Māori had a higher rate of mortality compared with non-Māori, both in health service users and non-users.

Inequities in quality of care

We investigated complications as a marker of the quality of care received. Māori were more likely to have in-hospital complications following emergency laparotomy surgery than non-Māori. The most common complications for Māori were severe sepsis (7.3%), renal failure (4.6%) and pneumonia (3.8%) (Table 17). Māori were more likely to experience each of these complications than non-Māori. However, the presence of complications was not related to inequities in mortality; the higher mortality rates in Māori were evident in those with and without each complication (Table 18).

Although the indication for surgery and the procedures performed differed between Māori and non-Māori, there was no evidence within the data to suggest that these contributed to inequities in mortality (Table 19 and Table 20).

Tables and figures

Table 2: Demographics of people undergoing emergency laparotomy in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori n=3,624	Non-Māori n=24,456	P-value comparing Māori to non-Māori
Age at discharge			
Median (inter-quartile range)	50 (35–62)	62 (45–74)	< 0.001
< 70 years	3,138 (86.6%)	15,762 (64.5%)	
70+ years	486 (13.4%)	8,694 (35.5%)	< 0.001
Sex			
Female	2,110 (58.2%)	13,127 (53.7%)	
Male	1,514 (41.8%)	11,329 (46.3%)	< 0.001
NZDep2013 (quintiles)			
1 (least deprived)	166 (4.6%)	4,091 (17.0%)	
2	269 (7.5%)	4,254 (17.6%)	
3	479 (13.3%)	5,012 (20.8%)	
4	867 (24.0%)	5,584 (23.2%)	
5 (most deprived)	1,827 (50.6%)	5,154 (21.4%)	< 0.001

Table 3: Emergency laparotomy rates in Māori and non-Māori by sex and age, Aotearoa New Zealand 2012–17

	Māori			Non-Māori		
	Cases	Rate	95% CI	Cases	Rate	95% CI
Sex						
Female	2,110	79.6	76.1–83.2	13,127	57.6	56.3–58.8
Male	1,514	62.8	59.6–66.2	11,329	47.9	46.8–49.1
Age at surgery (years)						
15–19	97	22.8	18.7–27.8	362	24.7	22.3–27.4
20–24	279	74.8	66.5–84.1	1,025	63.2	59.5–67.2
25–29	273	93.2	82.8–104.9	1,017	65.1	61.2–69.2
30–34	252	103.1	91.2–116.7	1,073	72.9	68.6–77.3
35–39	257	106.8	94.5–120.7	1,077	75.2	70.8–79.8
40–44	302	118.8	106.1–132.9	1,356	84.7	80.4–89.4
45–49	350	143.9	129.6–159.8	1,548	93.8	89.3–98.6
50–54	362	158.0	142.6–175.2	1,725	104.0	99.2–109.0
55–59	353	190.7	171.9–211.7	1,972	129.8	124.2–135.6
60–64	330	236.2	212.1–263.1	2,108	155.2	148.8–162.0
65–69	283	285.4	254.1–320.6	2,499	206.8	198.9–215.1
70–74	211	322.7	282.1–369.2	2,580	281.6	270.9–292.6
75–79	157	381.3	326.2–445.6	2,376	353.9	340.0–368.4
80–84	85	385.3	311.7–476.2	2,015	421.5	403.5–440.2
85+	33	277.1	197.4–388.9	1,723	373.2	356.0–391.2

Note: Rates for males and females are age-standardised.

CI = confidence interval.

Table 4: **Emergency laparotomy rates in Māori and non-Māori by year, Aotearoa New Zealand 2012–17**

	Māori			Non-Māori			Māori to non-Māori
	Cases	Rate	95% CI	Cases	Rate	95% CI	RR
Year of surgery							
2012	571	71.3	65.4–77.6	3,983	53.9	51.8–56.1	1.32
2013	543	66.3	60.7–72.4	4,041	54.2	52.1–56.4	1.22
2014	520	61.8	56.3–67.6	4,075	53.5	51.4–55.6	1.16
2015	637	75.1	69.1–81.5	4,075	52.1	50.0–54.2	1.44
2016	652	76.2	70.1–82.6	4,181	52.3	50.3–54.4	1.46
2017	701	79.1	73.1–85.6	4,101	51.4	49.5–53.5	1.54

Note: Rates are age-standardised.

CI = confidence interval.

RR = rate ratio.

Table 5: Rates of emergency laparotomy by DHB in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori			Non-Māori		
	Cases	Rate	95% CI	Cases	Rate	95% CI
DHB						
Tairāwhiti	127	67.4	55.2–81.9	208	59.0	47.9–73.6
Lakes	233	92.2	80.0–105.8	453	55.0	48.4–62.8
Northland	297	69.4	61.1–78.9	856	57.0	51.2–63.5
Whanganui	101	89.8	72.2–110.8	459	76.7	66.6–88.4
Hawke's Bay	248	88.3	77.0–101.0	1,027	62.2	56.7–68.3
Bay of Plenty	273	69.8	61.2–79.4	1,075	45.4	41.4–49.9
Waikato	521	83.7	76.4–91.6	2,148	57.9	54.7–61.3
MidCentral	119	52.2	42.9–63.1	967	52.1	47.7–57.1
Taranaki	90	58.1	46.2–72.6	673	55.3	49.6–61.7
Hutt Valley	106	64.0	52.1–77.9	680	45.5	41.2–50.2
Wairarapa	35	63.2	43.0–91.8	254	51.0	41.8–62.6
Counties Manukau	467	87.9	79.9–96.6	2,212	51.7	49.2–54.3
Capital & Coast	135	54.1	45.2–64.5	1,318	44.0	41.3–47.0
West Coast	8	31.1	12.7–68.0	184	55.8	45.4–69.0
Nelson Marlborough	53	49.8	36.7–66.8	755	45.7	41.0–50.9
Waitematā	271	69.8	61.6–79.0	3,187	55.2	52.9–57.6
Southern	146	74.4	62.3–88.4	2,412	67.2	63.7–70.9
Canterbury	143	42.5	35.6–50.5	2,450	39.6	37.7–41.8
Auckland	225	74.4	64.8–85.4	2,424	52.6	50.3–55.0
South Canterbury	16	39.0	21.5–69.3	374	45.4	38.8–53.6

Note: Rates are age-standardised. The DHBs are ordered by the proportion of the population who identify as Māori.
CI = confidence interval.

Table 6: Prevalence of ASA score in Māori and non-Māori undergoing emergency laparotomy, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
ASA score						
1	473	16.9	3,450	18.1	0.62	0.52–0.72
2	1,113	39.7	7,318	38.3	0.89	0.81–0.96
3	820	29.2	5,965	31.2	1.14	1.05–1.23
4	351	12.5	2,136	11.2	1.53	1.40–1.67
5	50	1.8	227	1.2	1.84	1.48–2.20

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).
ASA = American Society of Anesthesiologists.
CI = confidence interval.

Table 7: Prevalence of comorbidities in Māori and non-Māori undergoing emergency laparotomy, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
Comorbidity						
Current smoker	1,008	40.8	3,667	14.8	2.06	1.99–2.12
Ever smoker	1,479	27.8	7,397	29.8	1.18	1.10–1.26
Diabetes (complicated)	440	15.1	1,631	8.7	2.31	2.19–2.44
Diabetes (uncomplicated)	97	3.3	434	2.3	1.45	1.20–1.71
Cancer (any malignancy)	354	12.2	3,305	17.6	0.80	0.66–0.94
History of hypertension	430	11.9	2,294	9.2	1.71	1.59–1.84
Chronic obstructive pulmonary disease	282	9.7	1,046	5.6	2.17	2.02–2.33
Renal disease	279	9.6	1,123	6.0	2.02	1.86–2.18
Congestive heart failure	190	6.5	846	4.5	2.33	2.13–2.52
Atrial fibrillation and flutter	195	5.4	1,195	4.8	1.86	1.68–2.04
Metastatic solid tumour	134	4.6	1,227	6.5	0.68	0.47–0.90
Cerebrovascular disease	116	4.0	811	4.3	1.44	1.21–1.68
Mild liver disease	115	4.0	515	2.7	1.31	1.08–1.54
Peripheral vascular disease	114	3.9	760	4.0	1.28	1.04–1.52
Peptic ulcer disease	99	3.4	418	2.2	1.76	1.50–2.03
Myocardial infarction	89	3.1	768	4.1	1.15	0.89–1.41
Hemiplegia or paraplegia	91	3.1	450	2.4	1.86	1.58–2.14
Palliative care	53	1.5	456	1.8	1.10	0.74–1.47
Moderate/severe liver disease	24	0.8	205	1.1	0.74	0.21–1.27
Dementia	17	0.6	198	1.1	1.36	0.78–1.93
Rheumatoid disease	16	0.6	201	1.1	0.42	NA
CCI (weighted)						
0	1,634	45.1	10,798	44.2	0.88	0.81–0.94
1–2	599	16.5	4,284	17.5	1.15	1.05–1.26
3–4	292	8.1	1,636	6.7	1.53	1.38–1.68
5+	384	10.6	2,072	8.5	1.58	1.45–1.71
Unknown	715	19.7	5,666	23.2	0.75	0.66–0.85

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval.

CCI = Charlson Comorbidity Index.

