POMRC

Perioperative Mortality Review Committee

Perioperative Mortality in New Zealand:

Inaugural report of the Perioperative Mortality Review Committee

Report to the Health Quality & Safety Commission New Zealand

2011

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- the organisations and workplaces that have allowed Committee members to be involved with the Committee
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- the Analytical Services team at the Ministry of Health for providing the baseline data
- the many individuals and organisations that have worked tirelessly over many years to recommend the establishment of national perioperative mortality review, including developing the Terms of Reference for this Committee.

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Contents

Foreword

The Health Quality & Safety Commission welcomes the Perioperative Mortality Review Committee's inaugural report. As the Committee's first report, the focus is on how a truly national, whole-of-system perioperative mortality review can be developed. The emphasis is on enhancing resources where considerable investment has already been made.

The National Minimum Dataset and National Mortality Collection are analysed in this report for the years 2005 to 2009 looking at certain major operative/procedural categories: hip and knee arthroplasty, colorectal resection, cataract surgery and anaesthesia. The selection of these was not to be exclusive of other areas, but rather to use these categories as an index of work carried out in most hospitals around the country and to take advantage of information already held at a national level. The aim is to use this information to drive improvements to our health system, primarily to reduce harm to patients, but also to obtain better value from our available resources.

This is the first time that these data have been examined in this way, and the whole of system approach taken by the Perioperative Mortality Review Committee is internationally innovative. This approach will allow us to track performance over time, make comparisons with the published literature and identify and start to understand variation between providers within New Zealand. This first report provides an opportunity for the sector to give us feedback on these data, and on how we have presented the information. This is an opportunity to discuss its limitations and to consider ways to improve the robustness of the process. Success in the next stage, particularly in relation to reporting variation, will depend on the degree to which the data are accepted as credible. Now is the time for providers to engage with us to make sure that it is.

Having been a member of the working party that was responsible for developing the Terms of Reference for this Committee, I am delighted to see this work come to fruition. This report includes a number of recommendations on how we can work together to build a national perioperative mortality review system. Professor Martin and the many other people who have worked on producing this report are to be congratulated.

Professor Alan Merry, ONZM
Chair, Health Quality & Safety Commission

Chairperson's Introduction

The Perioperative Mortality Review Committee (the Committee) is a statutory committee established in 2010 under the New Zealand Public Health and Disability Act 2000 and reports to the Health Quality & Safety Commission (the Commission).

The Committee is required to:

- review and report to the Commission on deaths that are within the Committee's scope, with a view to reducing these deaths and continuously improving quality through the promotion of ongoing quality assurance programmes
- advise on any other matter related to mortality
- develop strategic plans and methodologies designed to reduce morbidity and mortality, relevant to the Committee's functions.

In this, our first report, we look to establishing an integrated whole-of-healthcare system approach for the identification and reporting of perioperative mortality. The Committee clearly aims to develop an approach for the review and reporting of national perioperative mortality to the Commission to assist in reducing avoidable deaths, act as part of a continuous improvement process for the quality of the healthcare system and therefore enhance outcomes for patients.

The Committee, in starting its work, had to consider how to address issues related to the two core areas within its remit, firstly deaths occurring following an operative procedure and secondly deaths occurring under the care of a surgeon when no operation was performed. Whilst this latter group will undoubtedly contain cases that provide important lessons for system improvement, the Committee made an early decision to focus its initial efforts in the first area and to return to the second area when a national system for the assessment of perioperative mortality is established.

When considering what approaches to take we looked towards what was currently being done nationally, regionally and internationally to measure and review perioperative mortality. Firstly, it was clear that whilst there was much to learn, there was no other example of an approach that both sought to measure the incidence of perioperative mortality across the whole-of-system and at the same time serve as the backbone for a peer-review process that will allow for reflection and improvement at the level of individual clinical services.

The second major consideration we faced was to consider the fact that between 4000 and 5000 patients die following an operative procedure in New Zealand each year. In many of these cases the procedure was a small factor in a complex episode of care and played no part in the later death of the patient, whilst in a small number there are important lessons to learn. We were, as a Committee, very aware that detailed peer review of each of the 4000 to 5000 deaths was neither practical nor desirable. The challenge for the Committee was in considering how we establish a system that can accurately record a data set that speaks to the whole-of-system issues but at the same time allows for the supplementary addition of more detailed peer-review information.

The third key area the Committee investigated was how to utilise the existing data systems that currently report on much of the activity within the New Zealand healthcare system to ensure the minimum of duplication within any new system. To this end we spent considerable time looking at the potential to make use of the National Minimum Dataset (NMDS) and associated data collections as the backbone of any new system. This report contains data from the NMDS for a number of common procedures that indicate both the opportunities and challenges that this approach will engender.

This first report makes a small number of core recommendations that will sit behind the future work of the Committee. They will, if implemented, lead to the establishment of a whole-of-system approach to perioperative mortality that will build upon the substantive investment that the New Zealand healthcare system already has in place to consider system performance.

In seeking the views of key stakeholders during the next period of consultation we are very aware that our proposals will only work if there is widespread support and adoption across the entire New Zealand healthcare system. Consequently, it is important we obtain a comprehensive set of feedback and the Committee is grateful in advance for your responses to our proposals.

We hope that this report marks the start of the establishment phase of a national perioperative mortality review system that has long been the goal of those championing the Perioperative Mortality Review Committee.

Professor Iain Martin
Chair, Perioperative Mortality Review Committee

"We always hope for the easy fix: the one simple change that will erase a problem in a stroke. But few things in life work this way. Instead, success requires making a hundred small steps go right – one after the other, no slipups, no goofs, everyone pitching in." [i]

– Atul Gawande

Executive Summary

Mortality review is recognised as a key component of healthcare system quality and safety. The Perioperative Mortality Review Committee spent much of its first year considering a number of key questions that would underpin the establishment of a national system for recording and reviewing perioperative mortality. Early in the process, the Committee came to the view that the methods adopted must be able to make recommendations to strengthen the quality and safety of New Zealand's healthcare system.

The Committee's main aim is to review and report on perioperative deaths occurring in New Zealand. This includes all deaths occurring within 30 days of an invasive procedure or anaesthetic; those occurring prior to hospital discharge, irrespective of the time from the index procedure; and those occurring in hospital whilst under the care of a surgeon, even if an operation is not undertaken. Operative procedures are defined in the broadest sense and include investigations such as gastroscopies, colonoscopies and angiographic procedures. Similarly, anaesthesia includes any general anaesthetic, neuraxial block (eg, epidural or spinal), regional block, local anaesthetic and/or sedation.

Any proposed approach to make recommendations within the Committee's scope to strengthen the quality and safety of the healthcare system must enable accurate data to be produced that will describe both the range and numbers of procedures being carried out (the epidemiology of perioperative mortality) supplemented by targeted peer review of case cohorts (qualitative, expert opinion). Only with an accurate understanding of both of these aspects can we expect to optimally use this information to enhance the quality of healthcare delivery.

In reaching this conclusion the Committee considered the wide variety of approaches that have been used to study perioperative mortality in other jurisdictions. Much can be learnt from these studies, but there was clearly no single example of a whole-of-system approach to both the quantitative and qualitative study of perioperative mortality. Although there were no examples of such an approach, the Committee viewed that the structure of the New Zealand healthcare system, the relatively small population and the ability to use the National Health Index (NHI) coupled to existing data sets offered a real opportunity to institute a 'world leading' whole-of-system approach.

To achieve this outcome, the Committee resolved to spend considerable time understanding which components of existing data collections could be utilised as the backbone of a system for the recording and assessment of perioperative mortality. This, coupled with specific components of existing national and international systems for the study of perioperative mortality, could facilitate the development of the New Zealand system. The Committee looked in detail at existing data sets to assess what can be achieved using existing data sources. The Committee concluded that the NMDS and the National Mortality Collection (NMC) held by the Ministry of Health (the Ministry) served as a useful baseline data set.

Whilst the vast majority of patients' admissions that occurred during this period would have been captured using this approach, including all of the public sector and some of the private sector, a number of private providers do not contribute NMDS data. The Committee acknowledges this gap and recognises that if the data are to be reliable and comprehensive, all providers must participate in providing NMDS data. If the Committee's recommendations are to be acted on, all providers must use this system, including day-stay, procedural and in-room services.

Reviews were chosen across four major diagnostic categories to explore the use of these administrative data sets for the purpose of national perioperative mortality review. We recognised that this approach would only achieve the quantitative component of the system, but felt that this would be an important starting point. The following selection criteria were used to determine which areas to initially examine:

1. the procedure(s) should be relatively common (ie, a large number undertaken each year)
2. the procedures should take place in a large number of hospitals across the healthcare system
3. the procedure(s) should be relatively similar

4. the procedures chosen should be of moderate risk. This was either because the procedure was relatively invasive, or because of the vulnerability of those undergoing the procedure (eg, procedure common in older age groups, those with multiple co-morbidities)
5. it was also felt important that the mix of procedures chosen should reflect a balance between in-hospital and community mortality.

These early analyses enabled the Committee to both understand in detail the potential utility and limitations of these current data sets and to also describe from a large data set the current patterns of post-operative mortality following these selected procedures.

Hip and knee arthroplasty

- In New Zealand between 2005 and 2009 there were 37,266 admissions (29,325 electives, 78.7 percent) for hip arthroplasty and 26,000 admissions (25,617 electives, 98.5 percent) for knee arthroplasty recorded in the NMDS.
- Overall, cumulative 30-day mortality following an acute admission for hip arthroplasty was 7.3 percent (7,268.6 per 100,000). For an elective/waiting list admission 30-day mortality was 0.24 percent (235.3 per 100,000).
- Falls were the most frequently listed main underlying cause of death in those dying after acute hip arthroplasty. It was the view of the Committee that this reflected the cause of the acute admission rather than the immediate cause of death. This finding and other similar coding issues led the Committee to recommendations in this area. Following falls myocardial infarction and other forms of ischaemic heart disease were the most frequently cited main cause of death. Similarly, myocardial infarctions, followed by other forms of ischaemic heart disease were most frequently listed main underlying causes of death following an elective/waiting list admission for hip arthroplasty.
- Following an elective/waiting list knee arthroplasty, mortality was highest during the first week post procedure. A small number of deaths occurred up until 29 days post procedure with cumulative 30-day mortality being 0.21 percent (206.9 per 100,000 elective/waiting list knee arthroplasty admissions).
- Due to the potentially higher mortality rates following acute and semi-acute procedures and the small annual number of acute knee arthroplasties, analysis for this category was restricted to 30-day mortality for adults 45+ years following elective/waiting list admissions for knee arthroplasty. Myocardial infarctions and other types of ischaemic heart disease were the most frequently coded main underlying causes of death.

Colorectal resection

- In New Zealand between 2005 and 2009 there were 16,238 admissions (10,226 electives, 63 percent) for colorectal resection.
- Mortality was highest on the first and second day post-surgery for an acute admission and highest on the second and third day for an elective/waiting list admission. Cumulative 30-day mortality was 9.8 percent for acute admissions (9,818 per 100,000 procedures and 2.1 percent for elective/waiting list resections (2,058 per 100,000 procedures).
- Malignant neoplasm of the colon was the most frequently coded underlying cause of death for those undergoing colorectal resection, irrespective of the admission category. As was the case for hip arthroplasty the view of the Committee was that current coding practice does not enable the identification of the exact post-procedure cause of death.
- Mortality was significantly higher for males (elective/waiting list) than females 2.6 percent and 1.6 percent respectively.

Cataract surgery

- Between 2005 and 2009 there were 86,514 admissions for cataract surgery (85,527 electives, 98.9 percent).
- Admissions reached a peak at 80-84 years for females and 85-89 years for males.
- Myocardial infarctions and other forms of ischaemic heart disease were the most frequently coded underlying cause of death for those dying within 30 days of cataract surgery, with other forms of cardiovascular disease also making a significant contribution. Neoplasms and emphysema/COPD were the next most frequently coded main underlying causes of death.
- In the first 30 days post-surgery, mortality following cataract surgery was reasonably evenly distributed by day. A number of deaths continued to occur 20+ days post procedure. Cumulative 30-day mortality was 161.7 per 100,000 procedures, or 0.2 percent.

General anaesthesia

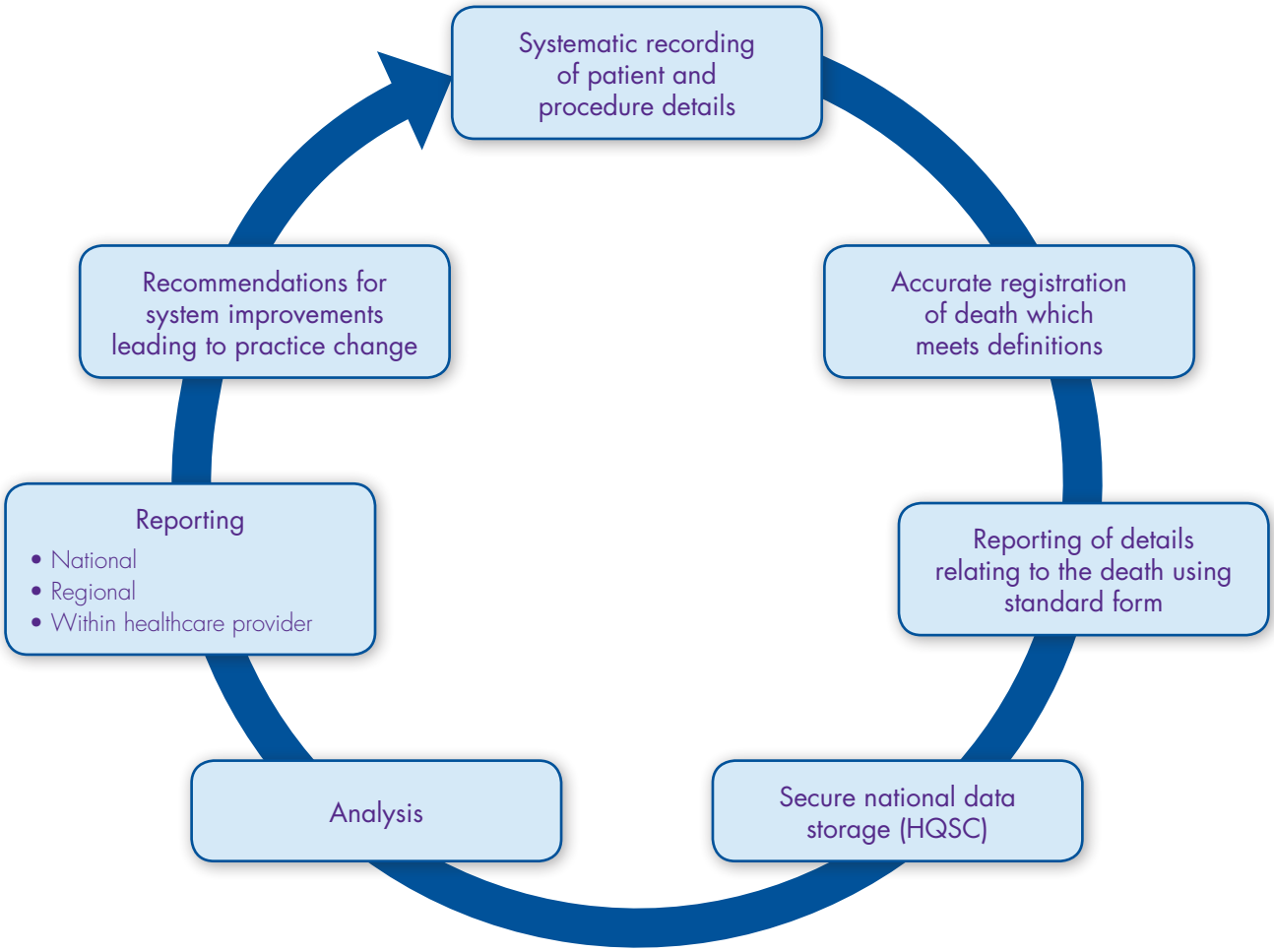
Deaths related to anaesthesia for all types of procedures were assessed for many years by the (New Zealand) Anaesthesia Assessment Mortality Committee. Similarly to the analyses of mortality following the common procedures (above), the Committee decided to assess mortality after anaesthesia by using general anaesthesia with or without other forms of anaesthesia (neuraxial, local) as the procedure being studied. For this, a shorter time period for the deaths (during, on the day of and day after general anaesthesia) was chosen, to minimise the confounding effect of further admissions for anaesthesia procedures within the reference period. This time period is used by some Australian Anaesthesia Mortality Committees (New South Wales, within 24 hours, Western Australia, within 48 hours). This analysis enabled the Committee to describe the pattern of deaths following anaesthesia, with identification of the degree of risk associated with the common risk factors.

- Twenty-four percent of admissions with one or more general anaesthetic were acute events, 7.9 percent were semi-acute (within seven days of referral) and 68 percent were drawn from the waiting list during 2005-2009.
- Same or next day mortality following general anaesthesia had an initial peak in those 0-4 years of age, dropped to a trough in those 5-9 years of age and then increased with increasing age for all admission groups.
- For all age groups, mortality was greater in the acute than elective admissions.
- Mortality was significantly higher for those with high ASA Score (4-5) and more than one general anaesthetic in their admission.
- Myocardial infarctions and other forms of ischaemic heart disease were the most frequently listed main underlying cause of death for those dying on the same or next day following a general anaesthetic as well as other forms of cardiovascular disease. Cancers and gastrointestinal diseases also made a significant contribution.
- There was a high proportion of cases with general anaesthesia but no documented ASA score.

Based upon these initial analyses of the available data, it was the view of the Committee that a whole-of-system quantitative record supplemented by qualitative analysis and peer review could provide the foundation of a whole-of-system perioperative mortality review process. It was, however, very clear that whilst the NMDS (National Minimum Dataset) and the NMC (National Mortality Collection) are a useful baseline data set, additional data is required to produce an enhanced system that can support national perioperative mortality review.

The Committee's Quality Improvement Cycle

A national system for understanding and reducing mortality following an operative procedure



The above diagram details the components and steps that such a system should include and our recommendations build upon this proposal. Within these components, the Committee recommends an enhancement to the current death certificate completion process to include mandatory recording of perioperative deaths that fall within this Committee's Terms of Reference.

The Perioperative Mortality Review Committee therefore recommends:

1. That a whole-of-system perioperative mortality review process is developed which builds on the NMDS and the NMC. This would include the accurate and systematic recording of patient and procedure details from all healthcare facilities and practitioners. The key components of this system would be:
    a. the enhancement and standardisation of existing data collections and current mortality review processes to ensure a uniform, efficient and meaningful national methodology
    b. a coding mechanism that recognises both procedures and deaths within the remit of this Committee. This will require investigation to determine optimal methodology
    c. the development of a national standardised perioperative mortality review form that will be common to all healthcare facilities and practitioners. This form will enable and facilitate additional data collection and peer review processes.

d. secure national data storage hosted by, and under the guardianship of, the Health Quality & Safety Commission

e. the ability to carry out whole-of-system and focussed (sub-group) analysis of both qualitative and quantitative data

f. the ability to report at a number of levels (national, regional, within healthcare facility) and to a variety of audiences, including consumers and the wider community

g. the ability to generate evidence-based, peer-reviewed recommendations for reinforcing current 'good practice' or system improvements leading to practice change.

2. Formalised memorandum of understanding between the Committee and Coronial Services is signed to enable enhanced and standardised data access.

3. The Committee works with the National Health Board to ensure that the NMDS and NMC collections are enhanced and standardised by:

   a. ensuring that an ASA score is recorded for all procedures

   b. separately identifying existing conditions from those acquired during that admission

   c. ensuring that the immediate cause of death can be identified from the data collections.

4. Submission of data to the NMDS is mandatory for all healthcare facilities.

Case Studies of Perioperative Mortality Review

Reporting on specific populations:

Baum VC, Barton DM, Gutgesell HP. Influence of Congenital Heart Disease on Mortality After Noncardiac Surgery in Hospitalized Children. Pediatrics 2000:105;332-5.

The aim of this study was to determine the incremental risk of congenital heart disease on mortality following noncardiac surgery in children. The study used the University Hospital Consortium (UHC) database in the US. The UHC is a group of more than 60 university hospitals within the US. They share diagnostic, demographic, procedural and outcome data on all hospital admissions.

A search was undertaken in the database for patients who were less than 18 years old and who had any of the identified 3136 ICD-9 procedure codes, during the period 1 January 1993 to 31 December 1996.

For the purposes of this study, patients were excluded if their procedures related to cardiac surgery. They were also excluded if the sole procedure code for the patient related to a diagnostic rather than surgical procedure. Procedures were included if it was felt that they would require a significant degree of sedation or anaesthesia in the paediatric population under study. For example, circumcisions were excluded. There are no details about the 3136 ICD-9 codes that were used, or any further detail about how they were selected.

Data were corrected to account for the possibility of multiple procedures being performed on any one patient. Perioperative mortality was defined as any death within 30 days of the surgical procedure.

The Establishment of Perioperative Mortality Review in New Zealand

The journey towards the establishment of a national perioperative mortality review system has its origins in the Maternal Deaths Assessment Committee, set up under legislation in 1962. Some years later in 1979, the Anaesthetic Mortality Assessment Committee (AMAC) was set up under the same legislation.

AMAC operated successfully for a decade until the Police obtained a report via the AMAC process as part of their preparation to press charges for manslaughter against an anaesthetist in 1989. This resulted in a campaign to change the standard for manslaughter when a person is owed a special duty of care by another person such as a doctor from simple to gross negligence. The 1989 case understandably resulted in a degree of caution around mortality review and reporting at that time and a re-examination of the legislative protections for such review groups.

At the same time, studies into the prevalence of iatrogenic injury in modern medical care, notably the Australian Quality & Healthcare and Harvard Medical Practice Study[ii, iii] highlighted the need for surveys in which the medical professionals critically examine their own practices. Consequently, while an environment of caution existed in the medical community around mortality review and reporting, there was a clear acknowledgement that such reporting was necessary to make improvements at both an individual practice and a wider healthcare system level.

Discussions within the medical community resulted in the proposal to set up the New Zealand Perioperative Deaths Committee to replace AMAC and widen the scope of the survey to take in all specialties involved with the care of the patient. The then Minister of Health's (1995) view was that for the "medical manslaughter" change to be supported, the profession must proceed with the Perioperative Deaths Committee.

The New Zealand Perioperative Deaths Survey (NZPODS) Working Party was set up in 1996. This had representation from the Royal Australasian College of Surgeons (RACS), the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG), the Australian and New Zealand College of Anaesthetists (ANZCA) and the Ministry. The Maternal Deaths Assessment Committee ceased to function because of similar issues around confidentiality to AMAC and reorganisation within the Ministry, resulting in loss of support and continuity for the committee. It was proposed that the NZPODS Working Party become a subcommittee of the Council of Medical Colleges (CMC).

Throughout the mid-to-late nineties there were discussions with successive governments about the establishment of a national perioperative mortality review committee. In the late nineties, the New Zealand Public Health and Disability Act 2000 (NZPHDA) was drafted and passed as legislation. This legislation made it possible to establish national mortality review committees to review specific classes of death. The first of these national committees was the Child and Youth Mortality Review Committee, established in 2002. The Perinatal and Maternal Mortality Review Committee was established in 2005. The Family Violence Death Review Committee was established in 2008. These committees were all appointed by the Minister of Health and protected by the NZPHDA. Confidence around the protection of information has grown as these committees have developed their systems and produced national reports.

With three national mortality review committees established under the NZPHDA, a clear gap was still evident in terms of national perioperative mortality review and reporting. Professional colleges and societies representing a range of medical subspecialties and the Ministry continued to make the case for the establishment of a national perioperative mortality review committee.

The Perioperative Mortality Review Committee was established in April 2010. Amendments to the NZPHDA have placed mortality review committees under the auspices of the Health Quality & Safety Commission.

Terms of Reference

The Committee's main aim is to review and report on perioperative deaths occurring in New Zealand. This includes all deaths occurring within 30 days of an invasive procedure or anaesthetic, as well as those occurring prior to hospital discharge, irrespective of the time from the index procedure. Operative procedures are defined in the broadest sense and include investigations such as gastroscopies, colonoscopies, and angiographic procedures. Similarly, anaesthesia includes any general anaesthetic, neuraxial block (eg, epidural or spinal), regional block, local anaesthetic and/or sedation.

Definition

For the purposes of the Terms of Reference of the Perioperative Mortality Review Committee, perioperative mortality deaths include:

a) a death that occurred after an operative procedure
   1. within 30 days
   2. after 30 days but before discharge from hospital to home or a rehabilitation facility

b) a death that occurred whilst under the care of a surgeon in hospital even though an operation was not undertaken.

For the purposes of this definition:

a) an operative procedure is defined as any procedure requiring anaesthesia (local, regional or general) or sedation

b) a surgeon is defined as a doctor who has achieved vocational registration with the Medical Council of New Zealand in a speciality of surgery (including oral surgery)

c) for the removal of doubt, gastroscopies, colonoscopies, and cardiac or vascular angiographic procedures (diagnostic or therapeutic) carried out in designated endoscopy or radiological rooms would be included in this definition.

Legal framework and protection of information collected

In order to conduct effective reviews that can lead to system-wide improvements, the Committee is able to gather information from a wide range of sources for the sole purpose of perioperative mortality review. The Committee is restricted to only collecting information that is relevant to carrying out its functions. Strict protections are placed on the gathering, use and viewing of this information.

Only Committee members, or agents of the Committee, may view the information gathered.

The Committee is able to collect information via the Committee Chair or an agent of the Committee.

Examples of information that may be requested are:

- patient records, clinical advice, and related information
- answers to questions posed by the chairperson in the notice, and that the person is able to answer
- information that became known solely as a result of a declared quality assurance activity, within the meaning of Part 6 of the Medical Practitioners Act 1995, or a protected quality assurance activity within the meaning of section 53(1) of the Health Practitioners Competence Assurance Act 2003.

The person from whom the information is requested must take all reasonable steps to comply with the notice.

Confidentiality

The maintenance of confidentiality is crucial to the functioning of the Committee.

What is an 'agent'

The NZPHDA gives the Committee the authority to appoint agents to collect information on its behalf. An agent may require any person to provide the Committee with information in that person's possession or control that is relevant to the Committee's functions. However, an agent may only require information in relation to the Committee they have been appointed to, and not in relation to any other mortality review committee unless they have also been appointed as agent of those other committees.

How protected is information the Committee gathers

The establishment of mortality review committees under the NZPHDA supersedes any previously established national mortality review systems or committees and the associated complications in terms of protection of information, most notably in the early nineties.

Schedule 5 places strict statutory limits on when and how the Committee can disclose information.

Section 59e of the NZPHDA provides that a person who discloses information contrary to Schedule 5 is:

- liable on summary conviction to a maximum fine of $10,000
- liable (if a member of a registered occupational profession) to any disciplinary proceedings of that profession.

Case studies of perioperative mortality review

Reporting on specific procedures:

Karanicolas PJ, Luc Dubois L, Colquhoun PHD, et al. The more the better? The impact of surgeon and hospital volume on in-hospital mortality following colorectal resection. Annals of Surgery 2009: 249: 954-9.

This study aimed to determine the in-hospital mortality rates for people undergoing colorectal resection (for both malignant and benign conditions). They also examined whether mortality rates were lower in high-volume hospitals, and when procedures were performed by 'high-volume' surgeons.

The authors used the Canadian Institute for Health Information (CIHI) Discharge Abstract Database, which contains data from all hospitals in Canada except those in Quebec. Data is contained on all hospital discharges and day surgeries. Primary and secondary diagnoses in the CIHI are coded in ICD-10-CA (Canadian Revision).

The authors extracted data on all adult (over 18 years of age) patients who underwent colonic or rectal resection between 1 April 2005 to 31 March 2006. Patients who met the eligibility criteria were categorised as to the degree of resection undertaken. Patients whom had more than one resection in the same admission were categorised according to the first resection. The indication for resection was determined based on the first occurrence of one of the following codes in the hospital admission: colorectal cancer, benign colorectal neoplasm, inflammatory bowel disease, ischaemic colitis, intussusception, volvulus, diverticular disease, functional colorectal disorder or rectal prolapse. All other cases were classified as 'other'. Patients were also categorised as to whether their surgery was elective or urgent. For each record there was a unique identifier and surgeon identifier.

They were not able to examine perioperative death outside of hospital.

Approaches to Perioperative Mortality Review by Other Jurisdictions

While systematic perioperative mortality review for the purpose of improving the quality and safety of the healthcare system is a well-established concept, a review of approaches taken by other jurisdictions highlighted that there are few, if any, established whole-of-system and all-encompassing perioperative mortality review programmes internationally.

In part, this is due to the sheer volume of surgical procedures occurring per head of population in some jurisdictions. This can also partly be attributed to mortality and morbidity review systems working in parallel to national perioperative mortality review programmes that historically may have included certain medical subspecialties covering perioperative mortality (eg, FINNVASC, SWEDVASC, CICS[iv]). Programmes that are established are typically run by professional colleges and societies or departments and ministries of health.

A review of the literature highlighted various types of mortality review:

1. reporting on specific populations
2. reporting on specific clinical specialties or procedures
3. aggregated system audit.

We were unable to find any system that looked at the whole of the healthcare system as the Perioperative Mortality Review Committee intends.

Scottish Audit of Surgical Mortality (SASM)

Deaths are notified to the SASM through a number of means, including medical record offices, ward clerks and mortuary technicians. Cases are then identified as to which were under the care of a surgeon. The surgeon responsible for the patient completes a surgical pro forma (with different forms for neurosurgery, orthopaedics and paediatric surgery). This identifies other clinicians involved in the care of the patient. These other clinicians are sent forms to complete. Once all of the paperwork has been completed, each case is examined by a consultant of the same surgical specialty, located in a different geographical area to the responsible clinician. If an area of concern is identified, the case is referred to a coordinator of the appropriate speciality. Further review is undertaken as required. The latest report of SASM (reporting data 2009), reported that of the 3,310 cases reported, 1,691 (51.1 percent) had undergone the complete SASM process as described above. The pro forma return rate was reported as 78 percent.[v]

With a population of approximately 4.4 million people, it is possible for New Zealand to develop a whole-of-system approach to perioperative mortality review, encompassing both anaesthesia and all surgical sub-specialties.

National Confidential Enquiry into Patient Outcome and Death (NCEPOD)

NCEPOD is a programme that is the closest to a national system that can be found internationally and has moved beyond mortality reporting to including morbidity. Reporting tends to occur around a sample of annual deaths in specific areas. An earlier concern of the NCEPOD has been the lack of good quality denominator data.[vi]

NCEPOD has its origins in a study of mortality associated with anaesthesia in 1982.[vii] The aims of this first study were to assess perioperative mortality information to improve the clinical practice of anaesthesia and provide comparative figures between regions. This gave rise to a joint venture between surgical and anaesthetic specialties. Initial reviews focused on surgical and anaesthetic practice over one year in three regions of the United Kingdom (excluding Scotland). In 1988 NCEPOD received government funding and its first national report was published in 1990.[viii]

Summary of a sample of national perioperative mortality systems

SYSTEM	JURISDICTION	KEY FEATURES	SCOPE
National Confidential Enquiry into Perioperative Deaths (NCEPOD)	UK (excluding Scotland)	Mortality and morbidity review of all specialties. Reporting focused around annual sample of deaths.[viii] Modified nominal group technique (NGT).	Deaths within 30 days of surgical procedure. Includes anaesthesia.
Scottish Audit of Surgical Mortality (SASM)	Scotland	Voluntary, peer-reviewed, critical event analysis.[ix]	Deaths in hospital under the care of a surgeon within 30 days of operation. Excludes obstetrics and cardiothoracic surgery.[ix]
National Surgical Quality Improvement Programme (NSQIP)	USA	Prospective, peer-reviewed validated database. Risk-adjusted surgical outcomes.[x] Risk-adjusted morbidity and mortality outcomes are computed for each participating hospital.	Thirty-day post-operative mortality and morbidity for patients undergoing major surgical procedures in both the inpatient and outpatient setting.
POMR	Malaysia	National reporting system. Direct reporting by clinicians and parallel reporting to ascertain true incidence.	All mortality cases following surgery. 'Procedure' exclusion criteria includes interventional radiology, and local anaesthetic.[xi]

Criteria for a good mortality review system[iv] *(adapted from Russell et al. 2003)*

1. Standard definitions and timeframes
2. Possible to calculate incidence with denominator
3. Data capture is immediate
4. Risk factors are included
5. Dedicated trained staff
6. Complete, reliable and accurate case ascertainment
7. Timely output and feedback that is user-friendly
8. Agreed surveillance procedures.

Perioperative Mortality Review Committee (Malaysia)

Perioperative mortality review in Malaysia was established in 1990. Its Committee publishes biennial reports, as well as a parallel process where an independent committee audits all maternal deaths. The Committee has a range of exclusion criteria. The ASA classification system is used to stratify risk factors. Deaths are assigned to one of six categories which indicate whether the death was potentially avoidable. The Committee does not have denominator data to quantify the risk of death for a specific condition. In addition, private hospitals do not participate in the programme.[xi]

Royal Australasian College of Surgeons bi-national surgical mortality audit

The Royal Australasian College of Surgeons (RACS) runs a bi-national surgical mortality audit program. This is modelled on the Western Australian Audit of Surgical Mortality which has its origins in the Scottish Audit of Surgical Mortality (SASM). According to the RACS Continuing Professional Development Program, it is a requirement of fellows of the college who are in operative-based practice to participate in this audit. Participation as a first or second line assessor remains voluntary but is encouraged. Each state of Australia also has its own regional audits that feed into the national program.[xii]

Australian and New Zealand College of Anaesthetists' mortality working group

The Australian and New Zealand College of Anaesthetists (ANZCA) mortality working group collaborates with the various anaesthetic mortality review committees in Australia. The group prepares triennial reports on anaesthetic mortality. Many regions have continuously functioning anaesthetic mortality review committees. Where these do not exist, ANZCA works to promote the establishment of such committees.[xiii]

Reporting first began in New South Wales in 1960. Subsequently, reporting was established in other states in Australia and established in New Zealand from 1981.[xiv]

Case studies of perioperative mortality review

Story DA, Leslie K, Myles PS, et al. Complications and mortality in older surgical patients in Australia and New Zealand (the REASON study): a multicentre, prospective, observational study. Anaesthesia 2010; 65: 1022-1030.

This prospective study of non-cardiac surgical patients aged 70 years or more in 23 hospitals in Australia and New Zealand studied 4158 patients, 65% of whom had pre-existing co-morbidities.

By day 30:

- 216 (5%) of these patients had died
- 835 (20%) suffered complications
- 390 (9.4%) were admitted to the Intensive Care Unit.

Pre-operative factors that were associated with mortality included increasing age, worsening ASA physical status, a below normal pre-operative plasma albumin and non-scheduled surgery.

Complications associated with mortality included acute renal impairment, unplanned Intensive Care Unit admission and systemic inflammation. Those patients with a complication stayed, on average, a week longer in hospital, and, of those, 14% had died within 30 days.

The authors note that this study had several limitations. Firstly, the results cannot be generalised to a younger population. Secondly, it was not easy to identify specific risks of less frequent but complicated operations. Further, hospitals self-selected participation in the study, possibly making the sample less representative and large teaching hospitals are over-represented. Finally, data were not collected for all complications.

Developing a Methodology for Reviewing Perioperative Deaths Using Routinely Collected Data

As outlined previously, the Committee's main aim is to review and report on perioperative deaths occurring in New Zealand.

This includes all deaths occurring within 30 days of an invasive procedure or anaesthetic; those occurring prior to hospital discharge, irrespective of the time from the index procedure; and those occurring in hospital whilst under the care of a surgeon, even if an operation is not undertaken. In this context, operative procedures are defined in the broadest sense and include investigations such as gastroscopies, colonoscopies, and angiographic procedures. Similarly, anaesthesia includes any general anaesthetic, neuraxial block (eg, epidural or spinal), regional block, local anaesthetic and/or sedation.

These broad definitions meant that the Committee needed to invest considerable time and effort reviewing possible methodologies for establishing a national perioperative mortality review process. It became apparent that the development of such a methodology would require two separate but related pathways.

Existing data collection

1. Firstly, an evaluation of the strengths and weaknesses of New Zealand's national health collections (eg, hospital admission and mortality data) would need to occur, in order to determine how much information could be gleaned from routinely collected data sources for the purposes of perioperative mortality review.

New data collection

2. Secondly, consideration needed to be given to the development of new data collection modalities, which could be used to inform mortality review, in areas where routinely collected data provided few insights (eg, descriptions of the circumstances surrounding individual perioperative deaths, analyses of systems failures leading to mortality).

The following section describes the approach taken by the Committee to develop a methodology for perioperative mortality review using routinely collected data. The current section begins by briefly reviewing the two national data collections initially identified by the Committee as being useful for perioperative mortality review (the NMDS and the NMC), before describing the approaches taken to identify perioperative cases within these data sets. The strengths and limitations of perioperative mortality review are then illustrated by means of a number of sample analyses (hip and knee arthroplasties, colorectal resections, cataract surgery, and general anaesthesia) which were undertaken using data from these collections for the period 2005-2009. The section concludes by briefly describing two other national data collections which may provide additional information, before making a series of recommendations as to how routinely collected data might best be used in the process of national perioperative mortality review.

Key routinely collected data sources available for mortality review

Following its initial deliberations, the Committee identified two data sources, which it felt would be the most useful starting points, for exploring a methodology for national perioperative mortality review. These were the NMDS and the NMC, both managed by the Ministry. The key features of these data collections are outlined in the text box below.
The Committee obtained initial data extracts from these collections, for the period 2005-2009. These initial data extracts included all hospital admissions occurring during 2005-2009 where the procedure code fields were not blank, or where a patient was discharged with a surgical health specialty code. The linked mortality data set included all those dying within 30 days of a hospital discharge meeting these same criteria.

National Health Data Collections Used in Initial Perioperative Mortality Review

The National Minimum Dataset (NMDS)

The NMDS, New Zealand's national hospital discharge data collection, is maintained by the Ministry. The information contained in the data set has been submitted by public hospitals in a pre-agreed electronic format since 1993. Private hospital discharges for publicly funded events (eg, births, geriatric care) have been submitted since 1997. The original NMDS was implemented in 1993, with public hospital information back-loaded to 1988.[xv] Information contained in the NMDS includes principal and additional diagnoses, procedures, external causes of injury, length of stay and sub-specialty code and demographic information such as age, ethnicity and usual area of residence. All diagnostic information is coded at the DHB level prior to submission to the Ministry, with coders using the international Statistical Classification of Diseases and Related Health Problems, Australian Modification (ICD-10-AM) to code diagnoses, and the Australian Classification of Health Interventions (ACHI) to code operative procedures.

In terms of its coverage, 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 are publicly funded maternity events. As NMDS reporting is not legally mandated for New Zealand healthcare providers many private surgical or procedural day-stay or outpatient hospitals, facilities or in-rooms do not report any events to the NMDS. The Ministry is unable to provide any estimate of the extent to which the NMDS undercounts private surgical or procedural day-stay or outpatient hospitals, facilities or in-room events, although it notes that the data most likely to be missing is privately funded or ACC funded events, or publicly funded long-stay geriatric cases. Thus in the sections which follow, it must be remembered that the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

The National Mortality Collection (NMC)

The NMC is also maintained by the Ministry. The data set contains information on all deaths registered in New Zealand since 1988 (including basic demographic data and cause of death information).[xvi] The Collection incorporates data from a variety of sources, with Births, Deaths and Marriages sending the Ministry electronic death registration information, and information from Medical Certificates of Cause of Death, and Coroner's reports each month. Additional information is obtained from the NMDS, private hospital discharge returns, the NZ Cancer Registry, the Department of Courts, the Police, the NZ Transport Authority, Water Safety NZ, Media Search and from writing letters to certifying doctors, coroners and medical records officers in public hospitals.[xvi]

Unlike the NMDS, where diagnostic information is coded at the hospital and then forwarded electronically to the Ministry, in the NMC each of the approximately 28,000 deaths occurring in New Zealand each year is coded manually by Ministry staff, using ICD-10-AM and the World Health Organization's rules and guidelines for mortality coding. For most deaths the Medical Certificate of Cause of Death provides the information required, although coders also have access to the information contained in the other data sources listed above.[xvii] As a consequence, while coding is still reliant on the accuracy of the death certificate and other supporting information, there remains the capacity for a more uniform approach to coding which poses challenges for hospital admission data.

The Identification of Perioperative Cases in Routinely Collected Data

Selection based on the presence of anaesthetic codes

Initial discussions amongst Committee members had suggested that the most useful way to identify cases for perioperative mortality review would be to select all admissions in the NMDS where an anaesthetic (including general anaesthesia, neuraxial blocks, regional blocks, local anaesthetics or sedation) was listed in any of the procedure codes, and then to follow these cases through into the NMC, to determine whether any had died within 30 days of the procedure.

Prior to the adoption of this methodology, an audit of the quality of anaesthetic coding was undertaken to ensure that this process could identify all of the procedures the Committee felt fell within the scope of perioperative mortality review. Because of the complexity of the NMDS (up to 90 procedures were listed for any one admission, a number of procedures were often performed under the same anaesthetic and a number of patients had more than one anaesthetic) an initial scan was undertaken to assess how many primary procedures (ie, the first listed procedure for each admission event) had a second or subsequent procedure listed (as most anaesthetic codes were listed as second or subsequent procedures).

Table 1 below considers the proportion of admission events for selected procedures, where a primary listed procedure was not accompanied by any secondary procedures. In general, for major procedures, where a general anaesthetic, or neuraxial block could be expected to be performed (eg, coronary artery bypass, total colectomy) very few admission events did not have a secondary procedure listed. However for more minor procedures, which may have been performed under sedation or local anaesthetic, but which the Committee felt fell within the scope of perioperative mortality review (eg, cataract surgery, carpal tunnel release, coronary angioplasty +/- stenting) a significant (but variable eg, 10-60 percent) proportion did not have a secondary procedure listed, thus precluding the possibility that an anaesthetic code could have been listed for that admission event. As a result, it was determined that the use of anaesthetic codes in isolation would be insufficient to identify all of the procedures the Committee felt should fall within the scope of perioperative mortality review, and that another methodology would thus be required to select perioperative cases.