Table 8: Colorectal cancer by extent and grade in Māori and non-Māori having an emergency laparotomy, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
Colorectal cancer diagnosis	714	19.7	6,703	27.4	0.90	0.80–1.00
Extent						
A	38	5.3	428	6.4	0.50	0.08–0.91
B	121	16.9	1,143	17.1	1.01	0.77–1.26
C	79	11.1	806	12.0	0.99	0.67–1.31
D	124	17.4	1,317	19.6	0.92	0.68–1.15
E	172	24.1	1,452	21.7	1.04	0.84–1.24
F	134	18.8	1,191	17.8	1.11	0.89–1.33
G	46	6.4	366	5.5	1.34	0.94–1.74
Grade						
1	87	16.8	490	10.0	1.91	1.61–2.21
2	264	50.9	2,781	56.7	0.89	0.72–1.06
3	143	27.6	1,437	29.3	0.87	0.64–1.09
4	25	4.8	193	3.9	1.23	0.70–1.76

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval. The extent and grade data come from the Cancer registry: https://www.health.govt.nz/nz-health-statistics/national-collections-and-surveys/collections/new-zealand-cancer-registry-nzcr/new-zealand-cancer-registry-table-available-data

Grade of tumour code: A code specifying the differentiation of the tumour: how much or how little it resembles the normal tissue from which it arose.

Extent of disease code: A code describing the stage of development reached by the tumour at diagnosis.

Table 9: Diagnoses associated with emergency laparotomy surgery according to diagnostic coding in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
Indication						
Peritoneal adhesions	1,010	27.9	6,360	26.0	0.99	0.90–1.07
Intestinal obstruction	654	18.1	6,023	24.6	0.92	0.82–1.02
Appendicitis	418	11.5	2,745	11.2	0.77	0.65–0.89
Cholelithiasis	411	11.3	2,336	9.6	1.03	0.90–1.16
Hernia	325	9	2,241	9.2	1.26	1.11–1.41
Injury of intra-abdominal organs	211	5.8	992	4.1	1.14	0.96–1.31
Diverticular disease	195	5.4	1,541	6.3	0.95	0.77–1.13
Peritonitis	251	6.9	1,386	5.7	1.18	1.02–1.34
Vascular disorder of intestines	160	4.4	1,399	5.7	1.10	0.89–1.31
Associated diagnosis						
Other disorders of fluid	298	8.2	2,054	8.4	1.22	1.07–1.38
Volume depletion	287	7.9	2,142	8.8	1.15	0.99–1.3
Acute kidney failure	270	7.5	1,434	5.9	1.66	1.50–1.82
Sepsis	228	6.3	1,249	5.1	1.39	1.22–1.56

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).
CI = confidence interval.

Table 9 shows that the frequency of associated diagnoses is similar between Māori and non-Māori. Sepsis and acute kidney failure, diagnoses that may represent illness severity or the occurrence of complications, are more common among Māori patients.

Table 10: Common procedures undertaken during emergency laparotomy in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	Cases	%	Cases	%	RR	95% CI
Procedure						
Division of abdominal adhesions	1,540	43.0	10,430	42.6	1.01	0.94–1.08
Other incision procedures (drainage)	657	16.7	3,646	14.9	1.12	1.02–1.22
Resection of small intestine	307	10.8	2,640	10.8	1.00	0.84–1.15
Colectomy	298	9.9	3,235	13.2	0.75	0.60–0.90
Other excision procedures (debridement)	343	7.9	1,881	7.7	1.02	0.88–1.17
Other repair on small intestine	177	5.3	1,157	4.7	1.11	0.92–1.30
Laparotomy (exploratory)	210	5.7	1,039	4.2	1.34	1.16–1.51
Rectosigmoidectomy or proctectomy	128	4.6	1,079	4.4	1.05	0.82–1.28
Stomas of small intestine	113	3.5	1,018	4.2	0.83	0.59–1.08

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).
CI = confidence interval.

Table 11: Mortality by age in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori			Non-Māori			Māori to non-Māori	
	Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Age (years)								
< 40	1,158	15	1.30	4,554	35	0.77	1.69	0.86–3.17
40–49	652	20	3.07	2,904	45	1.55	1.98	1.11–3.42
50–59	715	37	5.17	3,697	104	2.81	1.84	1.23–2.70
60–69	613	52	8.48	4,607	246	5.34	1.59	1.15–2.15
70–79	368	51	13.86	4,956	413	8.33	1.66	1.22–2.23
80–89	108	13	12.04	3,241	427	13.17	0.91	0.48–1.58
90+	10	2	20.00	497	82	16.50	1.21	0.14–4.52

Note: The table shows age-specific percentages and rate ratios (RR).

CI = confidence interval.

Table 12: Comparison of mortality by NZDep2013 quintile in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori			Non-Māori			Māori to non-Māori	
	Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Deprivation quintile								
1	166	6	2.73	4,091	172	1.81	1.51	0.72–3.17
2	269	12	3.48	4,254	212	2.13	1.64	0.94–2.85
3	479	21	2.89	5,012	255	2.06	1.40	0.91–2.17
4	867	40	3.40	5,584	371	2.66	1.28	0.93–1.76
5	1,827	111	4.42	5,154	321	2.83	1.57	1.27–1.93
Total	**3,624**	**190**	**3.34**	**24,456**	**1,352**	**2.27**	**1.47***	**1.18–1.84**

Note: The table shows crude percentages per deprivation quintile and age-standardised rate ratios (RR).

Excludes 377 people (21 deaths, all in non-Māori) for whom no NZDep2013 quintile was available.

* Adjusted for age and deprivation quintile.

CI = confidence interval.

Table 13: Contribution of variables to inequity in mortality between Māori and non-Māori, Aotearoa New Zealand 2012–17

Variables included in the model	Rate ratio	95% CI
Adjusted for age and gender	1.64	1.41–1.90
+ deprivation	1.48	1.27–1.72
+ CCI, selected diagnoses and prior GP and ED access	1.23	1.06–1.44
+ selected complications (severe sepsis, renal failure, pneumonia)	1.22	1.05–1.42
Adjusted for age, gender, and ASA score	1.09	0.89–1.34

Note: Selected diagnoses were smoking, hypertension, atrial fibrillation, palliative care and colorectal cancer.
ASA = American Society of Anesthesiologists.
CI = confidence interval.
CCI = Charlson Comorbidity Index.
ED = emergency department.
GP = general practitioner.

Table 14: Mortality by comorbidity in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori			Non-Māori			Māori to non-Māori	
	Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
CCI								
0	1,634	44	2.69	10,798	362	1.74	1.55	1.14–2.10
1–2	599	36	3.46	4,284	352	2.93	1.18	0.85–1.65
3–4	292	36	6.69	1,636	184	3.77	1.77	1.27–2.48
≥ 5	384	53	7.42	2,072	261	4.81	1.54	1.17–2.03
(Missing)	715	21	2.62	5,666	193	2.1	1.25	0.81–1.93
Total							**1.44**	**1.23–1.69**
Diabetes								
None	2,372	110	3.70	16,725	960	2.47	1.50	1.24–1.82
Uncomplicated	97	7	4.66	434	38	3.38	1.38	0.64–2.96
Complicated	440	52	5.82	1,631	161	3.32	1.76	1.30–2.37
Total							**1.54**	**1.16–2.04**
Colorectal cancer								
No	2,910	136	3.78	17,753	849	2.31	1.64	1.37–1.95
Yes	714	54	3.92	6,703	503	2.44	1.61	1.23–2.10
Total							**1.62**	**1.38–1.91**

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

The 'Total' rows show the mortality rate ratio adjusted for age and the relevant comorbidity.

CI = confidence interval.

CCI = Charlson Comorbidity Index.

Table 15: Health service usage in the 90 days prior to emergency laparotomy in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
GP visit in 90 days prior to surgery	172	4.7	1,122	4.6	1.20	0.99–1.40
Number of previous health care visits with previous 90 days						
0	3,452	95.3	23,334	95.4	0.99	0.95–1.04
1	112	3.1	770	3.1	1.19	0.94–1.44
2+	60	1.7	352	1.4	1.21	0.87–1.55
Any ED visit in the 90 days prior to surgery	1,021	28.2	5,221	21.0	1.40	1.31–1.48
Number of ED visits in the 90 days prior to surgery						
0	2,583	71.8	19,636	79.0	0.89	0.84–0.95
1	621	17.3	3,318	13.3	1.32	1.21–1.42
2+	420	10.9	1,903	7.7	1.53	1.39–1.66

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval.

ED = emergency department.

GP = general practitioner.

Table 16: Mortality by health service usage prior to surgery in Māori and non-Māori undergoing emergency laparotomy, Aotearoa New Zealand 2012–17

		Māori			Non-Māori			Māori to non-Māori	
		Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Any GP visits within previous 90 days	No	3,452	174	3.70	23,334	1,277	2.33	1.58	1.36–1.85
	Yes	172	16	5.78	1,122	75	2.60	2.22	1.33–3.72
Number of GP visits within previous 90 days	0	3,452	174	3.70	23,334	1,277	2.33	1.58	1.36–1.85
	1	112	11	5.85	770	41	2.10	2.79	1.49–5.24
	2+	60	5	5.61	352	34	3.66	1.53	0.62–3.82
Any ED presentations within 90 days prior to admission	No	2,603	123	3.54	19,294	1,016	2.28	1.55	1.29–1.87
	Yes	1,021	67	4.44	5,162	336	2.59	1.71	1.33–2.21
Number ED presentations within 90 days prior to admission	0	2,603	123	3.54	19,294	1,016	2.28	1.55	1.30–1.87
	1	627	39	4.28	3,279	199	2.38	1.80	1.30–2.49
	2+	394	28	4.68	1,883	137	2.96	1.58	1.07–2.34

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval.

ED = emergency department.

GP = general practitioner.

Table 17: Incidence of complications in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori		Non-Māori		Māori to non-Māori	
	n	%	n	%	RR	95% CI
Complication						
Severe sepsis	264	7.3	1,702	6.8	1.20	1.05–1.35
Renal failure	166	4.6	989	4.0	1.57	1.37–1.77
Pneumonia	137	3.8	1,016	4.1	1.24	1.03–1.46
Cardiac arrest*	31	0.9	134	0.5	2.15	1.71–2.59
Myocardial infarction	20	0.6	175	0.7	1.14	0.65–1.64
Heart failure	17	0.5	171	0.7	1.18	0.60–1.76
Pulmonary embolism	12	0.3	104	0.4	1.08	0.37–1.79
Stroke	8	0.2	57	0.2	1.59	0.65–2.53
Urosepsis	2	0.1	11	<0.1	1.78	0.08–3.48

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

* This does not include events coded as myocardial infarction, so the rates may be an underestimate, but it is unlikely to have affected the rate ratios as much.

CI = confidence interval.

Table 18: Mortality by most common complications in Māori and non-Māori, Aotearoa New Zealand 2012–17

		Māori			Non-Māori			Māori to non-Māori	
		Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Severe sepsis	**Yes**	264	38	14	1,677	230	14	1.58	1.16–2.16
	No	3,360	152	5	22,779	1,122	5	1.59	1.35–1.88
Pneumonia	**Yes**	137	15	11	1,001	125	12	1.44	0.88–2.36
	No	3,487	175	5	23,455	1,227	5	1.63	1.40–1.90
Renal failure	**Yes**	166	31	19	971	231	24	1.22	0.88–1.69
	No	3,458	159	5	23,485	1,121	5	1.62	1.38–1.91
Myocardial infarction	**Yes**	20	4	20	172	41	24	1.33	0.54–3.28
	No	3,604	186	5	24,284	1,311	5	1.63	1.40–1.89
Heart failure	**Yes**	17	8	47	169	61	36	2.03	1.21–3.40
	No	3,607	182	5	24,287	1,291	5	1.61	1.38–1.87

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).
CI = confidence interval.

Table 19: Mortality by most common diagnoses in Māori and non-Māori, Aotearoa New Zealand 2012–17

		Māori			Non-Māori			Māori to non-Māori	
		Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Peritoneal adhesions	No	2,614	162	4.38	18,096	1,181	2.72	1.61	1.37–1.89
	Yes	1,010	28	2.36	6,360	171	1.41	1.67	1.13–2.46
	Total			**3.21**			**1.96**	**1.64**	**1.33–2.02**
Intestinal obstruction	No	2,970	147	3.88	18,433	956	2.40	1.62	1.36–1.91
	Yes	654	43	3.43	6,023	396	2.09	1.64	1.21–2.23
	Total			**3.65**			**2.24**	**1.63**	**1.37–1.94**
Appendicitis	No	3,206	190	4.27	21,711	1,338	2.64	1.62	1.39–1.88
	Yes	418	0	0	2,745	14	0.44	–	–
	Total						**1.08**		
Cholelithiasis	No	3,213	185	4.14	22,120	1,322	2.56	1.62	1.39–1.88
	Yes	411	5	1.11	2,336	30	0.65	1.71	0.67–4.37
	Total			**2.14**			**1.29**	**1.66**	**1.03–2.68**
Hernia	No	3,299	173	3.92	22,215	1,248	2.41	1.63	1.39–1.90
	Yes	325	17	2.71	2,241	104	1.49	1.82	1.11–2.98
	Total			**3.26**			**1.89**	**1.72**	**1.33–2.23**

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval.

Table 20: Mortality by most common procedures in Māori and non-Māori, Aotearoa New Zealand 2012–17

		Māori			Non-Māori			Māori to non-Māori	
		Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
Division of abdominal adhesions	No	2,084	143	5.01	14,026	954	2.85	1.76	1.48–2.08
	Yes	1,540	47	2.17	10,430	398	1.60	1.36	1.01–1.82
	Total			**3.30**			**2.14**	**1.54**	**1.30–1.83**
Other incision procedures (drainage)	No	2,967	171	4.12	20,810	1,224	2.46	1.68	1.43–1.96
	Yes	657	19	2.36	3,646	128	1.78	1.32	0.83–2.11
	Total			**3.12**			**2.09**	**1.49**	**1.16–1.91**
Colectomy	No	3,326	159	3.60	21,221	1,095	2.29	1.58	1.34–1.85
	Yes	298	31	5.72	3,235	257	2.81	2.04	1.44–2.88
	Total			**4.54**			**2.53**	**1.79**	**1.48–2.17**
Resection of small intestine	No	3,317	166	3.79	21,816	1,114	2.27	1.67	1.42–1.96
	Yes	307	24	4.23	2,640	238	3.09	1.37	0.92–2.04
	Total			**4.01**			**2.65**	**1.51**	**1.22–1.88**
Other excision procedures (debridement)	No	3,281	178	3.81	22,575	1,262	2.29	1.67	1.43–1.94
	Yes	343	12	3.50	1,881	90	2.95	1.18	0.68–2.08
	Total			**3.65**			**2.60**	**1.41**	**1.05–1.88**

Note: The table shows percentage (crude) and age-standardised rate ratios (RR).

CI = confidence interval.

Table 21: Mortality by ASA score in Māori and non-Māori, Aotearoa New Zealand 2012–17

	Māori			Non-Māori			Māori to Non-Māori	
	Cases	Deaths	%	Cases	Deaths	%	RR	95% CI
ASA score								
1–2	1,586	11	0.79	10,768	78	0.60	1.30	0.70–2.44
3	820	39	3.47	5,965	366	3.29	1.05	0.76–1.46
4	351	73	13.96	2,136	477	11.20	1.25	1.00–1.56
5	50	21	29.92	227	149	36.10	0.83	0.60–1.14
Unknown	817	46		5,360	282			
Total			**5.81**			**5.32**	**1.09***	**0.89–1.34**

Note: The table shows percentage (crude) and age-standardised rate ratios (RR) for each level of ASA.

* Adjusted for age and ASA score.

ASA = American Society of Anesthesiologists.

CI = confidence interval.

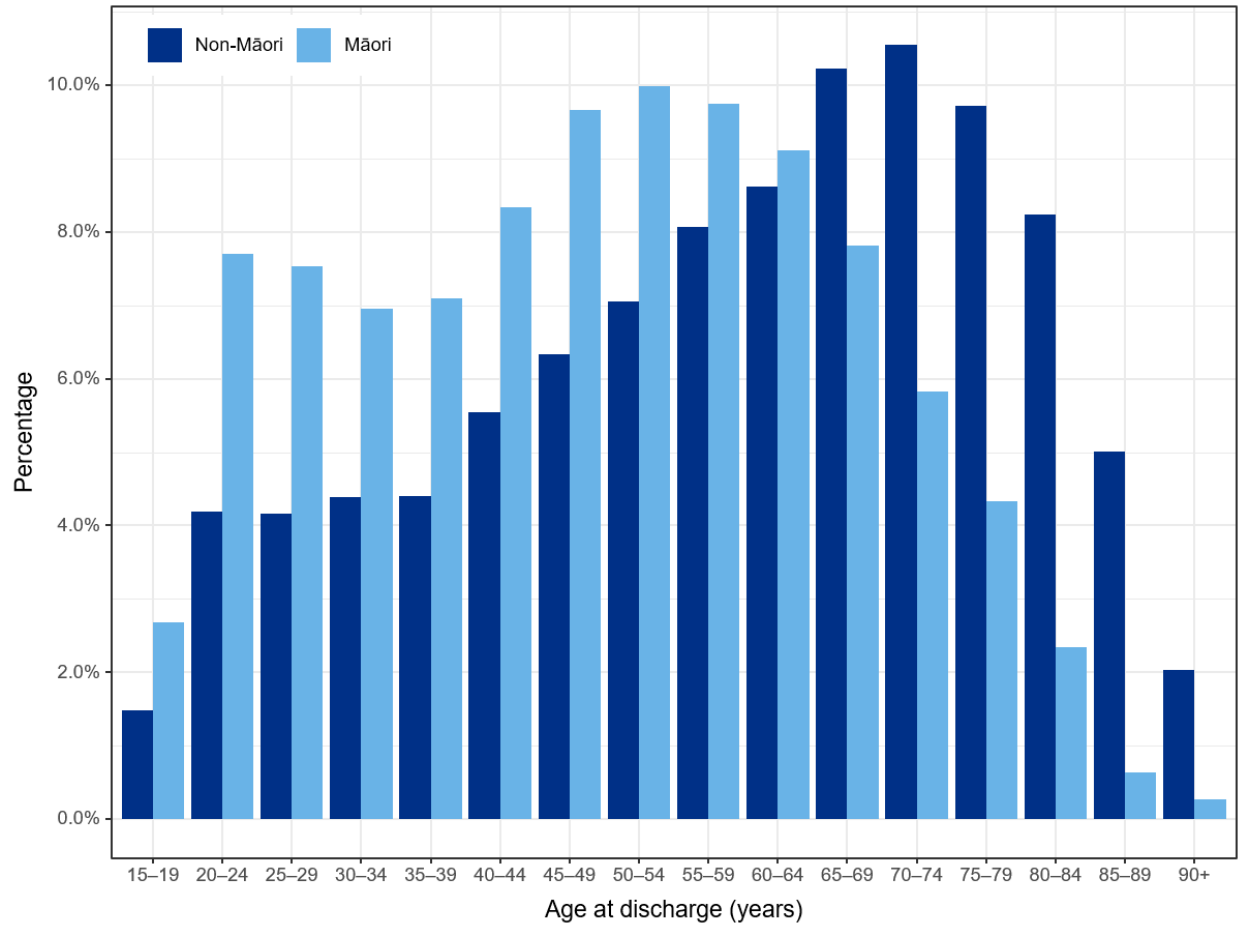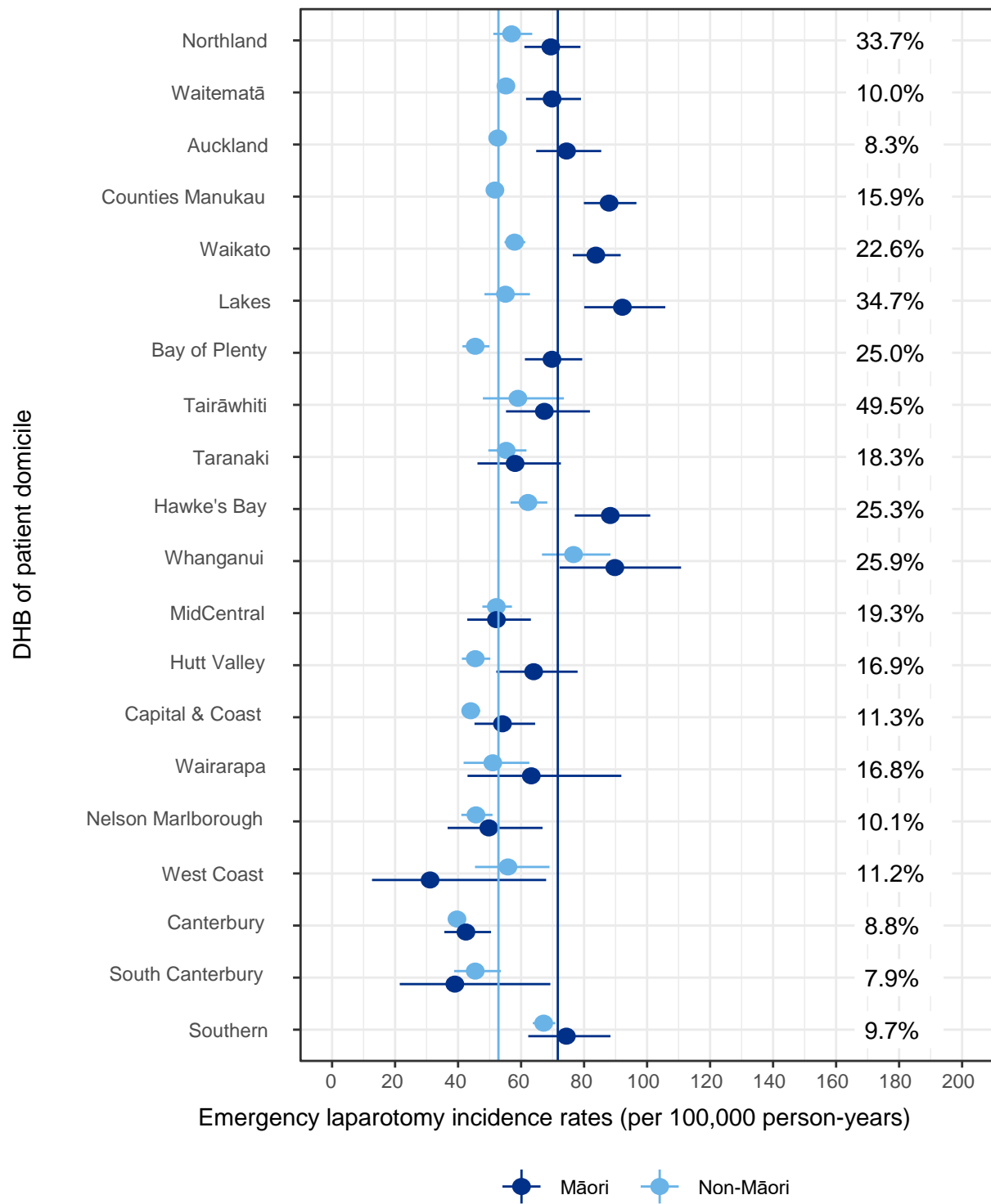**Figure 1: Age distribution of Māori and non-Māori undergoing emergency laparotomy, Aotearoa New Zealand 2012–17**