Selection based on the presence of a surgical specialty code

With anaesthetic coding proving to be an unreliable methodology for identifying many procedures falling within the scope of perioperative mortality review, the possibility of selecting eligible cases based on the presence of a surgical specialty code on discharge was explored. However, further analysis of the NMDS suggested that selection based on this criterion would result in a large number of 'operative' procedures being excluded from the analysis (eg, a significant proportion of coronary angioplasties and colonoscopies were undertaken by those working in medical or other non-surgical specialities, with mortality arising from these cases being overlooked, if only discharges from the surgical sub-specialties were considered (Table 2)). Such findings also had implications for any future review of mortality in those admitted under the care of a surgeon who did not subsequently undergo a procedure (6.2 under the term of reference of the Committee), as consideration would also need to be given to those admitted under the care of a physician or interventionist radiologist where the intended procedure did not proceed. As a result, the use of a methodology based primarily on surgical subspecialty codes was not explored further by the Committee.

Table 1. Proportion of Selected Procedures with No Second or Subsequent Procedure Listed in the National Minimum Dataset, New Zealand 2005-2009

PRIMARY PROCEDURE	Total No. 2005-2009	Total with no 2nd procedure	Percent with no 2nd procedure
Selected Eye Procedures			
Strabismus Repair	2,772	41	1.5
Lens or Cataract Related Procedures	85,242	31,353	36.8
Selected Cardiovascular Procedures			
Coronary Artery Bypass	7,254	1	0.0
Biopsy of Myocardium	261	30	11.5
Transluminal Coronary Angioplasty with Stenting	16,820	2,128	12.7
Transluminal Coronary Angioplasty	873	136	15.6
Total Coronary Angiography (+/- Heart Catherisation)	47,836	13,998	29.3
Biopsy of Myocardium by Cardiac Catheterisation	148	87	58.8
Selected Gastrointestinal/Genitourinary Procedures			
Total Colectomy	8,855	9	0.1
Laparoscopic Sterilisation	7,096	95	1.3
Fibreoptic Colonoscopy with Excision	50,877	1,473	2.9
Repair of Inguinal Hernia	32,317	1,060	3.3
Fibreoptic Colonoscopy	60,189	2,791	4.6
Endoscopic Biopsy of Bladder	2,446	235	9.6
Total Panendoscopy +/- Excision, Destruction, Removal Foreign Body	91,767	12,169	13.3
Rigid Sigmoidoscopy	4,746	3,202	67.5
Selected Musculoskeletal Procedures			
Knee Replacement (Arthroplasty)	25,812	40	0.2
Hip Replacement (Arthroplasty)	37,384	78	0.2
Primary Repair of Flexor Tendon of Hand	2,453	72	2.9
Palmar Fasciectomy for Dupuytren's Contracture	4,316	142	3.3
Amputation of Finger	1,055	183	17.3
Release of Carpal Tunnel	20,116	11,809	58.7

Source: National Minimum Dataset.

Table 2. Distribution of Selected Cardiovascular and Gastrointestinal Procedures by Health Specialty on Discharge, New Zealand 2005-2009

HEALTH SPECIALTY ON DISCHARGE	PRIMARY PROCEDURE	Number of events	Number of in hospital deaths*
Selected Cardiovascular Procedures			
Medical and Other Specialties (Excluding Maternity and Neonatal)	Coronary Angiography	45,514	189
	Transluminal Coronary Angioplasty	737	23
	Transluminal Coronary Angioplasty with Stenting	16,225	130
	Coronary Artery Bypass Graft	484	30
Surgical Specialties	Coronary Angiography	2,322	10
	Transluminal Coronary Angioplasty	136	0
	Transluminal Coronary Angioplasty with Stenting	595	3
	Coronary Artery Bypass Graft	6,770	114
Selected Gastrointestinal Procedures			
Medical and Other Specialties (Excluding Maternity and Neonatal)	Fibreoptic Colonoscopy With Excision	31,184	48
	Rigid Sigmoidoscopy with Excision	86	1
	Colectomy	558	40
Surgical Specialties	Fibreoptic Colonoscopy with Excision	19,688	11
	Rigid Sigmoidoscopy with Excision	418	4
	Colectomy	8,277	275

Source: National Minimum Dataset;
* Hospital admissions where the event end type was recorded as a death. This may differ from the total number of deaths identified in the NMC as occurring within 30 days of the procedure.

Selection of cases based on the nature of the procedure code

It was then suggested that perioperative events might be selected on the basis of ICD-10-AM Australian Classification of Health Interventions (ACHI) code, as within the NMDS, each procedure was coded by ACHI. However, a review of the ACHI coding list revealed over 6,000 unique ACHI codes, each of which needed to be reviewed, in order to determine whether it fell within the scope of perioperative mortality review. For example, it was often unclear where on the spectrum of related procedures (eg, x-ray with contrast → angiography → coronary angiography → coronary angioplasty → coronary angioplasty with stenting) a particular procedure moved from being a simple radiological investigation into an operative procedure. For such an approach to be successful, it would have been necessary to firstly identify which of the 6,000+ procedures fell clearly within the scope of perioperative mortality review (eg, coronary artery bypass surgery), and which procedures clearly fell outside of it (eg, chest x-ray), and then to take the remainder in the grey zone to the Committee, for their consideration. While such an undertaking would have been theoretically possible, the resource intensiveness of such an undertaking (eg, the nature of many procedures was unclear to those without surgical training, ACHI versions were updated every 2-3 years), meant that from a practical point of view, such an undertaking was not seen as being feasible within the time frame and resources available to the Committee.

As a consequence, the Committee decided that in the short term, it would not be possible to develop a methodology for reporting total perioperative mortality rates, as the denominator for this analysis (number of perioperative procedures) could not be readily identified from the NMDS. However, what was seen as being feasible, was to use ACHI codes to select a number of clinically important groups of procedures, and then to review 30-day mortality for these procedures using the NMDS and the NMC.

In determining which procedures should be selected for initial review using this methodology, a number of selection criteria were identified:

- the procedure(s) should be relatively common (ie, a large number undertaken each year)
- the procedures should take place in a large number of hospitals across the healthcare system
- the procedure(s) should be relatively similar
- the procedures chosen should be of moderate risk. This was either because the procedure was relatively invasive, or because of the vulnerability of those undergoing the procedure (eg, procedure common in older age groups, those with multiple co-morbidities)
- it was also felt to be important that the mix of procedures chosen should reflect a balance between in-hospital and community mortality.

Following a review of hospital admissions for the period 2005-2009, four illustrative procedures were selected, which the Committee felt provided an appropriate balance across these criteria. These were hip arthroplasty, knee arthroplasty, colorectal resections and cataract surgery. In addition, a fifth section on general anaesthesia was selected, on the basis of its centrality to many operative procedures. The NMDS and the NMC are used to review perioperative mortality for these five procedure groupings during 2005-2009. Each section begins with an overview of the distribution of the procedure(s) by age, ethnicity, gender and NZ Deprivation Index (NZDep) decile, before mortality in the first 30 days is explored (or in the case of general anaesthesia, same or next day mortality).
The reader is urged to review the contents of these sections before continuing on to the section below, which considers the strengths and weaknesses of such routinely collected data sources for the purposes of perioperative mortality review.

The Strengths and Limitations of Routinely Collected Data for Perioperative Mortality Review

This report uses the NMDS and the NMC to review mortality following hip and knee arthroplasties, colorectal resections, cataract surgery, and general anaesthesia during 2005-2009. The analyses presented suggest that routinely collected data sources may be a cost-effective way of reviewing mortality following operative procedures, but that they do not provide all of the information required to address the potential preventability of individual deaths. The following section thus discusses the strengths and weaknesses of routinely collected data in more detail.

Strengths of routinely collected data for perioperative mortality review

The analysis in this report suggests that routinely collected data has a number of distinct strengths.

1. The NMDS affords near complete coverage of publicly funded operative procedures occurring in New Zealand hospitals, and is thus the best source of 'denominator' information for estimating the number of operative procedures occurring nationally. Similarly, the NMC provides near complete coverage of deaths registered in New Zealand, with the National Health Index (NHI) number allowing these two data sets to be linked to provide a valuable source of local information on perioperative mortality risk following specific procedures.
2. Both the NMDS and the NMC have relatively complete demographic information, making it possible to estimate differences in access to, and perioperative mortality following different procedures by age, gender, ethnicity, NZDep decile and region. Information on ASA Score is also available for most patients undergoing moderate to significant procedures requiring anaesthesia (eg, 82 percent of those admitted acutely for hip arthroplasty), making it possible to assess the impact current health status has on risk of perioperative mortality. Thus the data provide policy makers, clinicians and patients with a valuable source of local information on risk of mortality following specific procedures, which can be broken down by age, ASA Score and other demographic variables. Further, such data may also serve to identify variation in access to such procedures in the first place.

The use of routinely collected data, however, does have a number of limitations.

1. The coverage of the NMDS for privately funded operative procedures occurring in private hospitals is incomplete, with information from the Ministry suggesting that a number of New Zealand's private inpatient and day-stay providers are not represented in the data set. While such cases will be absent from both the denominator (number of operative procedures) and the numerator (number of deaths following such procedures), the extent to which this introduces bias into the more descriptive analyses is difficult to quantify (eg, are the higher rates of cataract surgery amongst Pacific groups identified in the Cataract Surgery section of this report, due to Pacific peoples having a higher prevalence of cataracts, or due to the differential utilisation of public versus private services by Pacific peoples).
2. The coding rules associated with ascribing the underlying cause of death in the NMC often mean that it is difficult to use its ICD-10-AM coded data to determine the reason for a perioperative death (eg, a large number of those dying following acute admissions for hip arthroplasty had a 'fall' listed as the main underlying cause of death. While it is indeed likely that a fall was the main reason for the patient being admitted acutely for hip arthroplasty, from a mortality review perspective such information does not provide any additional insights into why the patient died following the procedure. Similarly, for elective knee arthroplasties, a main underlying cause of death of knee arthrosis is uninformative from a mortality review perspective). The inclusion of additional/contributing cause of death codes however, was unable to shed further light on causality in the majority of cases.
3. While the NMDS and the NMC provide useful information on the number, and demographic profiles of those dying in the perioperative period, they afford few insights into the circumstances surrounding individual deaths, or the types of systems issues that may have contributed to their occurrence. Thus while useful for identifying potential areas of concern, once identified, routinely collected data has a very limited capacity to inform system changes which would prevent such deaths occurring in future. For this to occur, it is likely that additional sources of data will be required, which provide additional detail on the circumstances surrounding individual deaths.

While previous sections have provided a more detailed overview of the Committee's deliberations regarding additional data collection modalities, the section below briefly reviews two other routinely collected data sources, which might be used to supplement the NMDS and the NMC for the purposes of national perioperative mortality review.

Other routinely collected data of relevance for perioperative mortality review

As outlined above, while useful for providing broad overviews of perioperative mortality and being a necessary pre-requisite to any in-depth study of specific categories of death, the NMDS and the NMC provide very limited insights into the circumstances surrounding individual deaths. While in the medium to longer term it is likely that new data collection modalities will need to be developed to address this deficiency, two other routinely collected data sources may be of value in supplementing these data collections in the short to medium term. These are the Coroner's Case Management System (CMS) and the NZ Cancer Registry, each of which is briefly outlined below.

Coroner's Case Management System

CMS is a national internet-based data storage and retrieval system. It was established to assist coroners in their role as death investigators, by allowing them to review coronial cases that are similar in nature to their current investigations. Information about every death reported to a Coroner since July 1 2007 is stored within the system, with some of the available variables including:

- demographic and administrative details: date of death notification, age, sex, date of birth, place of residence, period of residence in New Zealand, country of birth, employment status, occupation, marital status, ethnicity
- if a *Work-Related Incident*: occupation at time of incident, industry at time of incident
- intent (both suspected at time of death reported and final)
- mechanism of injury (primary, secondary and tertiary)
- object or substance involved (primary, secondary and tertiary)
- medical cause(s) of death (as specified in post-mortem report)
- Coroner's provisional and final finding as to cause(s) and circumstances of death
- additional text field summaries for location events. These include a brief synopsis of the following reports: Police Narrative of Circumstances, Witness Testimony, Toxicology Report.

While full text reports are not available from the CMS, once a case has closed, New Zealand Coronial Reports are uploaded to Australia's National Coronial Information System.

It is likely that the CMS would be of considerable utility for perioperative mortality review, as the Coroner's Act 2006 (Section 13(1c)) states that every death must be reported to the Coroner that:

(i) Occurred while the person concerned was undergoing a medical, surgical, dental, or similar operation or procedure; or

(ii) Appears to have been the result of an operation or procedure of that kind; or

(iii) Appears to have been the result of medical, surgical, dental, or similar treatment received by that person; or

(iv) Occurred while that person was affected by an anaesthetic; or

(v) Appears to have been the result of the administration to that person of an anaesthetic or a medicine (as defined in section 3 of the Medicines Act 1981).

While deaths arising in such circumstances would likely comprise only a subset of those occurring perioperatively, the additional information provided (in particular the narratives arising from the coroner's findings, witness testimonies and police reports) would make the CMS a very valuable source of descriptive information on the circumstances surrounding individual deaths and would thus serve to fill an information gap not addressed by the NMDS or the NMC.

NZ Cancer Registry

The NZ Cancer Registry (NZCR) is a population-based register established in 1948 to collect information on all primary malignant diseases diagnosed in New Zealand. Cancers are registered once, in the year of their first known diagnosis. Incidence thus reflects the number of primary tumours diagnosed, rather than the number of individuals with cancer in any one year. (Squamous cell and basal cell skin cancers have traditionally been excluded from the Register, as have in-situ cancers since 1985).[xviii]

When the register was set up in 1948, it primarily used information sent by public hospitals to the NMDS. With the introduction of the Cancer Registration Act and the Cancer Registry Regulations during 1993/1994 however, it became a legal requirement for all laboratories to report newly diagnosed cancers to the Ministry for inclusion in the NZCR. Notification data is then supplemented with that contained in the New Zealand death certificate and hospital admission databases. To ensure a high standard of data quality, NZCR staff screen all records when adding them to the Register and cancer deaths are reconciled to cancer registrations as they occur.[xix] Since the advent of laboratory-based reporting, the quality and the completeness of the data have improved significantly, meaning that data collected since 1995 cannot be directly compared with that collected in previous years.[xviii]

Since November 2001 all cancer registrations have been coded using ICD-10-AM for the topographical site of the cancer and the International Classification of Diseases for Oncology (ICD-O-2) for the morphological type of the tumour.[xix] Thus in the context of perioperative mortality review, this data collection may provide additional information on deaths where cancer was the main underlying or a contributory cause of death. While potentially less useful than the CMS in addressing qualitative information gaps, the NZCR is nevertheless routinely available and likely to add some additional information, at a very low additional cost.

Concluding remarks pertaining to data sources

As outlined above, routinely collected data sources such as the NMDS and the NMC have the ability to provide information on mortality following specific operative procedures relatively quickly and in a very cost-effective manner. As a result, they are very useful for identifying areas of potential concern, where further research may be necessary. They do have a number of limitations however, including an inability to provide detailed descriptions of the circumstances surrounding individual deaths. In the short to medium term, it may be possible to address these deficiencies by augmenting these data sources with additional descriptive information from the Coronial CMS. Further information may also be gained from sources such as the National Non-Admitted Patient Collection (NNPAC) and the ACC. Additional data collection modalities will still need to be developed, if national perioperative mortality review is to lead to system changes which will prevent such deaths occurring in future.

New Zealand's Perioperative Mortality 2005-2009 Using Selected Diagnostic Categories

The strengths and limitations of using routinely collected data for the purposes of perioperative mortality review have been outlined. While there are clear limitations and further enhancements will be required, such data sets provide a useful starting point.

The sections which follow thus review perioperative mortality associated with the following four classes of procedures:

1) Hip and Knee Arthroplasty
2) Colorectal Resections
3) Cataract Surgery
4) General Anaesthesia

Hip and knee arthroplasty

This section uses information from the NMDS and the NMC, to review hospital admissions for hip and knee arthroplasty in adults aged 45+ years, as well as mortality in the first 30 days following these procedures.

Data source and methods

Definition

1. Hospital Admissions for Hip or Knee Arthroplasty in Adults Aged 45+ Years
2. Mortality in the First 30 Days Following a Hip or Knee Arthroplasty in Adults Aged 45+ Years

Data Sources

Hospital Admissions for Hip or Knee Arthroplasty

Numerator: NMDS: All hospital admissions in adults 45+ years of age with a hip or knee arthroplasty listed in any of the first 90 procedure codes (see Appendix).

Denominator: Statistics New Zealand Estimated Resident Population

Mortality Following Hip or Knee Arthroplasty

Numerator: NMC: All those aged 45+ years who died within 30 days of a hip or knee arthroplasty (with cases being selected from the cohort of those aged 45+ years undergoing hip or knee arthroplasty, as recorded in the NMDS).

Denominator: NMDS: All hospital admissions with a hip or knee arthroplasty listed in any of the first 90 procedure codes.

Notes on Interpretation

Re-admissions: As outlined in Appendix, both first time arthroplasties and revisions of previous arthroplasties were included in the analysis, with a small number of individuals appearing more than once in the data. In such cases, if a second arthroplasty occurred within 30 days of the initial procedure, it was considered to be a revision, arising as a complication of the first procedure (eg, due to dislocation) and in such cases, the outcomes arising from the second procedure were attributed to the first. Further, these re-admissions were not included in the denominator used to calculate mortality rates by procedure. If a re-admission occurred more than 30 days from the original procedure however, this was considered to be a new procedure in the calculation of mortality rates.

Acute, Arranged (Semi-Acute) and Waiting List Admissions: The NMDS defines an acute admission as an unplanned admission occurring on the day of presentation, while an arranged admission is a non-acute admission with an admission date less than seven days after the date the decision was made by the specialist that the admission was necessary. Similarly waiting list admissions arise when the planned admission date is seven or more days after the date the decision was made that the admission was necessary. These definitions are inconsistently used by private hospitals uploading their data to the NMDS however, with a significant proportion of private hospital admissions being coded as arranged when in reality they meet the criteria for a waiting list admission as outlined above. As a result, in the sections which follow, all arranged private hospital cases have been included in the elective/waiting list category, while arranged admissions occurring in public hospitals have been included in the public hospital semi-acute admission category. Thus unless otherwise specified, acute and elective/waiting list admission include both public and private cases, while semi-acute admissions are confined to public hospital cases only.

Privately Funded 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 are publicly funded maternity events. As NMDS reporting is not legally mandated for New Zealand healthcare 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 is unable to provide any estimate of the extent to which the NMDS undercounts private surgical or procedural day-stay or outpatient hospitals, facilities or in-room events, although it notes that the data most likely to be missing is privately funded or ACC funded events, or publicly funded long-stay geriatric cases. Thus in the section which follows, it must be remembered that the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

Hospital admissions for hip arthroplasty

Hip arthroplasty admissions by admission type

In New Zealand during 2005-2009, 20.0 percent of hip arthroplasty admissions were acute events, 1.34 percent were semi-acute (occurring within seven days of referral), and 78.7 percent were drawn from the waiting list (Table 3).

Table 3. Hospital Admissions for Hip Arthroplasty by Admission Type in Adults 45+ Years, New Zealand 2005-2009

ADMISSION TYPE	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Hip Arthroplasty			
Acute	7,443	1,488.6	20.0
Public Hospital Semi-Acute	498	99.6	1.34
Elective/Waiting List	29,325	5,865.0	78.7
Total Admissions	37,266	7,453.2	100.0

Numerator: NMDS Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.

Table 4. Hospital Admissions for Hip Arthroplasty by Primary Diagnosis and Admission Type in Adults Aged 45+ Years, New Zealand 2005-2009

PRIMARY DIAGNOSIS	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Hip Arthroplasty			
Acute			
Fracture of Neck of Femur	5,907	1,181	79.4
Other Fracture of Femur	346	69	4.65
Mechanical Complication Internal Joint Prosthesis	213	43	2.86
Infection/Inflammation Internal Joint Prosthesis	126	25	1.69
Other Complications Internal Orthopaedic Prosthesis*	143	29	1.92
Arthrosis of Hip	84	17	1.13
Other Diagnoses	624	125	8.38
Total Acute Admissions	7,443	1,489	100.0
Public Hospital Semi-Acute			
Fracture of Neck of Femur	110	22	22.1
Other Fracture of Femur	15	3	3.01
Arthrosis of Hip	101	20	20.3
Mechanical Complication Internal Joint Prosthesis	66	13	13.3
Infection/Inflammation Internal Joint Prosthesis	54	11	10.8
Other Complications Internal Orthopaedic Prosthesis*	43	9	8.63
Other Diagnoses	109	22	21.9
Total Publicly Funded Arranged Admissions	498	100	100.0
Elective/Waiting List			
Arthrosis of Hip	25,181	5,036	85.9
Mechanical Complication Internal Joint Prosthesis	2,014	403	6.87
Infection/Inflammation Internal Joint Prosthesis	271	54	0.92
Other Complications Internal Orthopaedic Prosthesis*	552	110	1.88
Fracture of Neck of Femur	12	2	0.04
Other Fracture of Femur	10	2	0.03
Other Diagnoses	1,285	257	4.38
Total Elective/Waiting List Admissions	29,325	5,865	100.0

Numerator: NMDS Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.
* Orthopaedic Prosthesis includes orthopaedic prosthetic devices, implants and grafts.