Figure 2: Age-standardised emergency laparotomy incidence by DHB in Māori and non-Māori, Aotearoa New Zealand 2012–17

Summary

In summary, age-standardised emergency laparotomy incidence is 36% higher in Māori than in non-Māori, and the gap is continuing to widen. In comparison to their non-Māori counterparts, Māori are:

- younger
- more likely to reside in the most deprived neighbourhoods
- more likely to have had an emergency rather than elective laparotomy
- more likely to have visited their GP or the ED in the 90 days prior to surgery.

Māori have an overall higher burden of comorbidities, especially smoking, diabetes, cancer and hypertension. They also have a significantly higher burden of disease (measured by ASA score) and experience more complications following emergency laparotomy surgery than non-Māori. We found similar overall colorectal cancer rates; however, Māori are less likely to have presented with localised disease.

Having adjusted for age and sex, 30-day mortality following emergency laparotomy is 64% higher in Māori than in non-Māori. In every decade from 40 to 79 years, Māori mortality rates are higher than non-Māori. Increasing proportions of patients died with increasing deprivation levels. At each level of deprivation, Māori mortality rates are higher than non-Māori. Adjusting for socioeconomic deprivation showed that deprivation explained 25% of the inequity in mortality between Māori and non-Māori. Additionally, adjusting for comorbidities and health care access reduced the inequity in mortality to 23%.

Discussion | Kōrerorero

In the previous section, we introduced a systems-level view of health equity and investigated emergency laparotomy mortality data in terms of inequities in health outcomes that exist in surgical health between Māori and non-Māori at three levels:

1. inequities in exposures and life opportunities that impact on a person's health
2. inequities in the ability to access appropriate health care
3. inequities in the quality of care delivered.

The results reported indicate multiple inequities within the system.

Inequities in exposures and health opportunities

Large differences in age at procedure, socioeconomic deprivation, and comorbidities between Māori and non-Māori reflect inequities in exposures, life and health opportunities that drive health inequities for Māori.

Māori are having emergency laparotomies on average 10 years younger than non-Māori and also die younger at much higher rates. This is concerning because higher rates of mortality are usually associated with ageing (> 70 years) (Story 2010). Only 13.4% of Māori emergency laparotomy patients were aged over 70 years, compared with 44.5% in the fourth NELA (NELA Project Team 2018). In contrast, the non-Māori cohort is more similar in age to the NELA cohort (35.5% aged over 70 years). However, we have demonstrated that for Māori, mortality following emergency laparotomy is twice that of non-Māori in those aged 40–59.

Higher rates of Māori requiring emergency surgery compared with non-Māori, and having a higher mortality rate at each age, show that differences in exposure contribute to increased emergency laparotomy mortality rates.

Because it is well established that elderly patients die at much higher rates, clinical teams pay extra attention to elderly patients. But what our data shows is that in Aotearoa New Zealand, young Māori in their 40s have a 98% higher risk of dying than non-Māori. To begin addressing these inequities, Māori from the age of 40 years onwards having emergency laparotomies should be considered high-risk patients, and they should receive the care they need to ensure they have equitable outcomes compared with non-Māori.

Māori having emergency laparotomies have a high level of socioeconomic deprivation, which is associated with a 15% higher mortality. We used the NZDep2013 as our measure. It uses nine variables (income, home ownership, employment, education, qualifications, family structure, housing, access to transport and communications) to calculate a deprivation score for each census mesh-block area (Atkinson et al 2014). We have analysed in quintiles from 1 (least deprived) to 5 (most deprived). The data shows that half of the Māori having emergency laparotomies live in the most deprived areas, with the worst quality of housing, low qualifications and poor access to transport. In comparison, only one-fifth of non-Māori having emergency laparotomies reside in these neighbourhoods. There is good evidence to show that Māori are

exposed to very different education, employment, income and housing opportunities compared with non-Māori.

Since socioeconomic deprivation accounts for 15% of the overall increased mortality, inequities in deprivation clearly impact inequities in mortality following emergency laparotomy surgery. Socioeconomic position is neither predetermined nor unchanging, but is affected by 'basic causes', as described by Williams and Mohammed (2009). In the context of Aotearoa New Zealand health inequities, these causes might include the historical acts of taking of land, resources and culture, and also modern effects of a health system that is Eurocentric rather than one incorporating a Māori interpretation of health and wellbeing. The loss of lands contributed to the fragmentation of Māori communities as whānau, hapū and iwi were stripped of the ability to nourish and protect one another as a collective unit. The disconnection from tribal lands had consequences for Māori that were much broader than economic losses. This is because Māori culture, identity and wellbeing are inseparable from Māori whenua (lands) (Cram et al 2019).

Thus, in order to eliminate inequities for Māori following surgery, equity of access and outcomes across a wide range of systems, policies and services is needed, including housing, employment, education, transport and communication.

We have demonstrated that Māori have an overall higher burden of comorbidity, which is associated with poorer outcomes. Since people with diabetes have increased susceptibility to infection and sepsis, and impaired wound healing, it is possible that the presence of diabetes and sepsis contributed to the higher mortality among Māori (Greenhalgh 2003; Brem and Tomic-Canic 2007; Koh et al 2012).

In the United States, systemic sepsis is one of the most significant variables associated with emergency laparotomy mortality (Al-Temimi et al 2012). Because it has such a huge impact, preoperative high-dose, intravenous broad-spectrum antibiotics are a major focus of many improved care bundles and emergency laparotomy audit interventions (Huddart et al 2015; Tengberg 2017; Aggarwal et al 2019; Peden et al 2019). Further work on the joint effects of diabetes and sepsis in Māori is therefore warranted.

Despite cancer being the third most common comorbidity, colorectal cancer did not contribute to the inequity in perioperative mortality between Māori and non-Māori. Further research looking at other cancers may reveal specific types of cancer that have a significant impact on mortality.