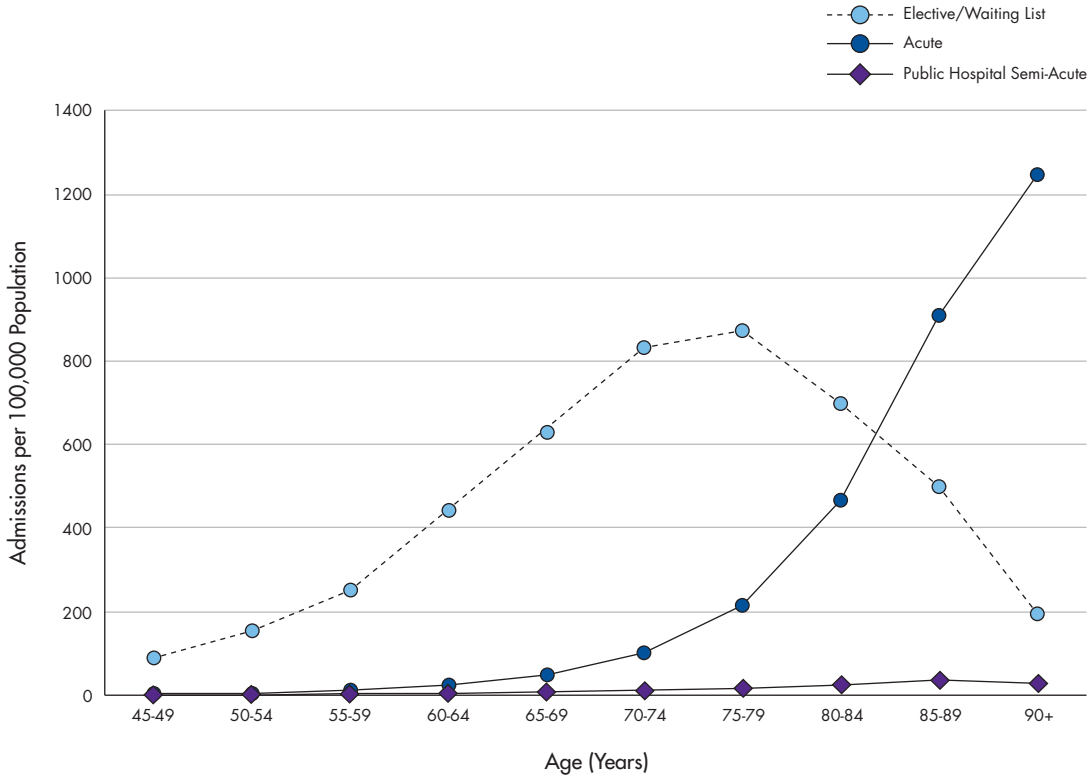
Hip arthroplasty admissions by primary diagnosis

In New Zealand during 2005-2009, fractures of the neck of femur were the leading reason for an acute admission for hip arthroplasty, followed by other femur fractures and mechanical complications of internal joint prosthesis. In contrast, arthrosis of the hip was the leading reason for an elective/waiting list admission, followed by mechanical complications of internal joint prostheses (Table 4).

Hip arthroplasty admissions by admission type and age

In New Zealand during 2005-2009, acute admission rates for hip arthroplasty increased with increasing age, with the highest rates being seen in those 90+ years. In contrast, elective/waiting list admission rates increased during the fifth to seventh decades, reached a peak in those 75-79 years, and then declined again (Figure 1).

Figure 1. Hospital Admissions for Hip Arthroplasty by Age and Admission Type in Adults 45+ Years, New Zealand 2005-2009

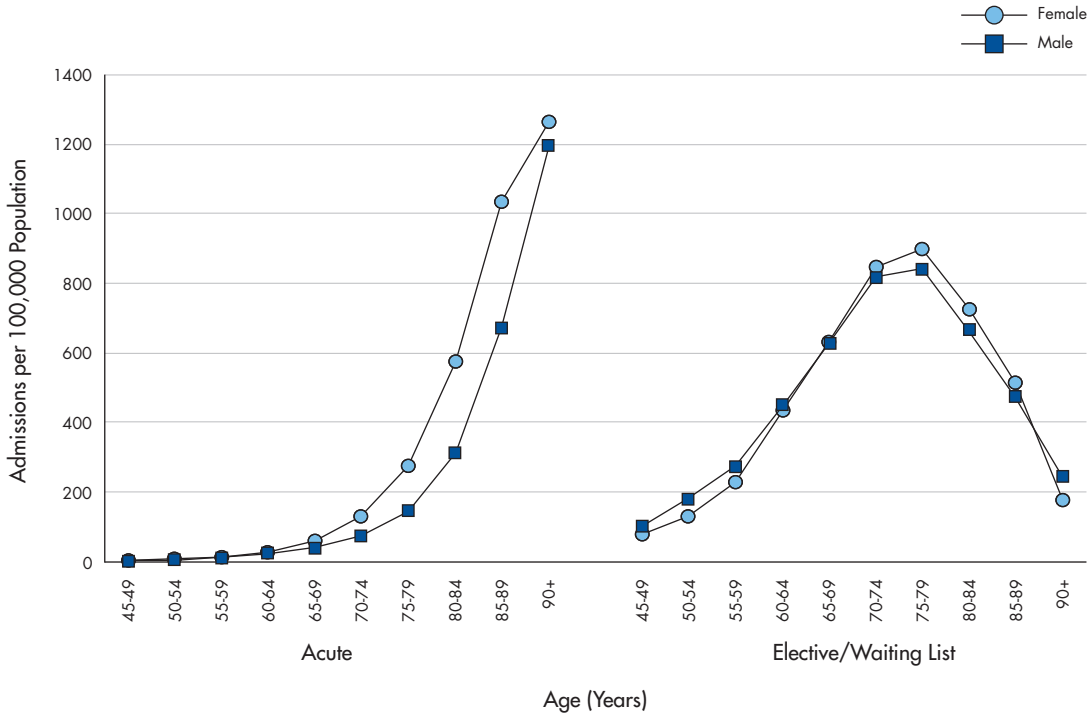


Numerator: NMDS Hospital admissions with hip arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Hip arthroplasty admissions by admission type and gender

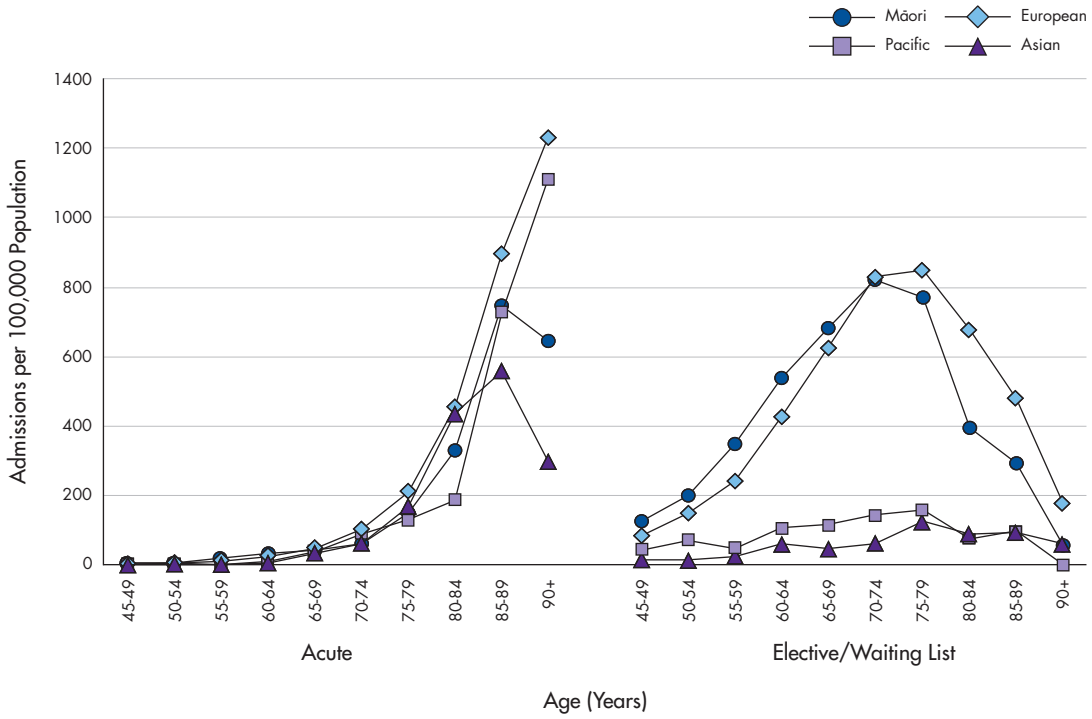
In New Zealand during 2005-2009, acute admission rates for hip arthroplasty increased with increasing age for both males and females, although from 70 years of age onwards, admission rates for females were higher than for males. Gender differences for elective/waiting list admissions for hip arthroplasty were less prominent, with rates decreasing for both genders after 75-79 years of age (Figure 2).

Figure 2. Hospital Admissions for Hip Arthroplasty by Age, Admission Type and Gender in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with hip arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Figure 3. Hospital Admissions for Hip Arthroplasty by Age, Admission Type and Ethnicity in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with hip arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Ethnicity is Level 1 Prioritised.

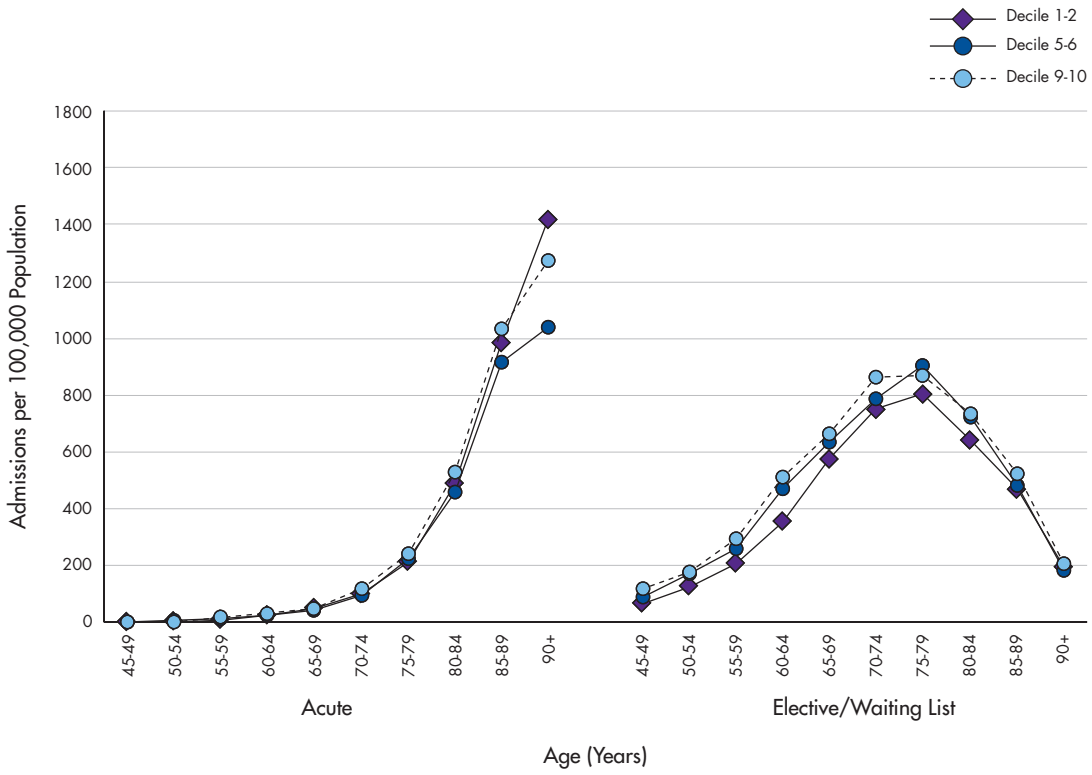
Hip arthroplasty admissions by admission type and ethnicity

In New Zealand during 2005-2009, acute admission rates for hip arthroplasty increased with increasing age for all ethnic groups, with the highest rates for European and Pacific peoples being seen in those aged 90+ years. Care should be taken when interpreting admission rates for Māori, Pacific and Asian peoples 90+ years however, due to the small number of cases involved (90+ years: Māori n=11; Pacific n=7; Asian n=5). In contrast, elective/waiting list admission rates for Māori and European peoples were highest for those in their 70s and declined steadily thereafter. For Pacific and Asian peoples, elective/waiting list admission rates were relatively evenly distributed by age, with admission rates being lower than for Māori and European peoples at nearly every age group (Figure 3).

Hip arthroplasty admissions by admission type and NZDep decile

In New Zealand during 2005-2009, acute admission rates for hip arthroplasty increased with increasing age for all NZDep decile groupings, with the highest rates being seen in those 90+ years. Elective/waiting list admission rates were highest amongst those in their 70s, with rates being similar for each NZDep decile grouping (Figure 4).

Figure 4. Hospital Admissions for Hip Arthroplasty by Age, Admission Type and NZ Deprivation Index Decile in Adults 45+ Years, New Zealand 2005-2009

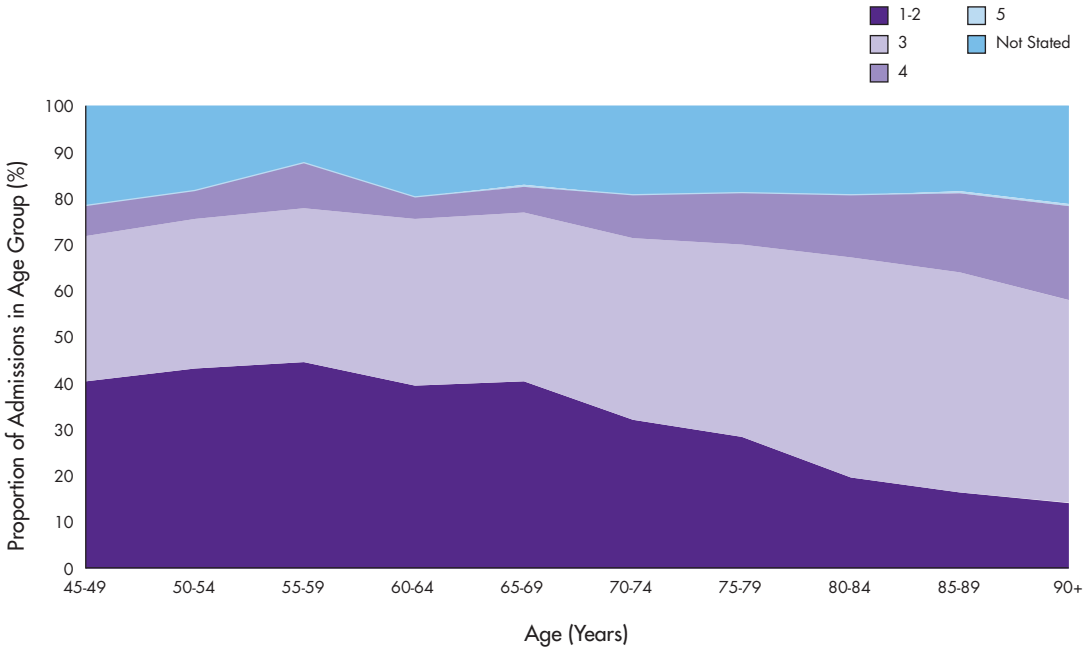


Numerator: NMDS Hospital Admissions with hip arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Decile is NZDep2001.

Hip arthroplasty admissions by admission type ASA score

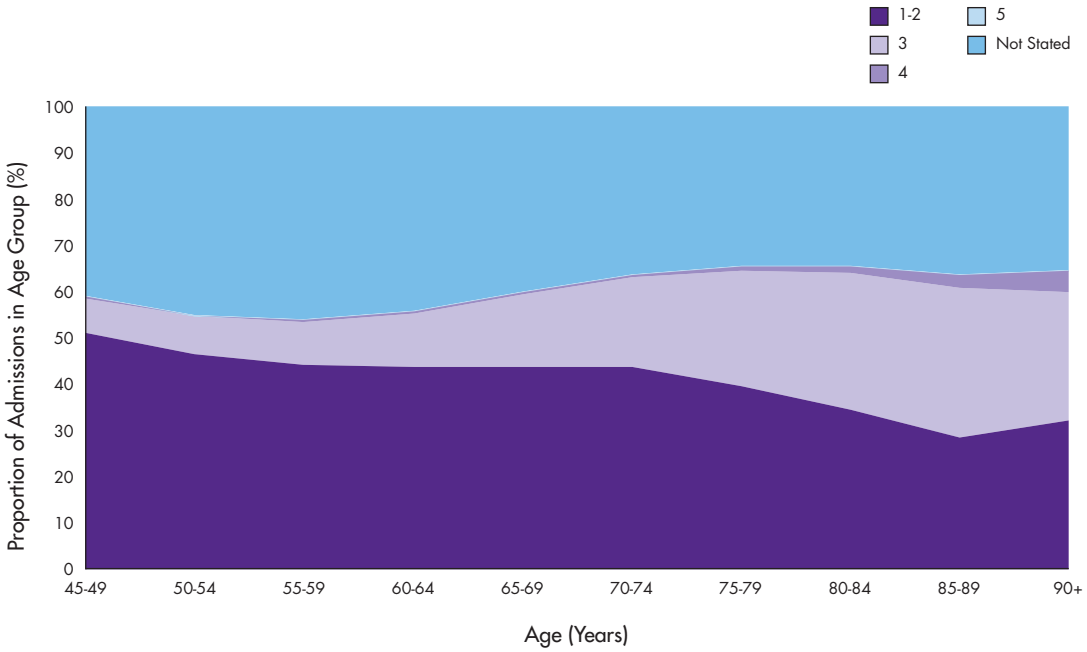
In New Zealand during 2005-2009, the proportion of acute and elective/waiting list admissions for hip arthroplasty with an ASA Score of 3 or higher increased with increasing age, although in many cases (particularly for elective/waiting list admissions) information on ASA Score was not available (Figure 5, Figure 6).

Figure 5. Proportion of Acute Hospital Admissions for Hip Arthroplasty by Age and ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital Admissions with hip arthroplasty listed in any of the first 90 procedures.

Figure 6. Proportion of Elective/Waiting List Admissions for Hip Arthroplasty by Age and ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital Admissions with hip arthroplasty listed in any of the first 90 procedures.

Mortality following hip arthroplasty

Mortality following hip arthroplasty by cause of death

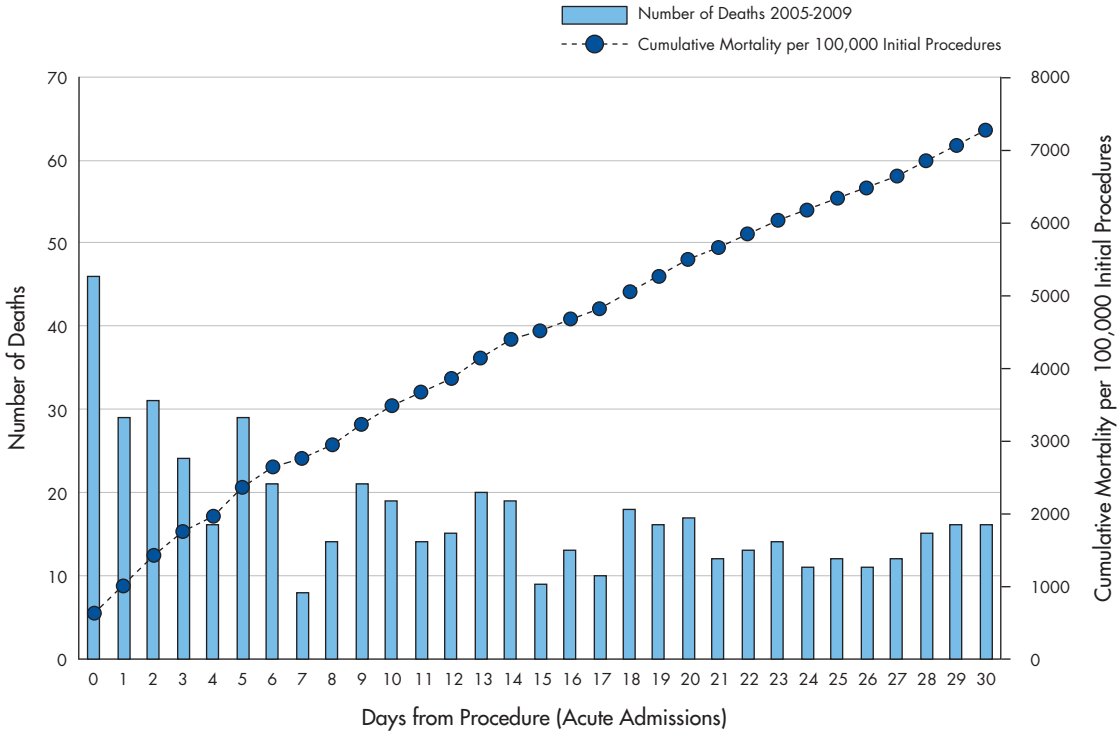
In New Zealand during 2005-2009, falls were the most frequently coded main underlying cause of death in those dying after acute hip arthroplasty, followed by myocardial infarction and other forms of ischaemic heart and cardiovascular disease. Similarly, myocardial infarctions, followed by other forms of ischaemic heart disease were most frequently listed main underlying causes of death following an elective/waiting list admission for hip arthroplasty (Table 5).

Table 5. Mortality Following Hip Arthroplasty by Admission Type and Main Underlying Cause of Death in Adults 45+ Years, New Zealand 2005-2009

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2005-2009	Annual average	Percent of Deaths in Category (%)
Hip Arthroplasty			
Acute Admissions			
Fall	174	34.8	31.7
Other Injuries /External Causes	7	1.4	1.3
Myocardial Infarction	88	17.6	16.0
Other Ischaemic Heart Disease	53	10.6	9.65
Cerebral Infarction	3	0.6	0.55
Other Cardiovascular Causes	55	11.0	10.2
Non-Insulin Dependent Diabetes	10	2.0	1.82
Chronic Renal Failure	8	1.6	1.46
Malignant Neoplasm Bronchus and Lung	14	2.8	2.55
Malignant Neoplasm Prostate	11	2.2	2.00
Other Neoplasms	36	7.2	6.56
Emphysema and COPD	29	5.8	5.28
Pneumonia and Other Respiratory Diseases	4	0.8	0.73
Dementia/Alzheimer's/CNS Degeneration	19	3.8	3.46
Gastrointestinal Diseases	10	2.0	1.82
No Cause Stated	4	0.8	0.73
Other Causes	24	4.8	4.37
Total Acute	549	109.8	100.0
Public Hospital Semi-Acute			
Fall	6	1.2	35.3
Cardiovascular Causes	7	1.4	41.2
Other Causes	4	0.8	23.5
Total Public Hospital Semi Acute	17	3.4	100.0
Elective/Waiting List Admissions			
Myocardial Infarction	19	3.8	27.5
Other Ischaemic Heart Disease	10	2.0	14.5
Other Cardiovascular Causes	10	2.0	14.5
Emphysema/COPD/Other Respiratory	5	1.0	7.25
Other Causes	25	5.0	36.2
Total Elective/Waiting List	69	13.8	100.0
Grand Total	635	127.0	100.0

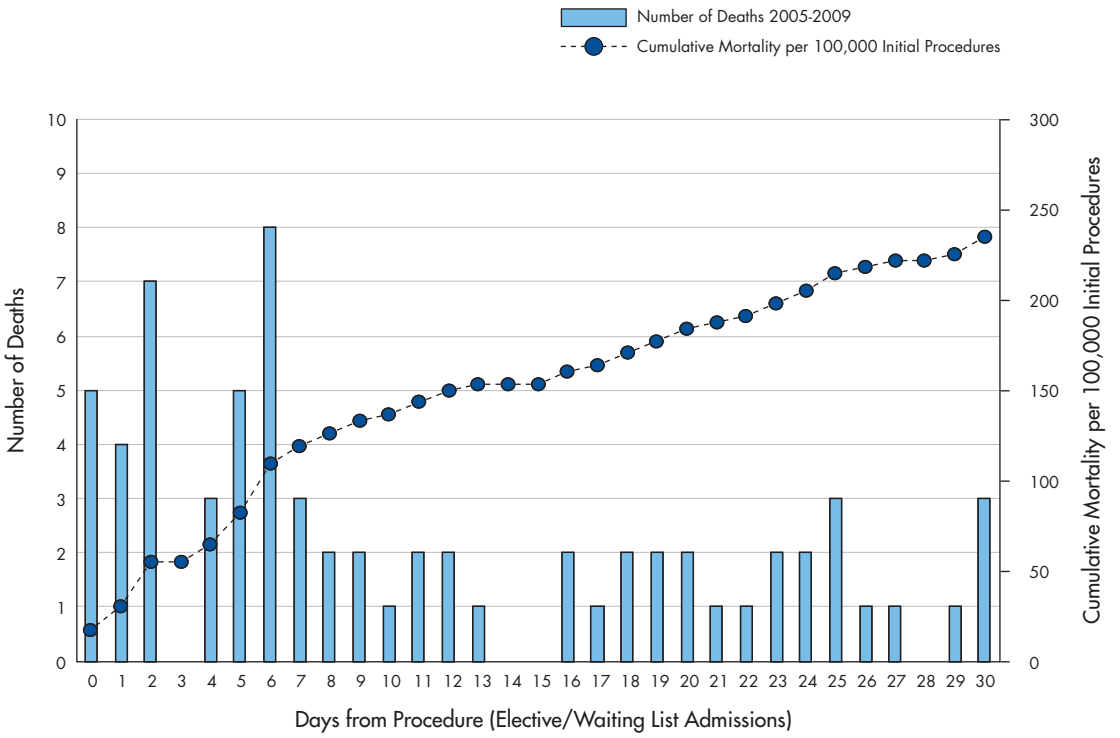
Numerator: National Mortality Collection: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.

Figure 7. Mortality Following Acute Admission for Hip Arthroplasty by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of an acute hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS Acute admissions with a hip arthroplasty listed in any of the first 90 procedures.

Figure 8. Mortality Following Elective/Waiting List Admission for Hip Arthroplasty by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS, elective/waiting list admissions with a hip arthroplasty listed in any of the first 90 procedures.

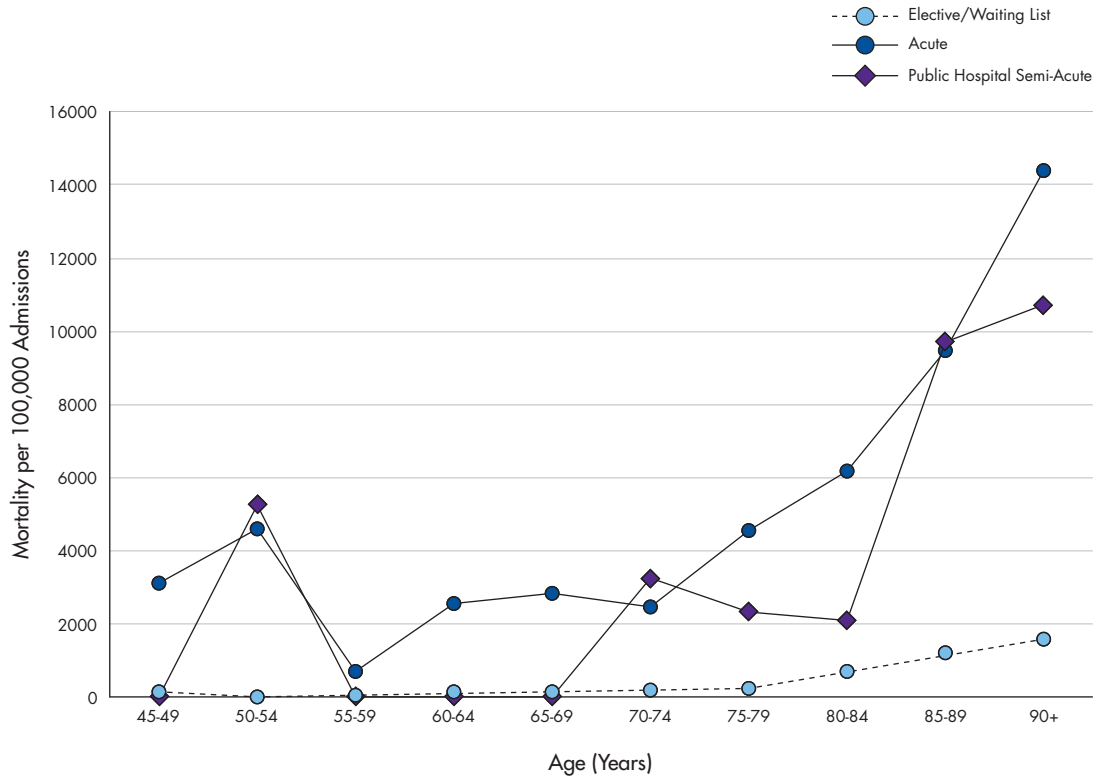
Mortality following hip arthroplasty by day from procedure

In New Zealand during 2005-2009, mortality following acute admissions for hip arthroplasty was greatest on the day of the procedure, with the next highest daily mortality occurring in the five days immediately thereafter. In contrast, the highest daily mortality rate following an elective/waiting list admission for hip arthroplasty occurred on day six, although again mortality was otherwise highest during the first five days immediately after the procedure. Overall, cumulative 30-day mortality following an acute admission for hip arthroplasty (7,268.6 per 100,000 or 7.3 percent) was higher than that following an elective/waiting list admission for hip arthroplasty (235.3 per 100,000 or 0.24 percent) (Figure 7, Figure 8).

Mortality following hip arthroplasty by age

In New Zealand during 2005-2009, mortality per 100,000 hip arthroplasties increased with increasing age for all hospital admission types (acute, semi-acute, elective/waiting list), with the highest rates being seen in those aged 90+ years. At each age group however, mortality following acute procedures was greater than that following an elective/waiting list admission (Figure 9).

Figure 9. Mortality Following Hip Arthroplasty by Admission Type and Age in Adults 45+ Years, New Zealand 2005-2009

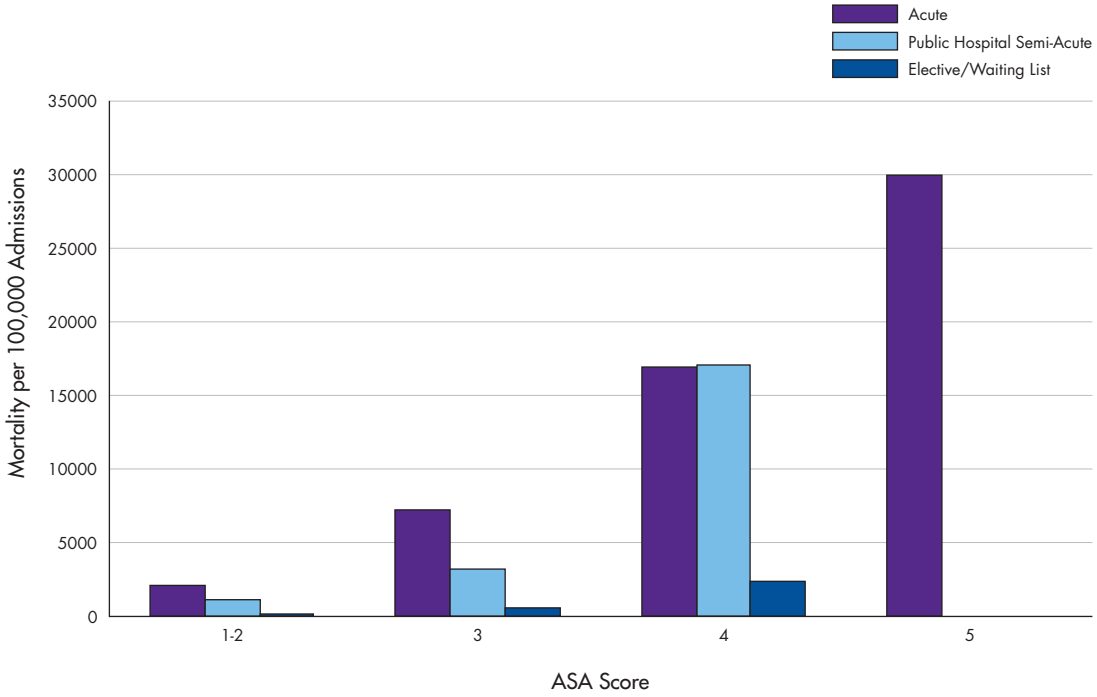


Numerator: National Mortality Collection: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS, Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.

Mortality Following Hip Arthroplasty by ASA Score

In New Zealand during 2005-2009, mortality following hip arthroplasty increased with increasing ASA Score for each admission type, although at each level of ASA Score, mortality rates were higher for those being admitted acutely, than for those admitted from the waiting list. Very few (<3) patients however were admitted from the waiting list with an ASA Score of 5, thus making mortality risk for those in this ASA category difficult to interpret for elective/waiting list patients (given that an ASA Score of 5 is assigned to moribund patients who are not expected to survive longer than 24 hours without surgical intervention, the paucity of elective admissions with an ASA Score of 5 would seem clinically appropriate) (Figure 10).

Figure 10. Mortality Following Hip Arthroplasty by Admission Type and ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS, Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.

Mortality following hip arthroplasty by socio-demographic factors and ASA score

Acute Admissions: In New Zealand during 2005-2009, mortality following an acute admission for hip arthroplasty was significantly higher for those 80+ years (vs. those 45-64 years), males (vs. females), and those with ASA Score of 3, 4 or 5 (vs. those with ASA Score of 1-2). These differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). While mortality was significantly lower for Māori than for European peoples in the univariate analysis, these differences did not reach statistical significance in the multivariate model. There were no significant socioeconomic differences in mortality, as measured by NZDep2001 quintile (Table 6).

Elective/Waiting List Admissions: In New Zealand during 2005-2009, mortality following an elective/waiting list admission for hip arthroplasty was significantly higher for those 65-79 and 80+ years (vs. those 45-64 years) and those with ASA Score of 3 or 4 (vs. those with ASA Score of 1-2). For those 80+ years or with an ASA Score of 3 or 4 these differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). Mortality was also significantly higher for Māori, once factors such as age, gender, ASA Score and NZDep deprivation were taken into account. Differences by NZDep deprivation however, did not reach statistical significance (Table 7). Similar patterns were evident when hip arthroplasty revisions were excluded from the analysis (Table 8).

Table 6. Mortality Following Acute Admission for Hip Arthroplasty by Age Group, Gender, ASA Score, Ethnicity and NZDep Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Hip Arthroplasty									
Acute									
Age Group	45-64 years	11	478	2,301.3	2.30	1.00		1.00	
	65-79 years	77	2,122	3,628.7	3.63	1.60	0.84 - 3.03	1.37	0.72 - 2.62
	80+ years	461	4,843	9,518.9	9.52	4.47*	2.44 - 8.18	3.24*	1.75 - 6.00
Gender	Male	202	2,177	9,278.8	9.28	1.00		1.00	
	Female	347	5,266	6,589.4	6.59	0.69*	0.58 - 0.83	0.66*	0.54 - 0.79
ASA Score	1-2	36	1,701	2,116.4	2.12	1.00		1.00	
	3	235	3,264	7,199.8	7.20	3.59*	2.51 - 5.12	2.94*	2.06 - 4.22
	4	175	1,033	16,941.0	16.9	9.43*	6.53 - 13.6	7.17*	4.93 - 10.4
	5	6	20	30,000.0	30.0	19.8*	7.21 - 54.5	14.9*	5.32 - 41.7
	Not Stated	97	1,425	6,807.0	6.81	3.38*	2.29 - 4.99	2.82*	1.91 - 4.18
Ethnicity	European	516	6,756	7,637.7	7.64	1.00		1.00	
	Māori	8	210	3,809.5	3.81	0.48*	0.24 - 0.98	0.65	0.31 - 1.36
	Pacific	3	80	3,750.0	3.75	0.47	0.15 - 1.50	0.57	0.18 - 1.84
	Asian/ MELAA/ Other	16	271	5,904.1	5.90	0.76	0.45 - 1.27	1.04	0.61 - 1.75
NZ Deprivation Index Decile	Decile 1-2	87	1,292	6,733.8	6.73	1.00		1.00	
	Decile 3-4	96	1,294	7,418.9	7.42	1.11	0.82 - 1.50	1.19	0.87 - 1.62
	Decile 5-6	121	1,628	7,432.4	7.43	1.11	0.84 - 1.48	1.11	0.82 - 1.49
	Decile 7-8	149	1,831	8,137.6	8.14	1.23	0.93 - 1.62	1.27	0.96 - 1.68
	Decile 9-10	96	1,345	7,137.6	7.14	1.07	0.79 - 1.44	1.13	0.83 - 1.55

Numerator: National Mortality Collection: Deaths occurring within 30 days of an acute hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS, Acute hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.
* significantly different from reference category. MELAA: Middle Eastern/Latin American/African.

Table 7. Mortality Following Elective/Waiting List Admission for Hip Arthroplasty by Age Group, Gender, ASA Score, Ethnicity and NZDep Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Hip Arthroplasty									
Elective/Waiting List									
Age Group	45-64 years	9	10,836	83.1	0.08	1.00		1.00	
	65-79 years	27	14,623	184.6	0.18	2.22*	1.05 - 4.73	2.11	0.98 - 4.55
	80+ years	33	3,866	853.6	0.85	10.4*	4.95 - 21.7	8.81*	4.00 - 19.4
Gender	Male	32	14,036	228.0	0.23	1.00		1.00	
	Female	37	15,289	242.0	0.24	1.06	0.66 - 1.71	0.93	0.57 - 1.50
ASA Score	1-2	16	12,340	129.7	0.13	1.00		1.00	
	3	26	5,052	514.7	0.51	3.99*	2.14 - 7.43	2.67*	1.41 - 5.04
	4	5	206	2,427.2	2.43	19.2*	6.95 - 52.8	9.66*	3.43 - 27.2
	5	0	<3	-	-	-	-	-	-
	Not Stated	22	11,726	187.6	0.19	1.45	0.76 - 2.76	1.57	0.82 - 3.02
Ethnicity	European	58	24,360	238.1	0.24	1.00		1.00	
	Māori	9	2,213	406.7	0.41	1.71	0.85 - 3.46	2.60*	1.20 - 5.62
	Pacific	0	202	-	-	-	-	-	-
	Asian/ MELAA/ Other	<3	836	s	s	s	s	s	s
NZ Deprivation Index Decile	Decile 1-2	10	4,828	207.1	0.21	1.00		1.00	
	Decile 3-4	6	5,561	107.9	0.11	0.52	0.19 - 1.43	0.49	0.18 - 1.36
	Decile 5-6	14	6,408	218.5	0.22	1.06	0.47 - 2.38	0.88	0.38 - 2.02
	Decile 7-8	25	7,007	356.8	0.36	1.73	0.83 - 3.60	1.42	0.68 - 2.98
	Decile 9-10	14	5,442	257.3	0.26	1.24	0.55 - 2.80	0.99	0.43 - 2.29

Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list hip arthroplasty, as recorded in the NMDS.
Denominator: NMDS, Elective/waiting list admissions with a hip arthroplasty listed in any of the first 90 procedures.
* significantly different from reference category; s rates suppressed due to small numbers MELAA: Middle Eastern/Latin American/African.

Table 8. Mortality Following Elective/Waiting List Admission for Hip Arthroplasty (Revisions Excluded) by Age Group, Gender, ASA Score, Ethnicity and NZDep Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Hip Arthroplasty (Revisions Excluded)									
Elective/Waiting List									
Age Group	45-64 years	7	9,927	70.5	0.07	1.00		1.00	
	65-79 years	22	12,896	170.6	0.17	2.42*	1.03 - 5.67	2.32	0.97 - 5.52
	80+ years	23	3,274	702.5	0.70	10.0*	4.30 - 23.4	8.74*	3.49 - 21.9
Gender	Male	23	12,331	186.5	0.19	1.00		1.00	
	Female	29	13,766	210.7	0.21	1.13	0.65 - 1.95	0.97	0.56 - 1.71
ASA Score	1-2	15	10,933	137.2	0.14	1.00		1.00	
	3	21	4,211	498.7	0.50	3.65*	1.88 - 7.08	2.48*	1.26 - 4.89
	4	3	173	1,734.1	1.73	12.9*	3.68 - 44.8	6.33*	1.77 - 22.6
	5	0	<3	-	-	-	-	-	-
	Not Stated	13	10,779	120.6	0.12	0.88	0.42 - 1.85	0.92	0.43 - 1.99
Ethnicity	European	42	21,593	194.5	0.19	1.00		1.00	
	Māori	8	1,967	406.7	0.41	2.10	0.98 - 4.47	3.20*	1.38 - 7.40
	Pacific	0	182	-	-	-	-	-	-
	Asian/ MELAA/ Other	<3	754	s	s	s	s	s	s
NZ Deprivation Index Decile	Decile 1-2	8	4,350	183.9	0.18	1.00		1.00	
	Decile 3-4	5	4,966	100.7	0.10	0.55	0.18 - 1.67	0.50	0.16 - 1.53
	Decile 5-6	10	5,670	176.4	0.18	0.96	0.38 - 2.43	0.71	0.27 - 1.85
	Decile 7-8	19	6,196	306.7	0.31	1.67	0.73 - 3.82	1.25	0.54 - 2.89
	Decile 9-10	10	4,842	206.5	0.21	1.12	0.44 - 2.85	0.75	0.29 - 1.98

Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list hip arthroplasty (revisions excluded), as recorded in the NMDS.
Denominator: NMDS, Elective/waiting list admissions with a hip arthroplasty (revisions excluded) listed in any of the first 90 procedures.
* significantly different from reference category; s rates suppressed due to small numbers. MELAA: Middle Eastern/Latin American/African.

Hospital admissions for knee arthroplasty

Knee arthroplasty admissions by admission type

In New Zealand during 2005-2009, acute and publicly funded semi-acute admissions made only a very minor contribution to knee arthroplasty admissions, with 98.5 percent of admissions being elective/admitted from the waiting list. As a consequence, all of the analyses of admission rates which follow consider knee arthroplasties as a group, with no further breakdown being provided by admission type (Table 9).

Table 9. Hospital Admissions for Knee Arthroplasty by Admission Type in Adults 45+ Years, New Zealand 2005-2009

ADMISSION TYPE	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Knee Arthroplasty			
Acute	226	45.2	0.87
Public Hospital Semi-Acute	157	31.4	0.60
Elective/Waiting List	25,617	5,123.4	98.5
Total Admissions	26,000	5,200.0	100.0

Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures

Knee arthroplasty admissions by primary diagnosis

In New Zealand during 2005-2009, arthrosis of the knee was the leading reason for an admission for a knee arthroplasty in adults aged 45+ years, and accounted for 90.4 percent of all admissions in this category. Mechanical and other complications of internal joint prostheses and rheumatoid arthritis also made a small contribution (Table 10).