Heart failure appeared to have a strong effect on mortality in the Māori population, but was based on a very small number of patients and the results should be interpreted with caution. Heart failure is associated with mortality in multiple cohort studies. Heart failure results in fluid overload and relative ischaemia of the tissues. This significantly reduces the healing of anastomosis and other repairs. Pulmonary oedema is also associated with congestive heart failure because the lungs are already compromised from the sub-diaphragmatic insults and the resultant ileus and pressure from the abdomen.

ASA scores are associated with higher mortality rates in both the Māori and non-Māori populations. The ASA score is a measure of disease severity that assesses the physical status of a patient before surgery. Since the ASA score is assigned at the time of a patient's surgery,

care should be taken in how these scores are interpreted. The ASA score partly reflects comorbidities and partly reflects acute illness. A patient with an ASA score of 4 has severe systemic disease that is a constant threat to life (Owens et al 1978). Higher ASA scores correlating with higher mortality simply means that sicker people die at higher rates.

Vascular disorder of intestine (or ischaemic bowel) is associated with high mortality in Māori. Patients who get ischaemic bowel are generally frail and have a host of comorbidities. They almost always have ischaemic cardiac disease, hypertension and other associated cardiac conditions. The underlying comorbidities may be diagnosed or undiagnosed.

Ischaemic bowel generally refers to an arterial ischaemic event in one of the mesenteric arteries. This usually leaves veins open initially. Systemic inflammatory response syndrome, sepsis from gut microbes, and cardiac arrhythmias all contribute to high mortality risk. Ischaemic bowel is notoriously hard to diagnose, and this often leads to operative delay. It is critical to operate on a patient without delay. Patients are frequently sent to the intensive care unit intubated and require 'relook' laparotomies. Further investigation of whether the highest quality of care is being given to Māori patients is warranted.

Inequities in access to health care

Differential access to health care, including the ability to financially and physically access appropriate health care, contributes to inequities in Māori health. Access to health care was measured in our data set through access to primary care, and ED attendance in the 90 days prior to surgery.

We also measured access to primary care (GP visits) and ED attendance in the previous 90 days before admission for emergency laparotomy. We found that Māori accessed their GPs 20% more than non-Māori, but still died at more than twice the rate. The Māori that visited their GP were younger and had slightly more comorbidities than non-Māori. Similarly, Māori visited the ED 40% more often, but still died at a 71% higher rate. Of those who presented at the ED, Māori were younger, had more comorbidities and were more likely to be women, than non-Māori. Therefore, Māori are not dying at higher rates through failure to present with their symptoms. Rather, they are not getting to surgery because they are not being diagnosed. It is possible that the GPs of Māori patients do not consider emergency laparotomy-associated diagnoses because their patients are considered too young for them. However, our data shows that Māori have a very different epidemiology to non-Māori.

Regarding access to health care, the composite story about Mr T highlights the discrimination that Māori often experience from clinicians about smoking. This was clearly a source of distress for the whānau of the patient. The belief that Mr T was a smoker contributed towards the delay in his treatment because the staff thought his cough was from smoking. However, his cough was related to hospital-acquired pneumonia. His respiratory effort increased and eventually resulted in cardiorespiratory arrest, a cerebral event and death. Yet, our data shows smoking had no greater effect on mortality in Māori than in non-Māori in this emergency laparotomy cohort.

Inequities in quality of care

We do not have enough information in our data set to ascertain if Māori are dying at a higher rate because of the quality of health care they receive. Since our study is retrospective, there is very little data that we could collect to measure the quality of care delivered. Emergency laparotomies do not involve the usual proxy measures that we would use: time from GP referral to first specialist appointment, waiting time from referral to operation, and access to and attendance at perioperative clinics.

We investigated complications as a marker of the quality of care received. Māori were more likely to have in-hospital complications following emergency laparotomy surgery than non-Māori. However, the presence of complications was not related to inequities in mortality; the higher mortality rates in Māori were evident in those with and without each complication.

In addition, emergency laparotomy quality improvement is a very specific area of research that will be thoroughly investigated by ANZELA-QI. On the strength of our results showing such large inequities between Māori and non-Māori undergoing emergency laparotomy operations, we would expect there to be significant differences in the quality of care received by Māori and non-Māori in ANZELA-QI. We hypothesise that differences in quality of care contributes in part to the residual 22% increase in Māori mortality that is unaccounted for.

There were several themes about quality of care that arose in the patient stories. Māori are often offended by staff with low cultural competency, resulting in bad experiences of the health system. Thus, staff training in cultural safety and competency is of the utmost importance. The Meihana model helps clinicians to understand components of hauora Māori (wairua, whānau, tinana, hinengaro, taiao, iwi katoa), biological and social determinants of Māori health, and causes of inequities between Māori and non-Māori. This could contribute towards achieving equity in health, and ultimately to improving health for all.

Māori want to be treated like a whole person, not just an illness. For example, Māori want staff to extend manaakitanga through being friendlier and caring – for example, making an effort to pronounce people's names correctly, and using Māori words. This puts Māori at ease in their surroundings. Whānau support is also important for wellbeing. When Māori have loved ones who are sick, they gather around not just to visit the sick person but to awhi (physically comfort) and tautoko (support) each other. Feeling a sense of social connection is also very important. There needs to be supportive care wrapped around the patient and their whānau.

Summary

In summary, differences in patient health and perioperative mortality between Māori and non-Māori show how the current system creates and maintains health inequity. Understanding and improving health for Māori is a responsibility the Crown must address as a Te Tiriti partner.

Large differences in both socioeconomic deprivation and age at procedure are examples of inequities in exposures and life opportunities that impact Māori mortality from emergency laparotomy. Although changes to the health system are required, wider societal changes are also necessary to address the inequities. In this report, a strong connection between mortality and deprivation has been identified. This means that if we want Māori perioperative mortality to improve, we need to reduce inequities in systems in addition to health, including housing, education and employment.

The higher burden of comorbidity among Māori needs to be addressed. In our model it accounts for 25% of the 64% higher overall 30-day Māori mortality. It means that Māori are starting from a different baseline of health, making achieving health equity even more challenging, and more urgent. Moreover, comorbidity is strongly related to deprivation. Our results reflect what was previously found in Māori with colon cancer – that higher patient comorbidity and poorer access to and quality of cancer care explain poorer survival in Māori compared with non-Māori (Hill et al 2010). The higher burden of comorbidity is also likely to contribute towards Māori having emergency laparotomies at a younger age than non-Māori. Māori are dying at much higher rates between the ages of 40 and 79 years, demonstrating the higher burden of disease at significantly younger ages among Māori.

There is often an assumption that Māori have a higher burden of comorbidity because they do not visit their GPs. The fact that Māori are presenting to their GPs and the ED more often than non-Māori, but have fewer elective surgery, suggests there are issues with referrals for elective surgery for Māori by their GPs. We observe this in one of our patient stories where the patient had had a myocardial infarction but had to visit his GP four times before he was referred to the appropriate specialist.

Māori ED attendance was also 40% higher. In the Māori composite case, Mr T, who had appendicitis, went to the ED with acute pain and was sent home with analgesics and antibiotics. When he was admitted after his second trip to the ED, there were large delays in diagnostic imagery intervention and subsequent review. Five days after his first presentation at ED, Mr T had his perforated and gangrenous appendix removed. The delays in Mr T's treatment increased his complications and eventually led to his death. This scenario highlights how systemic inequities can impact surgical outcomes.

Further research into Māori access to elective abdominal surgery and referrals from both GP and ED is needed to better understand the inequities in access to and quality of health care, so they can be subsequently addressed. As health professionals we must all implement the changes necessary to better meet the needs of Māori within the health system. We have developed recommendations to help address many of the findings from this report.

Appendix 1: Methods and limitations of data | Āpitihanga 1: Ngā tukanga me ngā here o te raraunga

Data sources

Hospital admission data was obtained from the National Minimum Dataset (NMDS), supplied by the Ministry of Health in June 2019. Mortality rates were sourced from National Mortality Collection (NMC) data and compared with NMDS admission counts. ED attendance and outpatient attendance information was obtained from the National Non-Admitted Patient Collection, supplied by the Ministry of Health. Cancer information was obtained from the New Zealand Cancer Registry, supplied by the Ministry of Health. General practice attendance information was obtained from the Primary Health Organisation Enrolment Collection, supplied by the Ministry of Health. All data was supplied in June 2019.

Analysis

All analyses presented in this report are based on the results provided by Phil Hider and Jonathan Williman in v11 of the statistical output, dated 18 October 2019.

Eligibility criteria

Eligibility criteria for the emergency laparotomy topic have followed the Care Delivery in New Zealand for the Acute Abdomen (CADENZAA) definitions specified in the New Zealand Emergency Laparotomy Audit (outlined below).

Results are generated from linked NMDS and NMC data supplied by the Ministry of Health with discharge date between 1 January 2012 and 31 December 2017.

The data includes admissions to all New Zealand hospitals that report data to the NMDS. That is, data from both public and private hospitals that submit data to the NMDS were included.