Table 10. Hospital Admissions for Knee Arthroplasty by Primary Diagnosis in Adults 45+ Years, New Zealand 2005-2009

PRIMARY DIAGNOSIS	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Knee Arthroplasty			
Arthrosis of Knee	23,514	4,703	90.4
Mechanical Complication Internal Joint Prosthesis	738	148	2.84
Infection/Inflammation Internal Joint Prosthesis	292	58	1.12
Other Complications Internal Orthopaedic Prosthesis*	307	61	1.18
Rheumatoid Arthritis	288	58	1.11
Other Diagnoses	865	173	3.33
Total Admissions	26,004	5,201	100.0

Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures. Acute, Semi-Acute and Elective/Waiting List Admissions Combined.
* Orthopaedic Prosthesis includes orthopaedic prosthetic devices, implants and grafts.

Knee arthroplasty admissions by gender

In New Zealand during 2005-2009, hospital admission rates for knee arthroplasty increased with increasing age for both males and females, with rates reaching a peak at 75-79 years of age, before declining again. Once broken down by age, gender differences in knee arthroplasty admissions were not marked (Figure 11).

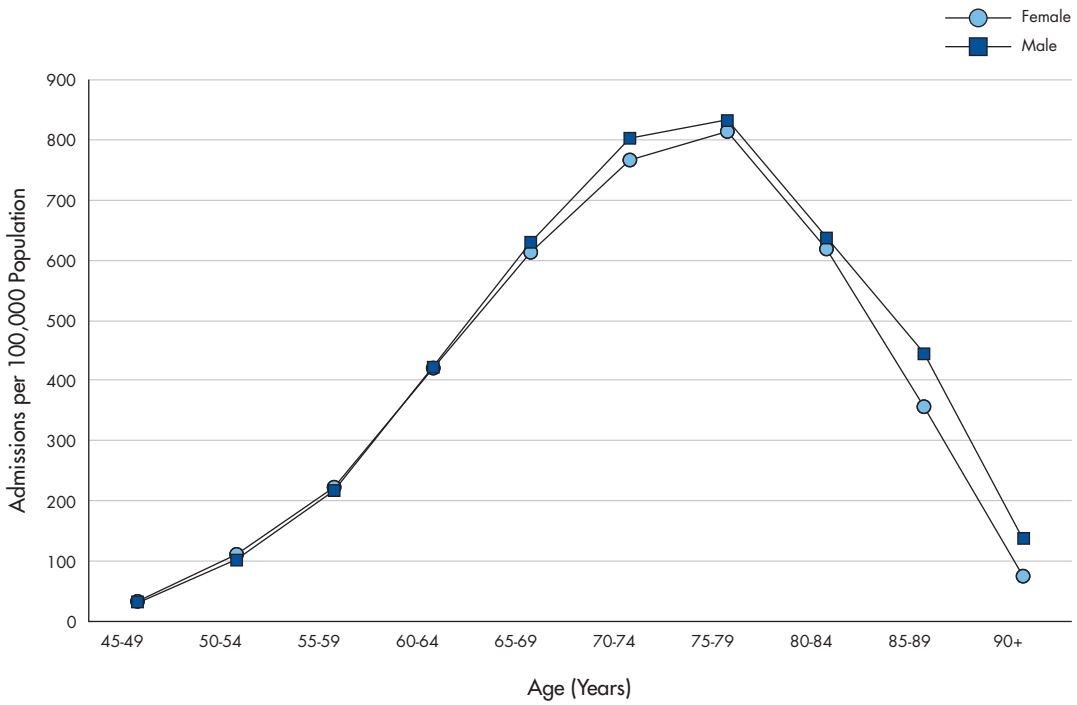
Knee arthroplasty admissions by ethnicity

In New Zealand during 2005-2009, hospital admission rates for knee arthroplasty increased with increasing age for each of New Zealand's largest four ethnic groups, with rates reaching a peak amongst those in their seventies, before declining again. Once broken down by age, admission rates for European peoples were higher than for Asian peoples at nearly every age group. Admissions for European peoples were also generally higher than for Māori and Pacific peoples from the late sixties onwards (Figure 12).

Knee arthroplasty admissions by NZDep decile

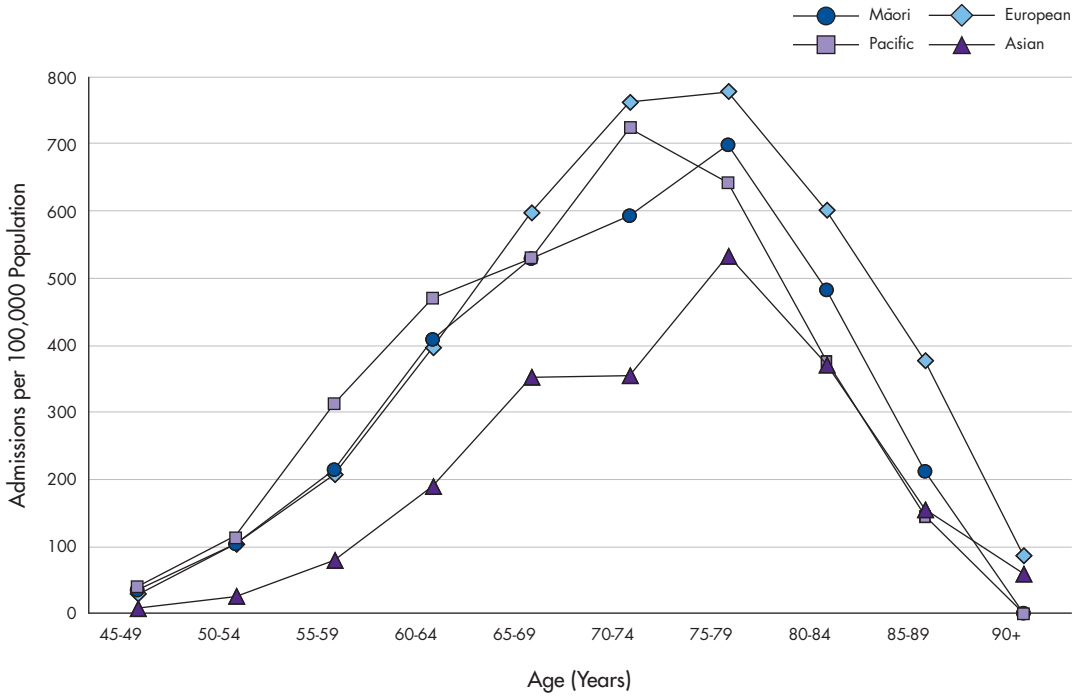
In New Zealand during 2005-2009, hospital admission rates for knee arthroplasty increased with increasing age for each NZDep2001 deprivation quintile, with rates reaching a peak amongst those aged 75-79 years, before declining again. Once broken down by age, admission rates for those living in the most deprived (NZDep decile 9-10) areas were higher than for those living in the least deprived (NZDep decile 1-2) areas up until 75-79 years of age, after which time, differences by NZDep deprivation were less evident (Figure 13).

Figure 11. Hospital Admissions for Knee Arthroplasty by Age and Gender in Adults 45+ Years, New Zealand 2005-2009



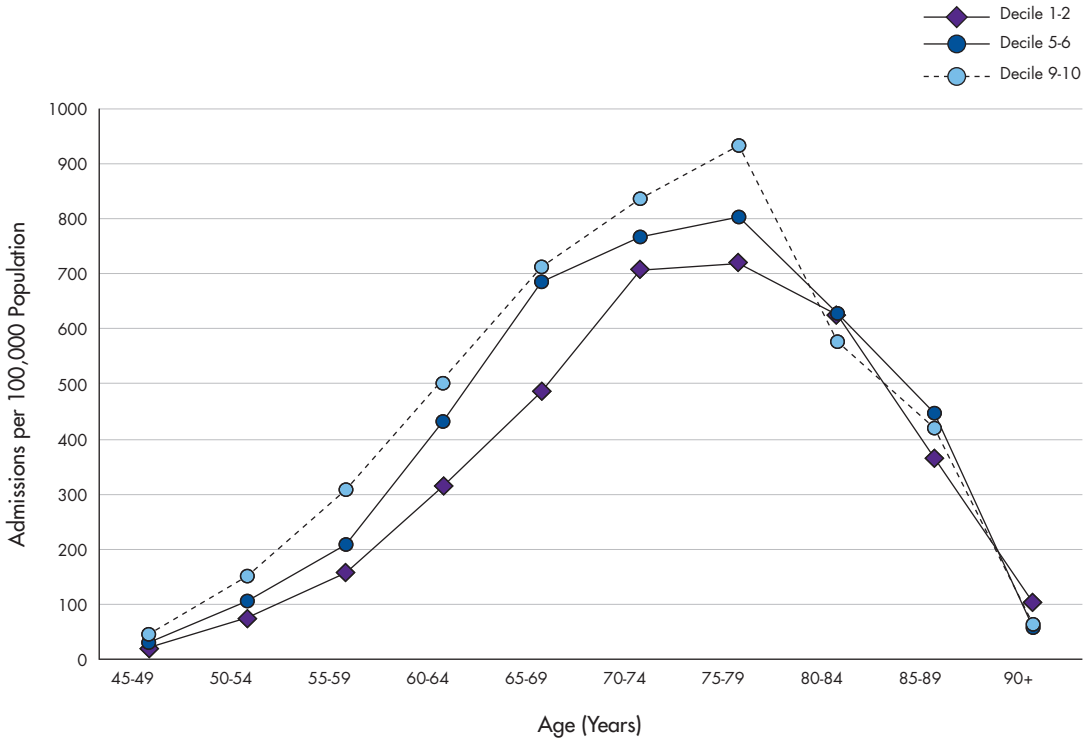
Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined.

Figure 12. Hospital Admissions for Knee Arthroplasty by Age, Admission Type and Ethnicity in Adults 45+ Years, New Zealand 2005-2009



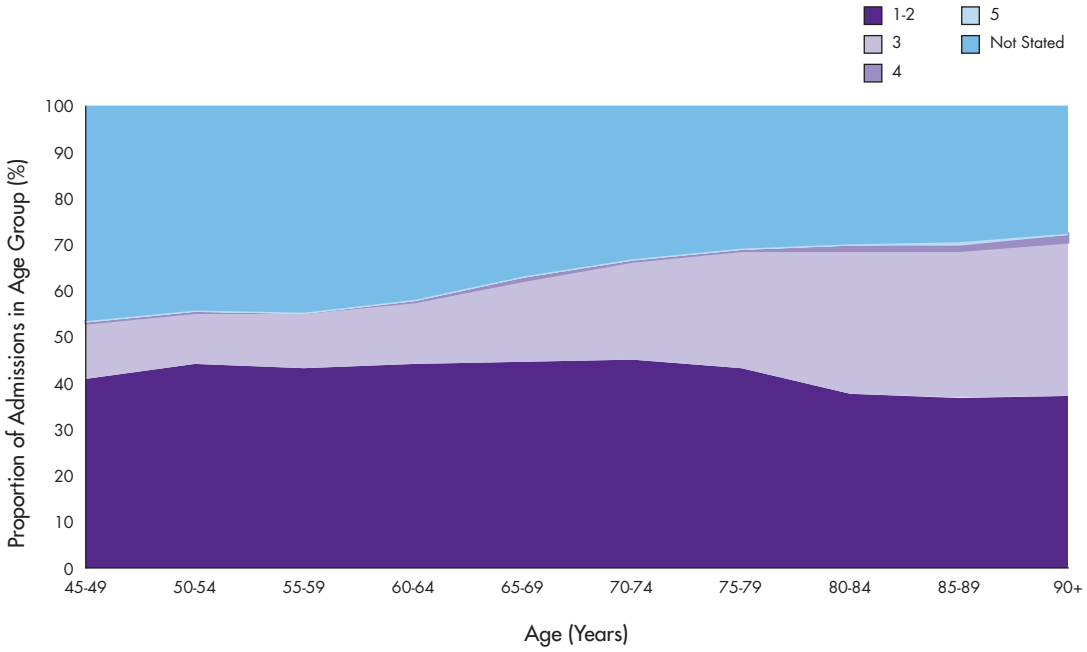
Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined. Ethnicity is Level 1 Prioritised.

Figure 13. Hospital Admissions for Knee Arthroplasty by Age and NZ Deprivation Index Decile in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined. Decile is NZDep2001.

Figure 14. Proportion of Hospital Admissions for Knee Arthroplasty by Age and ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures. Acute, Semi-Acute and Elective/Waiting List Admissions Combined.

Knee arthroplasty admissions by ASA score

In New Zealand during 2005-2009, the proportion of hospital admissions for a knee arthroplasty which had an ASA Score of 3 or more increased with increasing age, although in a high proportion of cases, information on ASA Score was not available (Figure 14).

Mortality following knee arthroplasty

Because of the potential for higher mortality rates following acute and semi-acute procedures (as compared to elective/waiting list procedures), and the small number of knee arthroplasties being undertaken acutely, the following analysis is restricted to a review of 30-day mortality for adults 45+ years following elective/waiting list admissions for knee arthroplasty.

Mortality following knee arthroplasty by cause of death

In New Zealand during 2005-2009, myocardial infarctions and other types of ischaemic heart disease were the most frequently listed main underlying causes of death for those dying following an elective/waiting list admission for knee arthroplasty. A smaller number had knee arthrosis or other causes listed as the main underlying cause of death (Table 11).

Mortality following knee arthroplasty by day from procedure

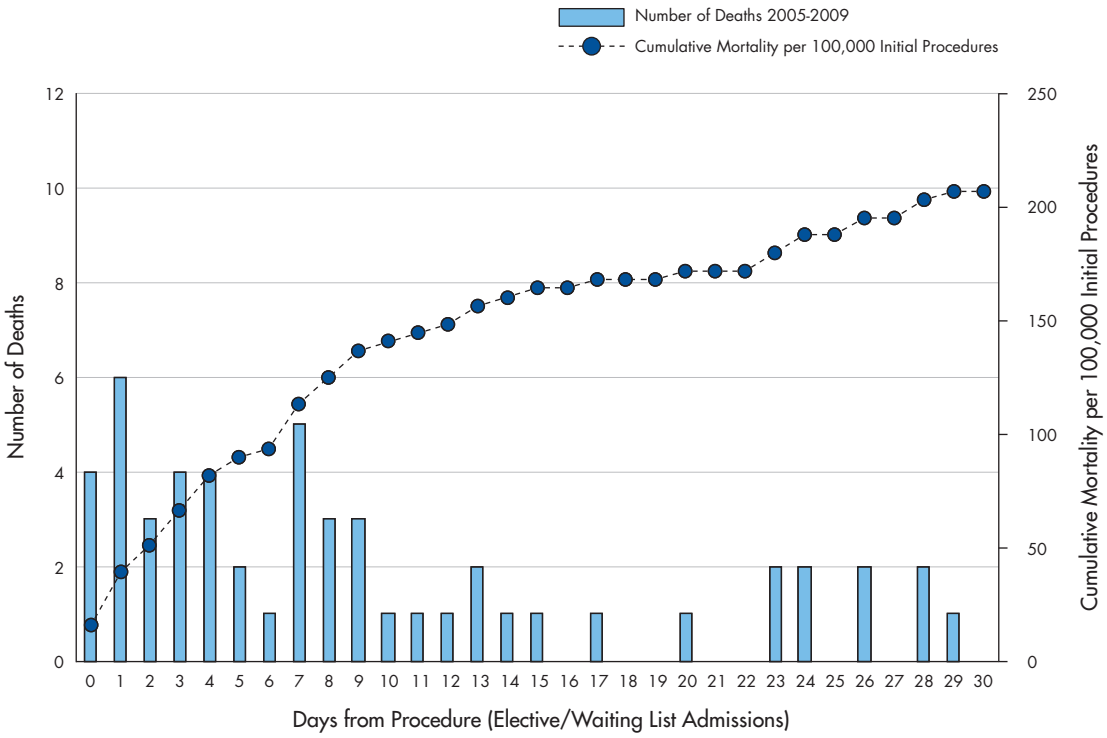
In New Zealand during 2005-2009, mortality following an elective/waiting list knee arthroplasty was greatest during the first week post procedure, but tapered off thereafter. A small number of deaths however occurred up until 29 days post procedure, with cumulative 30-day mortality being 206.9 per 100,000 elective/waiting list knee arthroplasty admissions (Figure 15).

Table 11. Mortality Following Elective/Waiting List Admission for Knee Arthroplasty by Main Underlying Cause of Death in Adults 45+ Years, New Zealand 2005-2009

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2005-2009	Annual average	Percent of Deaths in Category (%)
Knee Arthroplasty			
Elective/Waiting List Admissions			
Arthrosis of Knee	9	1.8	17.0
Myocardial Infarction	12	2.4	22.6
Other Ischaemic Heart Disease	12	2.4	22.6
Cerebral Infarction	4	0.8	7.5
Other Cardiovascular Causes	6	1.2	11.3
Other Causes	10	2.0	18.9
Total	53	10.6	100.0

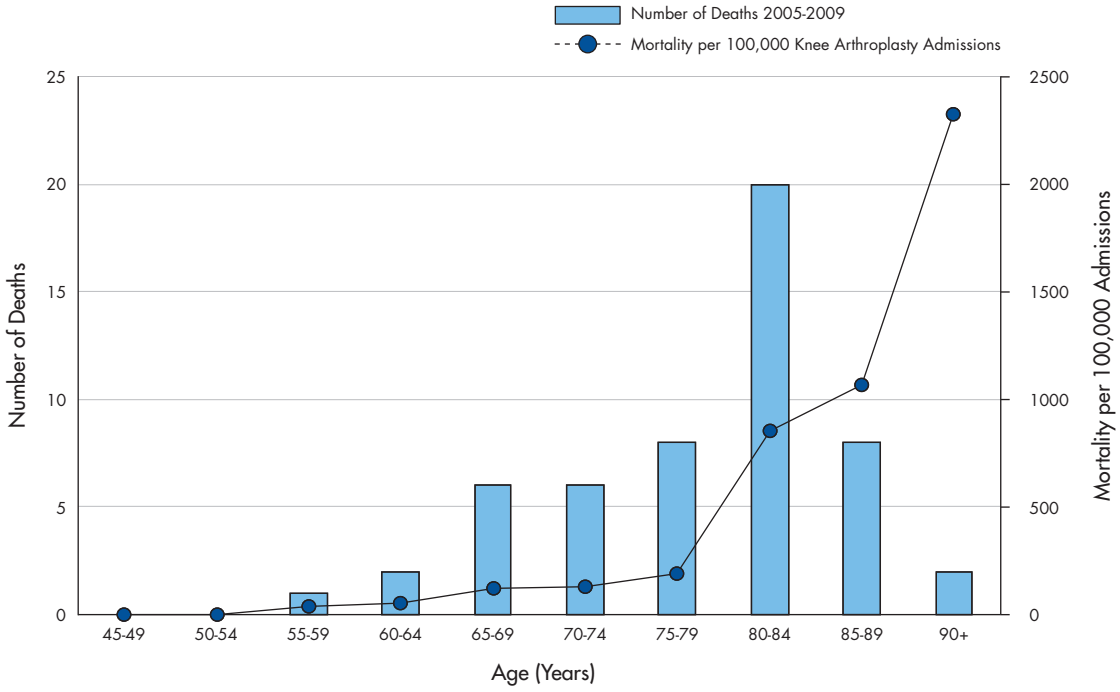
Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list knee arthroplasty, as recorded in the NMDS.

Figure 15. Mortality Following Elective/Waiting List Admission for Knee Arthroplasty by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



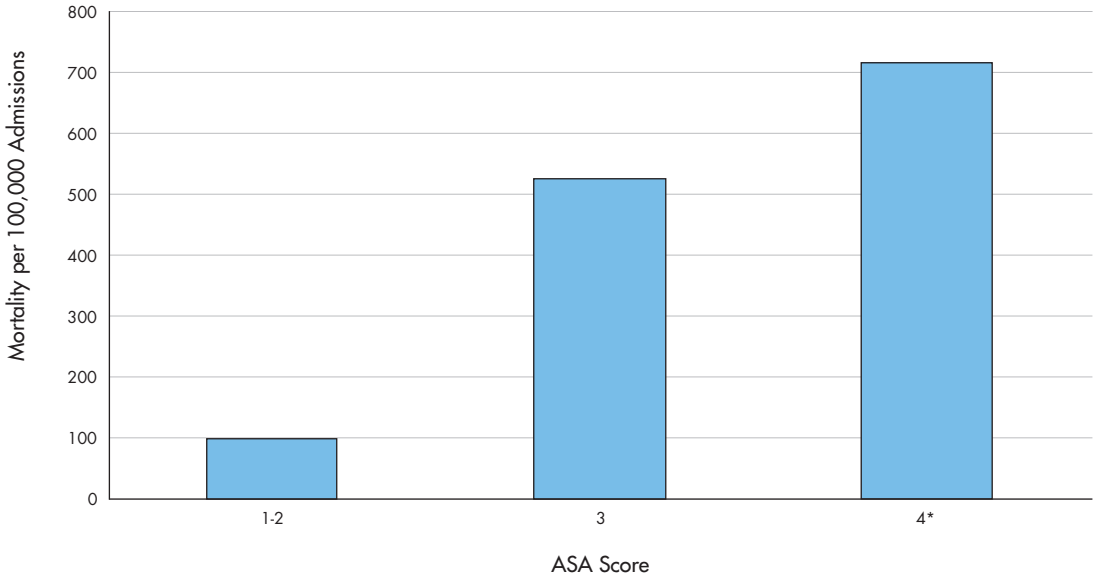
Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list knee arthroplasty, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.

Figure 16. Mortality Following Elective/Waiting List Admission for Knee Arthroplasty by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list knee arthroplasty, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.

Figure 17. Mortality Following Elective/Waiting List Admission for Knee Arthroplasty by ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list knee arthroplasty, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.
*Caution: Rate for ASA 4 is based on n <3 cases, so may be unreliable.

Mortality following knee arthroplasty by age

In New Zealand during 2005-2009, while the absolute number of deaths following an elective/waiting list admission for knee arthroplasty was greatest for those 80-84 years of age, mortality per 100,000 procedures was highest for those 90+ years (Figure 16).

Mortality following knee arthroplasty by ASA score

In New Zealand during 2005-2009, mortality rates for those admitted electively/from the waiting list for a knee arthroplasty increased with increasing ASA Score, with the highest risk being seen in those with an ASA Score of 4 (although the latter rate was based on n <3 cases so care should be taken when interpreting this figure). Very few (<3) patients were admitted electively/from the waiting list with an ASA Score of 5, making risk of mortality for those in this category difficult to assess (Figure 17).

Mortality following knee arthroplasty by socio-demographic factors and ASA score

In New Zealand during 2005-2009, mortality following an elective/waiting list admission for knee arthroplasty was significantly higher for those 65-79 and 80+ years (vs. those 45-64 years) and those with ASA Score of 3 (vs. those with ASA Score of 1-2). These differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). Mortality was also significantly higher for males, once other socio-demographic factors and ASA Score had been taken into account. There were no significant ethnic or socio-economic differences in mortality, although in the case of ethnicity, small numbers made valid comparisons difficult (Table 12).

Table 12. Mortality Following Elective/Waiting List Admission for Knee Arthroplasty by Age Group, Gender, ASA Score, Ethnicity and NZDep Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Knee Arthroplasty									
Elective/Waiting List									
Age Group	45-64 years	3	8,636	34.7	0.03	1.00		1.00	
	65-79 years	20	13,805	144.9	0.14	4.17*	1.24 - 14.1	11.4*	1.53 - 85.5
	80+ years	30	3,176	944.6	0.94	27.4*	8.37 - 89.9	69.2*	9.27 - 516
Gender	Male	31	12,193	254.2	0.25	1.00		1.00	
	Female	22	13,424	163.9	0.16	0.64	0.37 - 1.11	0.56*	0.32 - 0.98
ASA Score	1-2	11	11,085	99.2	0.10	1.00		1.00	
	3	26	4,948	525.5	0.53	5.32*	2.63 - 10.8	3.95*	1.89 - 8.25
	4	<3	140	s	s	s	s	s	s
	5	0	<3	-	-	-	-	-	-
	Not Stated	15	9,443	158.9	0.16	1.60	0.74 - 3.49	1.90	0.84 - 4.30
Ethnicity	European	45	20,969	214.6	0.21	1.00		1.00	
	Māori	4	1,461	273.8	0.27	1.28	0.46 - 3.55	2.24	0.77 - 6.50
	Pacific	0	715	-	-	-	-	-	-
	Asian/ MELAA/ Other	<3	1,249	s	s	s	s	s	s
NZ Deprivation Index Decile	Decile 1-2	9	3,919	229.7	0.23	1.00		1.00	
	Decile 3-4	6	4,676	128.3	0.13	0.56	0.20 - 1.57	0.61	0.21 - 1.77
	Decile 5-6	17	5,580	304.7	0.30	1.33	0.59 - 2.98	1.32	0.56 - 3.11
	Decile 7-8	12	6,311	190.1	0.19	0.83	0.35 - 1.97	0.87	0.35 - 2.14
	Decile 9-10	9	5,073	177.4	0.18	0.77	0.31 - 1.95	0.91	0.34 - 2.42

Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list knee arthroplasty, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.
* significantly different from reference category; s rates suppressed due to small numbers. MELAA: Middle Eastern/Latin American/African.

Colorectal resection

The following section uses information from the NMDS and the NMC, to review hospital admissions for colorectal resections, as well as mortality in the first 30 days following these procedures for adults 45+ years of age.

Data source and methods

Definition

1. Hospital Admissions for a Colorectal Resection (All Age Groups)
2. Mortality in the First 30 Days Following a Colorectal Resection in Adults 45+ Years of Age

Data Sources

Hospital Admissions for Colorectal Resection

Numerator: NMDS: All hospital admissions with a colorectal resection listed in any of the first 90 procedure codes (see Appendix).

Denominator: Statistics New Zealand Estimated Resident Population

Mortality Following Colorectal Resection

Numerator: NMC: All those who died within 30 days of a colorectal resection (with cases being selected from the cohort of those undergoing colorectal resection, as identified in the NMDS).

Denominator: NMDS: All hospital admissions with a colorectal resection listed in any of the first 90 procedure codes.

Notes on Interpretation

Re-admissions: In a small number of cases, a second admission for a procedure meeting the ACHI colorectal resection code criteria outlined in Appendix occurred within 30 days of the initial procedure. In such cases, this was considered to be a revision of the initial procedure (eg, due to complications arising from the first operation) and in such cases, the outcomes arising from the second procedure were attributed to the first. Further, these re-admissions were not included in the denominator used to calculate mortality rates by procedure. If a re-admission occurred >30 days from the original procedure however, this was considered to be a new procedure in the calculation of mortality rates.

Acute, Arranged (Semi-Acute) and Waiting List Admissions: The NMDS defines an acute admission as an unplanned admission occurring on the day of presentation, while an arranged admission is a non-acute admission with an admission date less than seven days after the date the decision was made by the specialist that the admission was necessary. Similarly waiting list admissions arise when the planned admission date is seven or more days after the date the decision was made that the admission was necessary. These definitions are inconsistently used by private hospitals uploading their data to the NMDS however, with a significant proportion of private hospital admissions being coded as arranged when in reality they meet the criteria for a waiting list admission outlined above. As a result, in the sections which follow, all arranged private hospital cases have been included in the elective/waiting list category, while arranged admissions occurring in public hospitals have been included in the public hospital semi-acute admission category. Thus unless otherwise specified, acute and elective/waiting list admission include both public and private cases, while semi-acute admissions are confined to public hospital cases only.

Privately Funded 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 are publicly funded maternity events. As NMDS reporting is not legally mandated for New Zealand healthcare 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 is unable to provide any estimate of the extent to which the NMDS undercounts private surgical or procedural day-stay or outpatient hospitals, facilities or in-room events, although it notes that the data most likely to be missing is privately funded or ACC funded events, or publicly funded long-stay geriatric cases. Thus in the section which follows, it must be remembered that the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

Hospital admissions for colorectal resection

Colorectal resection admissions by admission type

In New Zealand during 2005-2009, 30.8 percent of colorectal resection admissions were acute events, while 63.0 percent of admissions were elective/drawn from the waiting list, and 6.2 percent were semi-acute (occurring within seven days of referral) (Table 13).

Table 13. Hospital Admissions for Colorectal Resections by Admission Type, New Zealand 2005-2009

ADMISSION TYPE	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Colorectal Resection			
Acute	4,999	999.8	30.8
Public Hospital Semi-Acute	1,013	202.6	6.2
Elective/Waiting List	10,226	2,045.2	63.0
Total Admissions	16,238	3,247.6	100.0

Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.

Table 14. Hospital Admissions for Colorectal Resection by Primary Diagnosis and Admission Type, New Zealand 2005-2009

PRIMARY DIAGNOSIS	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Colorectal Resection			
Acute			
Malignant Neoplasm Colon/Rectum/Anus	2,051	410.2	41.0
Diverticular Disease	838	167.6	16.8
Volvulus	270	54.0	5.40
Crohn's Disease	125	25.0	2.50
Ulcerative Colitis	97	19.4	1.94
Benign Neoplasm Colon/Rectum/Anus	27	5.4	0.54
Other Diagnoses	1,591	318.2	31.8
Total	4,999	999.8	100.0
Public Hospital Semi-Acute			
Malignant Neoplasm Colon/Rectum/Anus	700	140.0	69.1
Diverticular Disease	55	11.0	5.43
Ulcerative Colitis	28	5.6	2.80
Benign Neoplasm Colon/Rectum/Anus	28	5.6	2.80
Volvulus	8	1.6	0.80
Crohn's Disease	22	4.4	2.17
Other Diagnoses	172	34.4	17.0
Total	1,013	202.6	100.0
Elective/Waiting List			
Malignant Neoplasm Colon/Rectum/Anus	6,482	1,296.4	63.4
Diverticular Disease	567	113.4	5.54
Benign Neoplasm Colon/Rectum/Anus	467	93.4	4.57
Crohn's Disease	243	48.6	2.38
Ulcerative Colitis	201	40.2	1.97
Volvulus	49	9.8	0.48
Other Diagnoses	2,217	443.4	21.7
Total	10,226	2,045.2	100.0

Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.

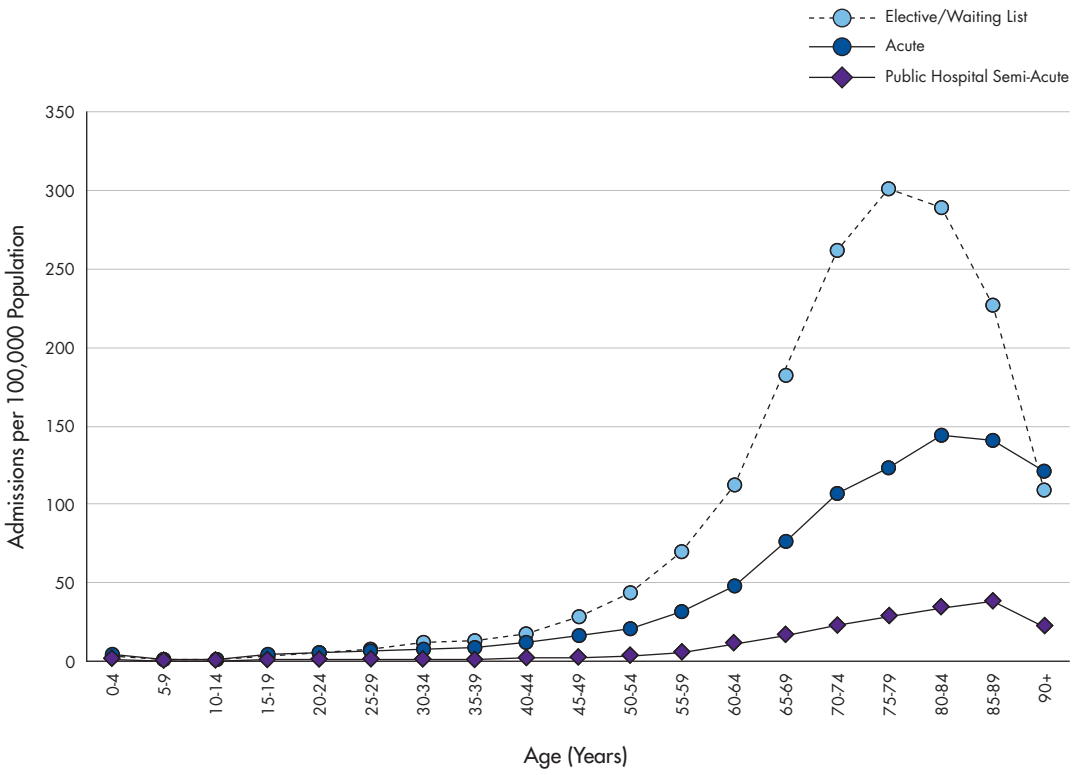
Colorectal resection admissions by primary diagnosis

In New Zealand during 2005-2009, malignant neoplasms of the colon, rectum and anus, followed by diverticular disease, were the leading reasons for acute, semi-acute and elective/waiting list admissions in those undergoing colorectal resection. Volvulus was the third most frequent cause of acute admissions, while benign neoplasms were the third most frequent reason for elective/waiting list admissions (Table 14).

Colorectal resection admissions by age and admission type

In New Zealand during 2005-2009, acute admission rates for colorectal resection increased with increasing age, reached a peak at 80-84 years and then declined slightly. Similarly, elective/waiting list admission rates reached a peak at 75-79 years of age, and then declined. Overall, elective/waiting list admissions were more frequent than acute/semi-acute admissions at nearly every age (Figure 18).

Figure 18. Hospital Admissions for Colorectal Resection by Age and Admission Type, New Zealand 2005-2009

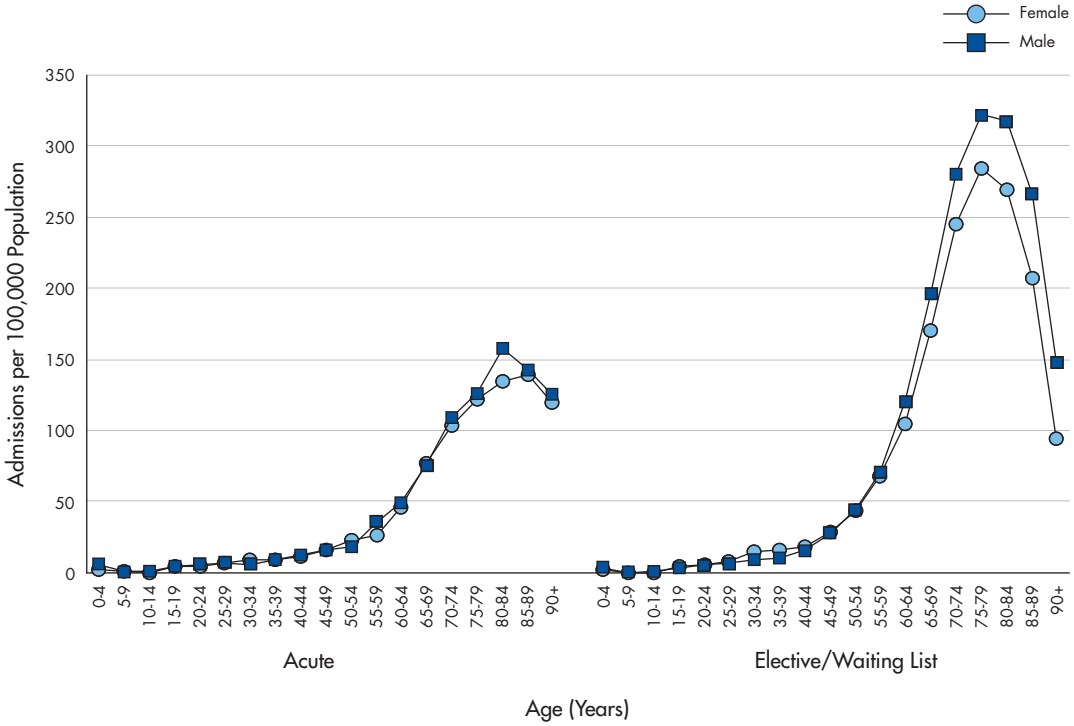


Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Colorectal resection admissions by age, admission type and gender

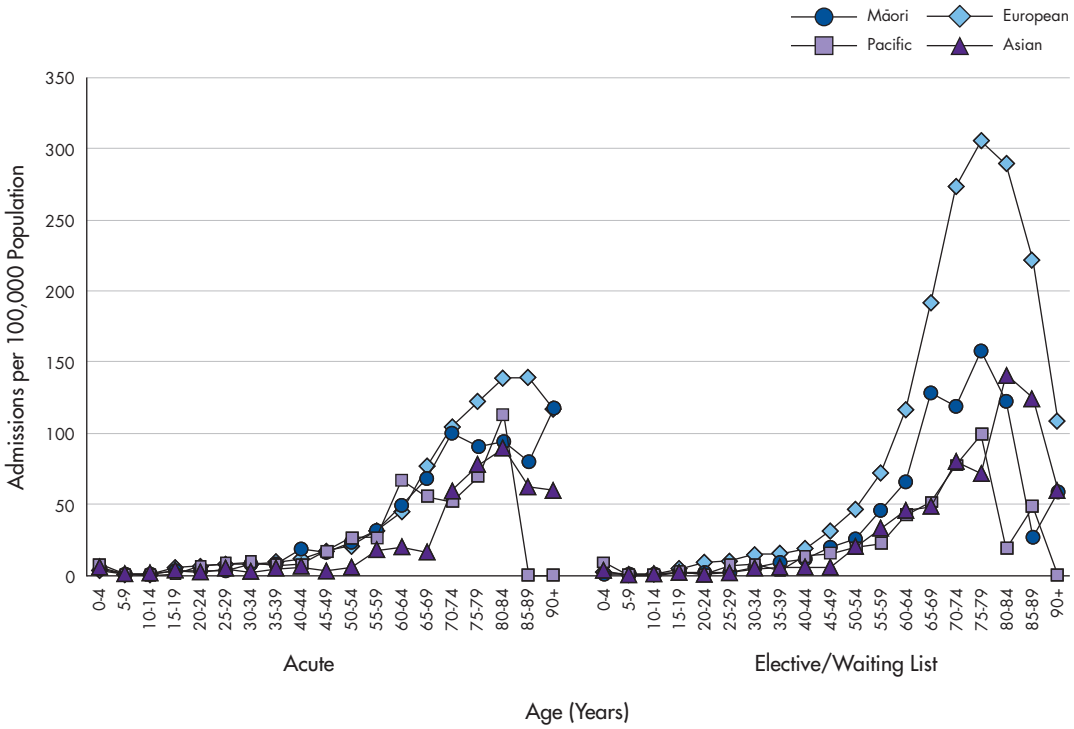
In New Zealand during 2005-2009, acute admissions for colorectal resection increased with increasing age, with rates reaching a peak at 80-84 years in males and 85-89 years in females. While elective/waiting list admissions increased to a peak at 75-79 years in both genders, admission rates were generally higher for males than for females from 60 years onwards (Figure 19).

Figure 19. Hospital Admissions for Colorectal Resection by Age, Admission Type and Gender, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Figure 20. Hospital Admissions for Colorectal Resection by Age, Admission Type and Ethnicity, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Ethnicity is Level 1 Prioritised.

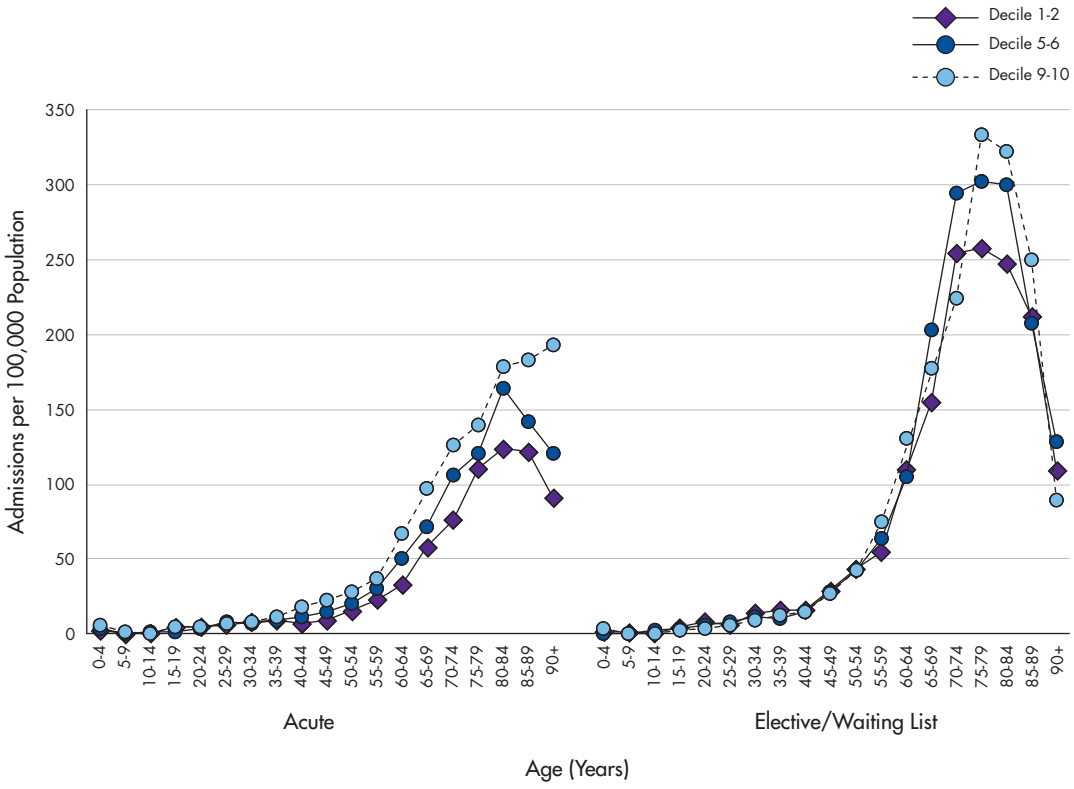
Colorectal resection admissions by age, admission type and ethnicity

In New Zealand during 2005-2009, acute and elective/waiting list admission rates for colorectal resections increased during the fifth-seventh decades for each of New Zealand's largest ethnic groups, although small numbers after 75 years, made ethnic differences in older age groups difficult to interpret. Elective/waiting list admission rates for colorectal resections were higher for European peoples than for other ethnic groups after 50 years of age. Similarly acute admissions were generally higher for European peoples than for other ethnic groups from 75 year of age onwards (Figure 20).