Inclusion criteria

NMDS data were coded according to International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). The following codes were used to define emergency laparotomy procedures and were obtained from the ANZELA-QI project:

3007512, 3017800, 3022401, 3022402, 3037300, 3037502, 3037503, 3037506, 3037509, 3037510, 3037512, 3037515, 3037517, 3037518, 3037519, 3037522, 3037523, 3037524, 3037525, 3037528, 3037529, 3037800, 3038200, 3038201, 3038202, 3038203, 3038500, 3039300, 3039400, 3039401, 3039600, 3039700, 3040200, 3040300, 3040303, 3040305, 3040500, 3040501, 3040502, 3046008, 3046600, 3046700, 3047200, 3047201, 3047603, 3049600, 3049700, 3049701, 3049702, 3049900, 3050300, 3050301, 3050302, 3050303, 3050304, 3050305, 3050500, 3050900, 3051100, 3051101, 3051200, 3051201, 3051202, 3051501, 3051502, 3051503, 3051504, 3051505, 3051506, 3051800, 3051801, 3051802, 3052000, 3052100, 3052300, 3052400, 3052701, 3052703, 3052705, 3056200, 3056202, 3056300, 3056301, 3056400, 3056500, 3056600, 3056800, 3056900, 3060000, 3060100,

3060101, 3200000, 3200001, 3200002, 3200003, 3200300, 3200301, 3200302, 3200303, 3200400, 3200402, 3200500, 3200502, 3200600, 3200601, 3200602, 3200603, 3200900, 3200901, 3201200, 3201201, 3201500, 3202400, 3202500, 3202600, 3202800, 3203000, 3203900, 3204700, 3205100, 3205101, 3206000, 3209601, 3211200, 3218600, 3653700, 4380700, 4381602, 4383702, 4393000, 4399301, 4557000, 9029701, 9029702, 9032000, 9032100, 9032900, 9032901, 9032902, 9032903, 9034000, 9034001, 9034203, 9037500, 9037501, 9037502, 9095200, 9095900, 9220800

Exclusion criteria

Cases/admissions were excluded if:

- the patient was aged <18 years on the day of the laparotomy or any of the following procedure codes was recorded at any time during the admission:

  1652000, 1652001, 1652002, 1652003, 3270800, 3270801, 3270802, 3270803, 3308000, 3310900, 3311200, 3311500, 3311800, 3312100, 3312400, 3312700, 3313000, 3313001, 3313900, 3315100, 3315400, 3315700, 3316000, 3316300, 3316600, 3316601, 3318100, 3381100, 3381101, 3411800, 3411801, 3412700, 3412701, 3412702, 3533001, 3533101, 3536001, 3551800, 3563704, 3563706, 3563707, 3563708, 3563800, 3563801, 3563802, 3563803, 3563804, 3563805, 3563806, 3563807, 3563808, 3563809, 3563810, 3563811, 3563812, 3564901, 3564903, 3565300, 3565301, 3565304, 3565800, 3566100, 3566400, 3566401, 3566700, 3566701, 3567000, 3567401, 3567700, 3567702, 3567704, 3567705, 3567800, 3567801, 3568000, 3568001, 3568400, 3568401, 3568800, 3568802, 3568803, 3569400, 3569401, 3569402, 3569403, 3569404, 3569405, 3569406, 3569407, 3569700, 3571302, 3571303, 3571304, 3571305, 3571306, 3571307, 3571308, 3571309, 3571311, 3571312, 3571700, 3571701, 3571702, 3571703, 3571704, 3572900, 3572901, 3575000, 3575302, 3575600, 3575603, 9043000, 9043001, 9043100, 9043200, 9043300, 9043301, 9043500, 9043501, 9044800, 9044801, 9044802

- OR the primary diagnosis for the admission was any of the following trauma codes: V00–V99, W00–W59, X72–X84, X85–Y09, Y22–Y35

- OR the patient was dead at the time of the laparotomy (highest ASA score on day of laparotomy = 6 or date of death occurred prior to date of laparotomy).

To avoid duplicates, laparotomies were excluded from the analysis if another eligible laparotomy had already occurred during the same admission or another eligible laparotomy had already occurred within the previous 30 days inclusive (for 30-day mortality, or the previous 90 days for 90-day mortality).

Cases were labelled as an emergency laparotomy if the admission was acute or the patient had an 'emergency' ASA code on the day of the laparotomy.

Analytical methods

Admission rates

Emergency laparotomy admissions were summarised by ethnicity (Māori/non-Māori), year, age, sex, and DHB of domicile. Crude rates were calculated using estimated resident population projections based upon the 2006 and 2013 censuses provided to the New Zealand Ministry of Health by Statistics New Zealand. Rates by New Zealand Index of Deprivation were calculated using the 2006 Census usually resident population.

Controlling for age differences

Since age was significantly different between the Māori and non-Māori populations, the data needed to be adjusted for age. For descriptive analyses, crude rates were presented to understand the absolute rates in Māori. In some cases (where noted), age-standardised rates were presented, which were adjusted using direct standardisation to the 2001 Census usually resident Māori population, with ages in five-year bands from 0 to 90+. For equity analyses, age-adjusted rate ratios were derived from multivariable regression models.

Age standardisation for the mortality from POMRC tracking procedures (Table 22) was undertaken using indirect standardisation (small numbers in some categories precluded direct standardisation). The reference standard for this was the mortality rates for the Māori population in the emergency laparotomy cohort.

Mortality risk ratios

Age-adjusted risk of mortality within 30 days was compared across population subgroups by using generalised linear regression modelling to calculate risk ratios with 95% confidence intervals. Mortality among Māori and non-Māori were compared in nested multivariable models, sequentially adjusted for demographic and admission factors.

Confidence intervals

Binomial confidence estimates were calculated using the Jeffreys equal-tailed interval.

Sociodemographic and clinical covariates used in this report

Sociodemographic and clinical factors have been dealt with in the same way as in previous reports, unless otherwise stated. Ethnicity is prioritised ethnicity based on the Ministry of Health algorithm that allocates ethnicity to Māori > Pacific > Asian > MELAA > other > European.

Charlson Comorbidity Index (CCI) score

The CCI is a method of categorising comorbidities of patients based on the International Classification of Diseases (ICD) diagnosis codes found in administrative data, such as hospital admission data. Each comorbidity category has an associated weight, based on the adjusted risk of mortality, and the sum of all the weights results in a single comorbidity score for an admission. The index has been validated in a variety of clinical settings and has been recently updated to enable it to be used with ICD-10 administrative data in New Zealand (Quan et al 2011). Comorbidity was assessed using the diagnoses included in previous admissions over the

last five years. Not all patients were admitted during the five years prior to undergoing an emergency laparotomy, and they were assigned a comorbidity score of zero.

New Zealand Index of Deprivation (NZDep2013) quintile

Analysis of NZDep2013 information in this report is based on NZDep2013 (Atkinson et al 2014). The results from the 2018 Census were not available for the report. Deprivation scores are allocated to a small area. The addresses of people admitted to hospital were coded by the Ministry of Health to these small areas. Deprivation scores relate to a small area and may not be accurate assessments of the socioeconomic status of individuals. The information they were based on may also not be reliable for years later than 2013.

ASA and emergency suffixes

All ICD-10 Australian Modification, Australian Classification of Health Interventions (ICD-10-AM ACHI) anaesthesia codes require a two-character extension, with the first digit indicating the ASA's Physical Status Classification and the second digit indicating whether the procedure was routine or carried out as an emergency, as follows.

ASA class description:
1 A normal healthy patient
2 A patient with mild systemic disease
3 Patient with severe systemic disease that limits activity
4 Patient with severe systemic disease that is a constant threat to life
5 A moribund patient who is not expected to survive longer than 24 hours without surgical intervention
6 A declared brain-dead patient whose organs are being removed for donor purposes
9 No documented ASA score, non-emergency or not known
E Emergency (modifier description)
0 Procedure being performed as an emergency

The ASA status referred to throughout this report is the ASA status derived from the first anaesthesia code for each admission event (with the order of procedure codes being determined by the diagnosis sequence variable within the NMDS). In the case of multiple anaesthetics, it is likely that this first ASA status reflects most closely the ASA status of the patient at the time of admission. An ASA score is allocated by clinicians to patients at the time of procedure. The accuracy and reliability of this allocation may vary. ASA status information was not available for all admissions.

Complications

Complications were analysed among those admissions that included a procedure where the condition onset flag indicated that the relevant diagnoses were not present on admission. However, the exact timing of the complication – that is, whether it was diagnosed before or after the procedure – cannot be further defined by the available NMDS data. Complications were defined using diagnoses that were not present on admission. Present on admission flag information was not available for all admissions.

Limitations of data and analysis

Data in this report was sourced from various routinely collected data sources. The NMDS and NMC data sets have limitations associated with clinical coding accuracy and data completeness. Both data sets are dependent on the quality of clinical records and classification systems. Similarly, there are limitations associated with the accuracy and completeness of the information included in the other databases that have supplied information used in this report.

- There may be limitations of the codes available in the ICD-10-AM to describe the procedures and diagnoses.
- There is uncertainty regarding the completeness and accuracy of information associated with the National Health Index (NHI), and of data linkage using the NHI between data sets held at the Ministry of Health, along with the methods that have been employed to undertake the linkages between databases.
- The accuracy and completeness of the New Zealand Cancer Registry, the Primary Health Organisation Enrolment Collection, and the National Non-Admitted Patient Collection may have affected the results.

Ethnicity was obtained from NMDS data and prioritised with any Māori response recorded as Māori. It is possible that this has resulted in an undercount of Māori in this report. A decision was made not to adjust for this in this report.

Some private day-stay or outpatient hospitals, facilities and in-rooms do not report any surgical or procedural events to the NMDS. The Ministry of Health is unable to estimate the extent to which the NMDS undercounts events from private surgical or procedural day-stay or outpatient hospitals, facilities or in-rooms. The data in this report is likely to undercount some private hospital events, and the magnitude of this undercount is difficult to quantify.

Small variations in the data sets over time can also result in slight variations in the mortality and hospitalisation rates included in each of the POMRC's reports. This variation can be caused by delays in data being entered into the NMDS and NMC databases, and also by changes in clinical coding over time. Such variation limits the ability to compare findings between time periods of interest.

Emergency laparotomy codes were obtained from the ANZELA-QI project, and as such are likely to be complete.

Perioperative mortality for selected clinical areas and procedures

Data sources

Hospital admission data was obtained from the NMDS, supplied by the Ministry of Health in June 2019. Mortality rates were sourced from NMC data and compared with NMDS admission counts.

Eligibility criteria and analytical methods

In relation to the specific tracking procedures and clinical areas included in this report, the following data was obtained.

- **General and neuraxial anaesthesia (same or next day) World Health Organization's (WHO's) day-of-surgery death ratio**
  All hospital admissions were included with a general or neuraxial anaesthetic (ICD-10-AM ACHI Version 6: 92514XX, 92508XX) listed in the first 90 procedure codes as recorded in the NMDS. Mortality rates of those who died (on the same day or the day following a general or neuraxial anaesthetic) were sourced from NMC data and compared with NMDS admissions counts in which a general or neuraxial anaesthetic was administered.

- **General and neuraxial anaesthesia (in hospital) WHO's postoperative in-hospital death ratio**
  All hospital admissions were included with a general or neuraxial anaesthetic (ICD-10-AM ACHI Version 6: 92514XX, 92508XX) listed in the first 90 procedure codes as recorded in the NMDS. In-hospital mortality was calculated from the number of people who were deceased upon discharge (within 30 days following a general or neuraxial anaesthetic) as recorded in the NMDS.

- **General and anaesthesia (within 30 days and 90 days)**
  All hospital admissions were included with a general or neuraxial anaesthetic (ICD-10-AM ACHI Version 6: 92514XX, 92508XX) listed in the first 90 procedure codes as recorded in the NMDS. Mortality rates of those who died (within 30 days and 90 days) following a general or neuraxial anaesthetic) were sourced from NMC data and compared with NMDS admissions in which a general or neuraxial anaesthetic was administered.

- **Cholecystectomy**
  Hospital admissions with a cholecystectomy listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 3044300, 3044500, 3044600, 3044800, 3044900, 3045401, 3045500). In a small proportion of cases (n=485), other more complex procedures were undertaken at the same time as the cholecystectomy (eg, liver resections). When a cholecystectomy was performed as part of a more complex procedure, the risk of mortality is likely to have been significantly higher than if a cholecystectomy was either the main or the only procedure undertaken at the time of the operation. These admissions were not included in the analyses. Mortality rates of those who died following a cholecystectomy were sourced from NMC data (with cases being selected from the cohort of those undergoing cholecystectomy, as identified in the NMDS) and compared with NMDS admissions in which a cholecystectomy was listed in any of the first 90 procedure codes.

- **Hip arthroplasty**
  All hospital admissions were included with a hip arthroplasty listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 1489, 1492) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Mortality in elective admissions with an ASA score of 1 or 2**
  All elective or waiting list hospital admissions were included in those with a first ASA score of 1 or 2 that included a general anaesthetic (ICD-10-AM ACHI Version 3: 92514-XX) or neuraxial block (ICD-10-AM ACHI Version 6: 92508-XX). Deaths related to elective/waiting list admissions with an ASA score of 1 or 2 were included when mortality occurred within 30 days (and 90 days) of the first general anaesthetic or neuraxial block.

- **Colorectal resection**
  Hospital admissions with a colorectal resection listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 913, 934, 935, 936) were obtained from the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Coronary artery bypass graft (CABG)**
  All hospital admissions were included with a CABG procedure listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 3849700, 3849701, 3849702, 3849703, 3849704, 3849705, 3849706, 3849707, 3850000, 3850300, 3850001, 3850301, 3850002, 3850302, 3850003, 3850303, 3850004, 3850304, 9020100, 9020101, 9020102, 9020103, 3863700) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Percutaneous transluminal coronary angioplasty (PTCA)**
  All hospital admissions were included with an angioplasty procedure listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 3530400, 3530500, 3531000, 3531001, 3531002) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **ASA score 4 or 5**
  All hospital admissions were included for those with an ASA score of 4 or 5 that included a general anaesthetic (ICD-10-AM ACHI Version 6: Block 1910, 92514-XX) or neuraxial block (ICD-10-AM ACHI Version 6: Block 1909, 92508-XX). Deaths related to the admissions with an ASA score of 4 or 5 were included in which mortality occurred within 30 days (and 90 days) of the general anaesthetic or neuraxial block.

- **Abdominal aortic aneurysm repair (AAA repair)**
  All hospital admissions were included with an AAA repair procedure listed in the first 90 procedure codes (ICD-10-AM ACHI Version 6: 3308000, 3310900, 3318100, 3314800, 3311200, 3315100, 3311500, 3315400, 3311800, 3315700, 3312100, 3316000, 3311600) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Day-of-the-week and holiday mortality**
  All hospital admissions were included with a general or neuraxial anaesthetic (ICD-10-AM ACHI Version 6: 92514XX, 92508XX) listed in the first 90 procedure codes as recorded in the NMDS. Mortality rates of those who died (within 30 days or 90 days following a general or neuraxial anaesthetic) were sourced from NMC data and compared with NMDS admissions counts in which a general or neuraxial anaesthetic was administered. Day-of-the-week information was sourced from the NMDS.

The first procedure that involved a general or neuraxial anaesthetic during a hospital admission was used as the index procedure, and the date of this procedure was obtained from information included in the NMDS. The day of the week for the occurrence of the index procedure was assigned on the basis of the date for the procedure. Deaths within 30 days or 90 days were assessed in relation to the day of the week of the index procedure. The analyses followed the methodology employed by Aylin et al (2010, 2013). The methods applied to the 30-day and 90-day mortality assessments were also followed with these analyses. In some analyses, information related to procedures on Saturday and Sunday were combined and assessed as weekend procedures.

The dates of national holidays were obtained from past calendars. Regional holiday dates were not included. Index procedures occurring on a national holiday were combined with those that had occurred during weekends.

Notes on interpretation

The following notes describe the data definitions used for analyses included in this report.

Private and public hospital admissions

The NMDS contains near complete information on all publicly funded inpatient events occurring in public hospitals. In contrast, private hospital events include a mix of publicly funded and privately funded cases. DHB-funded events occurring in private hospitals are usually reported to the NMDS by the DHB contracting the treatment, and thus are mostly complete in the data set. As NMDS reporting is not legally mandated for New Zealand health care providers, however, many private surgical or procedural day-stay or outpatient hospitals, facilities or in-rooms do not report any events to the NMDS.

The Ministry of Health is unable to provide any estimate of the extent to which the NMDS undercounts events from private surgical or procedural day-stay or outpatient hospitals, facilities or in-rooms, although it notes that the data most likely to be missing is privately funded or Accident Compensation Corporation (ACC) funded events, or publicly funded long-stay geriatric cases. Thus, in this report it must be remembered that the data presented is likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

Appendix 2: Current and previously reported mortality rates for POMRC tracking procedures and clinical areas | Āpitihanga 2: Ngā pāpātanga matenga o nāianei, kua pūrorongotia i muri rānei, mō ngā hātepe haurapa POMRC me ngā wāhi haumanu

This appendix summarises key findings from the period 2012–17 for the tracking procedures and clinical areas that were included in previous POMRC reports. Thirty-day mortality rates for these procedures and clinical areas are summarised in Table 22, along with the rates from previously reported time periods since 2007.

Changes in mortality rates over time should be interpreted with caution as a range of factors related to coding and small variations in data sets across years (due to time lapses in receiving and entering data) could influence apparent changes in rates. These factors also explain why some of the rates presented in each report may appear to differ slightly from year to year.

Table 22: Current and previously reported cumulative 30-day mortality rates per 100,000 (%) for POMRC tracking procedures and clinical areas, Aotearoa New Zealand 2007–17

Topics analysed over time	2007–11	2008–12	2009–14	2010–15	2011–16	2012–17
General anaesthesia	–	–	–	554 (0.55%)	–	–
General and/or neuraxial anaesthesia	–	–	–	–	542 (0.54%)	530 (0.53%)
Cholecystectomy: acute	975 (0.98%)	821.7 (0.82%)	695 (0.69%)	575 (0.58%)	584 (0.58%)	576 (0.58%)
Cholecystectomy: elective/waiting list	151 (0.15%)	181.8 (0.18%)	214 (0.21%)	220 (0.22%)	207 (0.21%)	182 (0.18%)
Hip arthroplasty: acute	6,608.9 (6.61%)	7,098 (7.10%)	7,113.8 (7.11%)	7,311 (7.31%)	7,185 (7.19%)	6,838 (6.84%)
Hip arthroplasty: elective/waiting list	180.5 (0.18)	171 (0.17%)	124.3 (0.12%)	181 (0.18%)	100 (0.10%)	163 (0.16%)
Knee arthroplasty: elective/waiting list	–	142.8 (0.14%)	168.3 (0.17%)	129 (0.13%)	–	–
Colorectal resection: acute	8,456 (8.46%)	–	8,449.8 (8.45%)	8,093 (8.09%)	7,631 (7.6%)	7,384 (7.4%)
Colorectal resection: elective	1,700.6 (1.70%)	–	2,031.5 (2.03%)	1,875 (1.87%)	1,855 (1.86%)	1,669 (1.67%)
Coronary artery bypass graft (CABG)	–	2,645 (2.65%)	2,918.8 (2.92%)	2,874 (2.87%)	2,886 (2.89%)	2,946 (2.95%)
Percutaneous transluminal coronary angioplasty (PTCA)	–	1,661.3 (1.66%)	1,768.5 (1.77%)	1,761 (1.76%)	1,822 (1.82%)	1,906 (1.91%)
ASA 4 & 5 (high-risk anaesthesia)	–	13,701.9 (13.7%)	12,237 (12.24%)	12,578 (12.58%)	11,652 (11.65%)	11,282 (11.28%)

Appendix 3: Comparison of 30-day mortality by DHB in Māori vs non-Māori | Āpitihanga 3: He whakatauritenga o te matenga 30-rā mā te Poari Hauora ā-Rohe i te Māori ki te hunga ehara i te Māori

Table 23: Mortality rates for Māori vs non-Māori by DHB, Aotearoa New Zealand 2012–17

DHB	Māori				Non-Māori				Māori to non-Māori	
	Cases	Deaths	%	95% CI	Cases	Deaths	%	95% CI	RR	95% CI
Northland	297	19	4.23	2.73–6.54	856	58	2.65	2.05–3.43	1.60	0.97–2.62
Waitematā	271	11	3.11	1.77–5.47	3,187	118	1.68	1.39–2.04	1.85	1.02–3.34
Auckland	225	4	1.42	0.54–3.71	2,424	110	2.38	1.97–2.88	0.60	0.22–1.59
Counties Manukau	467	22	3.93	2.63–5.87	2,212	112	2.68	2.21–3.24	1.47	0.95–2.28
Waikato	521	30	4.00	2.83–5.64	2,148	150	2.80	2.36–3.33	1.43	0.98–2.07
Lakes	233	14	4.52	2.76–7.40	453	42	3.99	2.98–5.34	1.13	0.64–2.00
Bay of Plenty	273	17	4.35	2.75–6.88	1,075	75	2.42	1.92–3.05	1.80	1.09–2.97
Tairāwhiti	127	8	3.86	1.97–7.58	208	12	2.12	1.21–3.73	1.82	0.76–4.34
Taranaki	90	4	2.70	1.03–7.12	673	45	2.49	1.87–3.33	1.08	0.40–2.96
Hawke's Bay	248	13	3.53	2.11–5.91	1,027	67	2.34	1.83–3.00	1.51	0.86–2.65
MidCentral	119	9	6.05	3.24–11.31	967	65	2.58	2.01–3.29	2.35	1.21–4.57
Whanganui	101	8	6.93	3.61–13.29	459	31	2.50	1.78–3.52	2.77	1.34–5.73
Capital & Coast	135	5	2.57	1.09–6.07	1,318	65	2.27	1.78–2.89	1.13	0.47–2.75
Hutt Valley	106	4	3.09	1.17–8.15	680	40	2.48	1.84–3.36	1.24	0.45–3.41
Wairarapa	35	2	3.49	1.00–12.23	254	18	2.56	1.64–3.98	1.37	0.36–5.16
Nelson Marlborough	53	4	5.51	2.10–14.45	755	42	2.20	1.63–2.97	2.51	0.92–6.85
West Coast	8	1	10.57	3.12–35.80	184	11	2.67	1.50–4.77	3.96	1.03–15.24
Canterbury	143	9	4.06	2.16–7.63	2,450	131	2.12	1.76–2.55	1.92	1.00–3.67
South Canterbury	16	2	6.05	1.54–23.79	374	20	1.89	1.22–2.92	3.21	0.77–13.43
Southern	146	4	2.09	0.84–5.21	2,412	119	1.96	1.62–2.38	1.06	0.42–2.71
Unknown	10	0			340	21				

CI = confidence interval.
DHB = district health board.

There are no significant differences in Māori mortality between DHBs. There are two outliers with high age-adjusted 30-day Māori mortality rates. Although these aren't significantly different, they do require comment. West Coast DHB has an age-adjusted 30-day Māori mortality rate of 13.5%; however, this is based on a single death from a total of eight emergency laparotomies performed there. Similarly, South Canterbury DHB has a 30-day age-adjusted Māori mortality rate of 8.5%; however, this is based on 2 deaths from a total of 16 emergency laparotomies performed there. At the other end of the scale, the 30-day age-adjusted Māori mortality rate at Auckland DHB is 1.6% based upon 4 deaths out of 225 emergency laparotomies.

Figure 3: Comparison of 30-day mortality by Māori ethnicity and DHB, Aotearoa New Zealand 2012–17
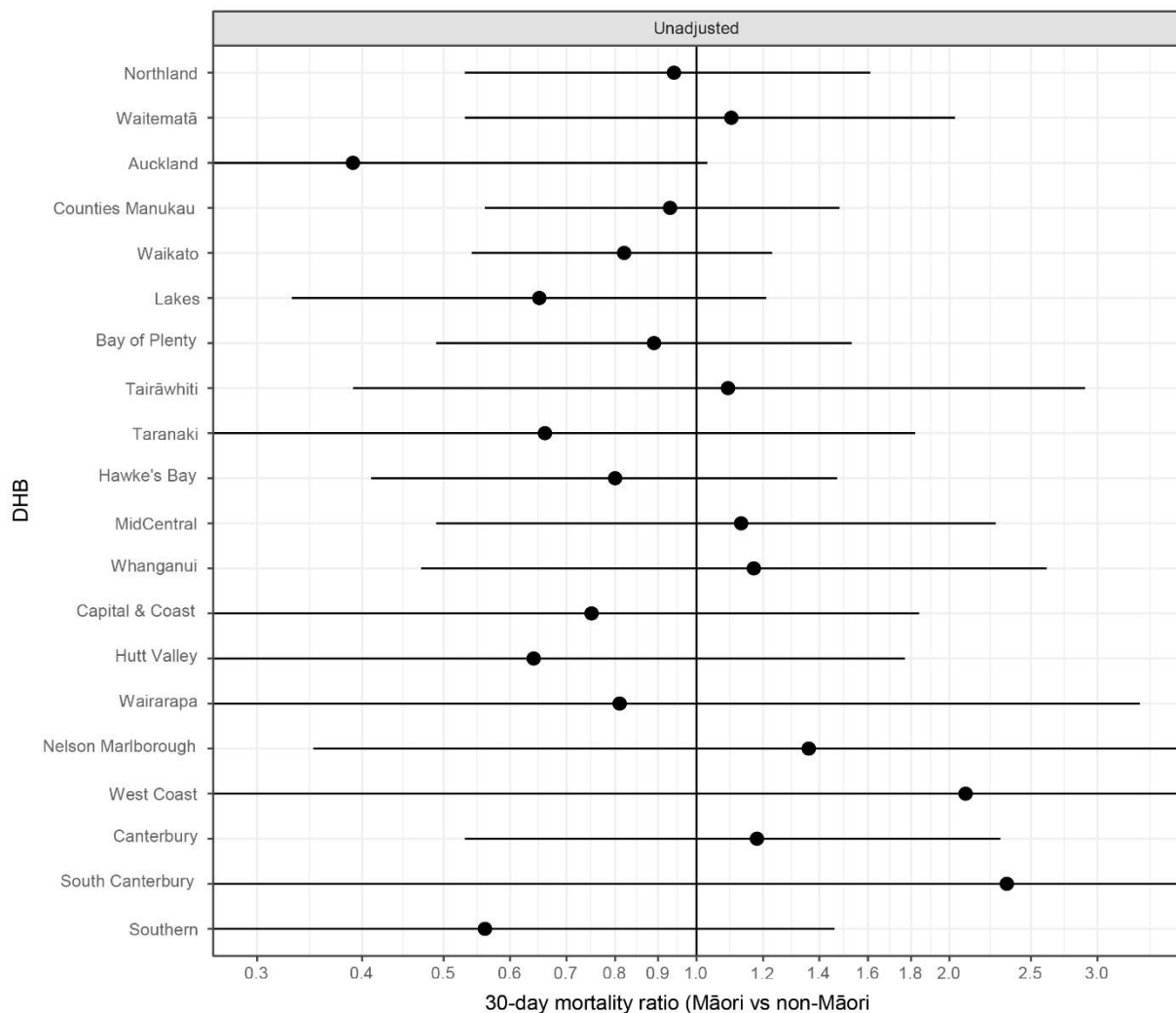
Glossary of Māori terminology | Kuputaka reo Māori

awhi	embrace, surround
hapū	subtribe; pregnant
hauora	overall physical, mental, emotional, environmental and spiritual health
hauora Māori	Māori health
hinengaro	mind
iwi	tribe
iwi katoa	all the tribes together
mahi tahi	working collectively, working as one
mana	spiritual or divine authority, influence and charisma
manaakitanga	hospitality, generosity, kindness
taiao	environment
tapu	sacred; restricted
tautoko	support
Te Tiriti o Waitangi	the Māori version of the Treaty of Waitangi
tika	right, straight, correct
tikanga	Māori customary practice and ceremony
tinana	body, physical
wairua	spirit
whānau	extended family

List of abbreviations | Rārangi whakapotonga

AAA	Abdominal aortic aneurysm
ACC	Accident Compensation Corporation
ACHI	Australian Classification of Health Interventions
ANZCA	Australian and New Zealand College of Anaesthetists
ANZELA-QI	Australian and New Zealand Emergency Laparotomy Audit – Quality Improvement
ASA	American Society of Anesthesiologists
CABG	Coronary artery bypass graft
CADENZAA	Care Delivery in New Zealand for the Acute Abdomen
CCI	Charlson Comorbidity Index
CI	Confidence interval
CT	Computed tomography
DHB	District health board
ED	Emergency department
GP	General practitioner
ICD	International Classification of Diseases
ICD-10-AM ACHI	International Statistical Classification of Diseases and Related Health Problems 10th Revision, Australian Modification, Australian Classification of Health Interventions
MCNZ	Medical Council of New Zealand
MELAA	Middle Eastern, Latin American and African
NELA	National Emergency Laparotomy Audit
NHI	National Health Index
NMC	National Mortality Collection
NMDS	National Minimum Dataset
NZDep2013	New Zealand Index of Deprivation 2013
OR	Odds ratio
POMRC	Perioperative Mortality Review Committee
RACS	Royal Australasian College of Surgeons
RR	Rate ratio
SMR	Standardised mortality ratio
WHO	World Health Organization

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