Colorectal resection admissions by age, admission type and NZDep decile

In New Zealand during 2005-2009, acute admission rates for colorectal resection increased with increasing age for all NZDep decile groupings, with rates tapering off after 80 years in those living in decile 1-2 and decile 5-6 areas. Elective/waiting list admissions were highest amongst those in their 70s and early 80s for each NZDep decile grouping (Figure 21).

Figure 21. Hospital Admissions for Colorectal Resection by Age, Admission Type and NZ Deprivation Index Decile, New Zealand 2005-2009

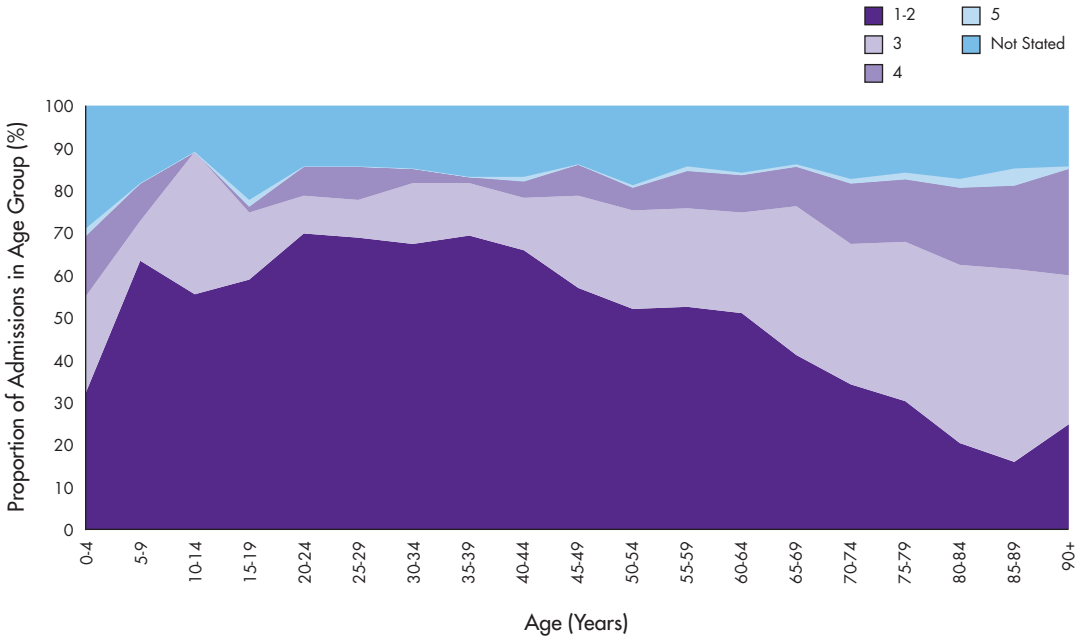


Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Decile is NZDep2001.

Colorectal resection admissions by age and ASA score

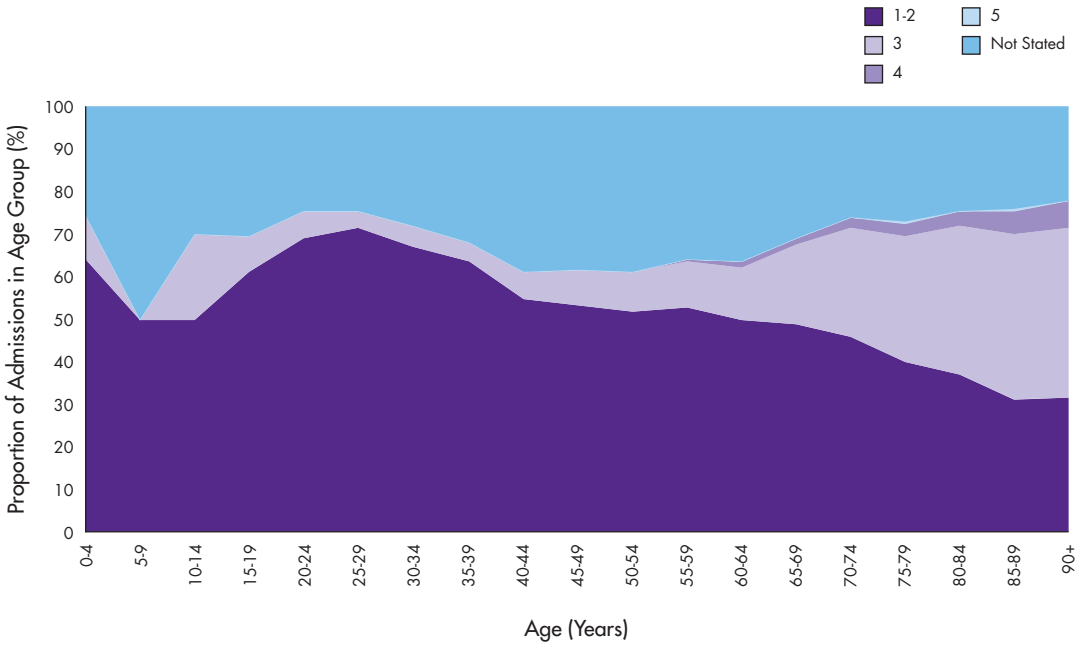
In New Zealand during 2005-2009, the proportion of acute admissions for colorectal resection with an ASA Score of 1-2 was highest amongst those in their 20s-40s, with those with ASA Scores of 3 or more being more common at either end of the age distribution. For elective admissions, the proportion with an ASA Score of 3 or more was highest amongst older patients (Figure 22, Figure 23).

Figure 22. Proportion of Acute Hospital Admissions for Colorectal Resection by Age and ASA Score, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.

Figure 23. Proportion of Elective/Waiting List Admissions for Colorectal Resection by Age and ASA Score, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with a colorectal resection listed in any of the first 90 procedures.

Mortality following colorectal resection

Mortality following colorectal resection by admission type and cause of death

In New Zealand during 2005-2009, malignant neoplasm of the colon was the most frequent main underlying cause of death for those undergoing colorectal resection, irrespective of whether the admission was acute, semi-acute or elective/from the waiting list. Diverticular disease was the most frequent cause of non-cancer death following acute colorectal resection, while myocardial infarction/ischaemic heart disease was the leading non-cancer cause for those admitted electively/from the waiting list (Table 15).

Mortality following colorectal resection by day from procedure

In New Zealand during 2005-2009, mortality following an acute colorectal resection was highest on the first and second day post-surgery, with mortality tapering off gradually after the first five days. Similarly, mortality following an elective/waiting list admission for colorectal resection was highest on the second and third day post-surgery, with mortality tapering off over the first 10-12 days. Cumulative 30-day mortality was higher for acute resections (9,818 per 100,000 procedures or 9.8 percent) than for elective/waiting list resections (2,058 per 100,000 procedures or 2.1 percent) during this period (Figure 24, Figure 25).

Mortality following colorectal resection by age

In New Zealand during 2005-2009, mortality following colorectal resection increased with increasing age for all hospital admission types, with the highest rates being seen in those aged 90+ years. Within each age group however, mortality was higher for acute than for elective/waiting list admissions (Figure 26).

Mortality following colorectal resection by ASA score

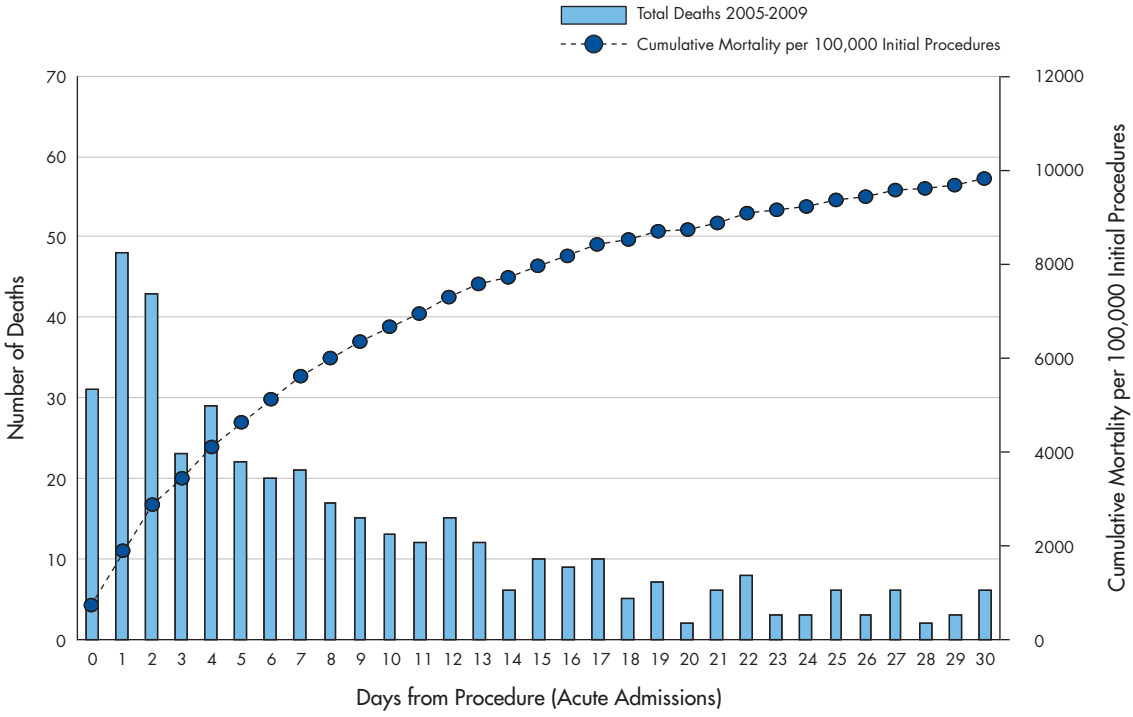
In New Zealand during 2005-2009, mortality rates following colorectal resection increased with increasing ASA Score for all hospital admission types. While mortality was lower for elective/waiting list admissions than for acute admissions amongst those with ASA Scores of 1-4, mortality for those with an ASA Score of 5 was similarly elevated for each admission type. However, care should be taken when interpreting ASA 5 mortality rates for elective/waiting list and publicly funded semi-acute admissions as they are based on very small sample sizes (n <3 deaths) (Figure 27).

Table 15. Mortality Following Colorectal Resection by Admission Type and Main Underlying Cause of Death in Adults 45+ Years of Age, New Zealand 2005-2009

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2005-2009	Annual average	Percent of Deaths in Category (%)
Colorectal Resection			
Acute			
Malignant Neoplasm Colon	118	23.6	28.4
Malignant Neoplasm Recto-Sigmoid Junction	5	1.0	1.2
Malignant Neoplasm Rectum	7	1.4	1.7
Other Neoplasms	39	7.8	9.4
Diverticular Disease	47	9.4	11.3
Paralytic Ileus/Intestinal Obstruction	19	3.8	4.6
Vascular Disorders Intestine	31	6.2	7.5
Other Gastrointestinal Diseases	26	5.2	6.3
Myocardial Infarction	29	5.8	7.0
Other Ischaemic Heart Disease	26	5.2	6.3
Other Cardiovascular Causes	33	6.6	7.9
Emphysema/COPD/Other Respiratory	13	2.6	3.1
Other Causes	23	4.6	5.5
Total Acute	416	83.2	100.0
Public Hospital Semi-Acute			
Malignant Neoplasm Colon	16	3.2	35.6
Malignant Neoplasm Recto-Sigmoid Junction	3	0.6	6.67
Malignant Neoplasm Rectum	3	0.6	6.67
Other Neoplasms	4	0.8	8.89
Diverticular Disease	3	0.6	6.67
Other Gastrointestinal Diseases	6	1.2	13.3
Myocardial Infarction/Other Cardiovascular	8	1.6	17.8
No Diagnosis/Other Causes	2	0.4	4.44
Total Public Hospital Semi-Acute	45	9.0	100.0
Elective/Waiting List			
Malignant Neoplasm Colon	69	13.8	36.1
Malignant Neoplasm Rectum	24	4.8	12.6
Malignant Neoplasm Recto-Sigmoid Junction	4	0.8	2.09
Other Neoplasms	9	1.8	4.71
Myocardial Infarction	25	5.0	13.1
Other Ischaemic Heart Disease	22	4.4	11.5
Other Cardiovascular Causes	13	2.6	6.81
Emphysema and COPD	10	2.0	5.24
Gastrointestinal Diseases	6	1.2	3.14
Other Causes	9	1.8	4.71
Total Elective/Waiting List	191	38.2	100.0
Grand Total	652	130.4	100.0

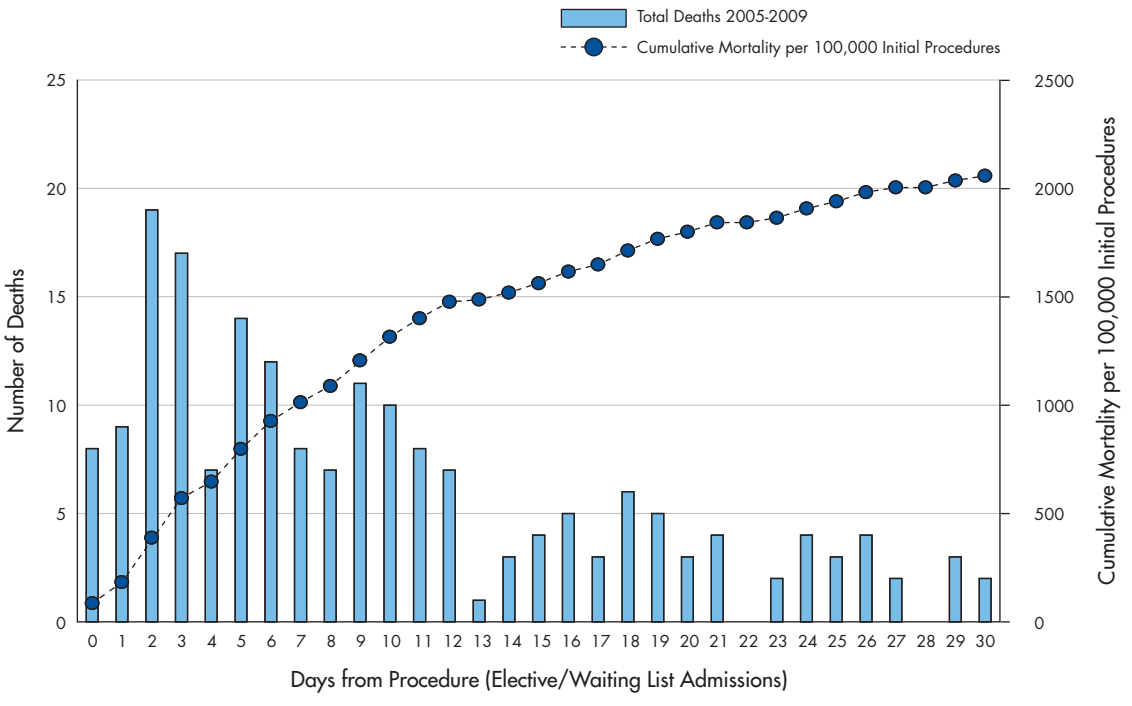
Numerator: National Mortality Collection: Deaths occurring within 30 days of a colorectal resection, as recorded in the NMDS.

Figure 24. Mortality Following Acute Admission for Colorectal Resection by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



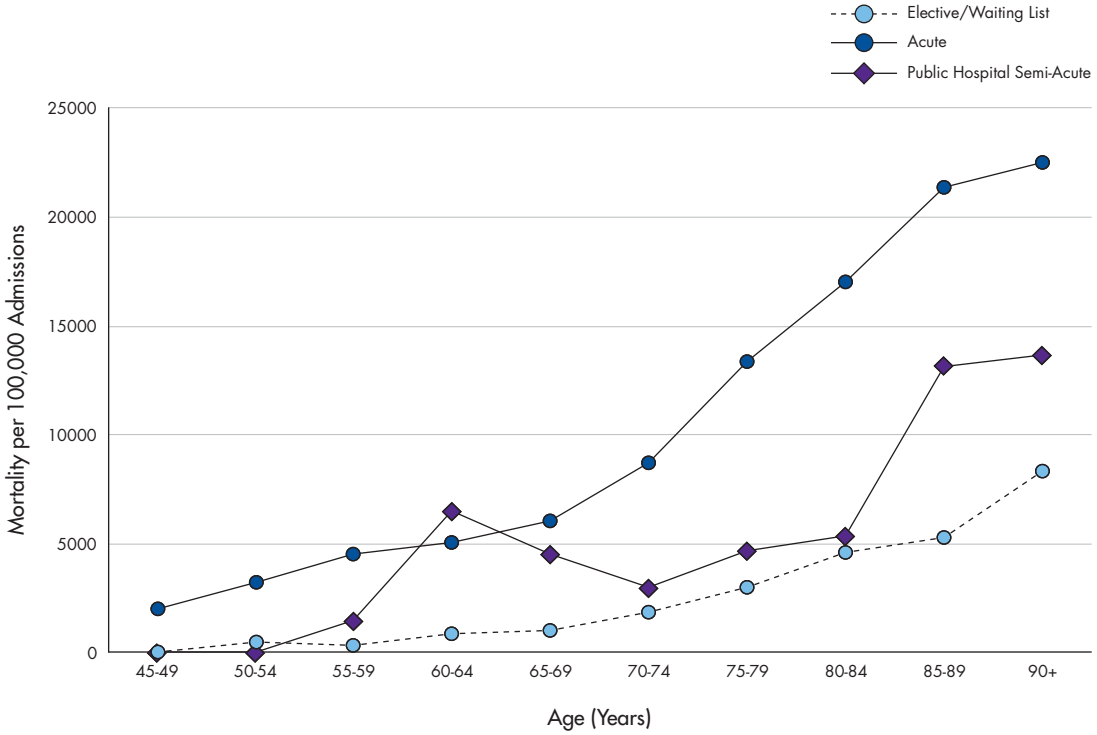
Numerator: National Mortality Collection: Deaths occurring within 30 days of an acute colorectal resection, as recorded in the NMDS.
Denominator: NMDS Acute admissions with a colorectal resection listed in any of the first 90 procedures.

Figure 25. Mortality Following Elective/Waiting List Admission for Colorectal Resection by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



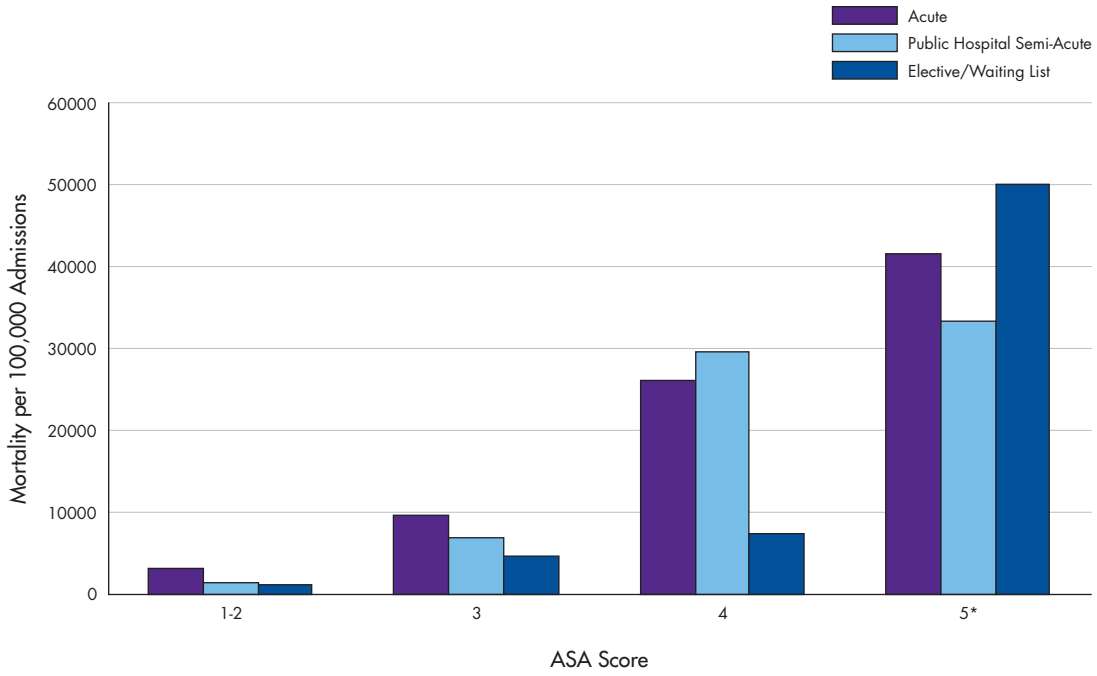
Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list colorectal resection, as recorded in the NMDS.
Denominator: NMDS elective/waiting list admissions with a colorectal resection listed in any of the first 90 procedures.

Figure 26. Mortality Following Colorectal Resection by Admission Type and Age in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of a colorectal resection, as recorded in the NMDS.
Denominator: NMDS admissions with a colorectal resection listed in any of the first 90 procedures.

Figure 27. Mortality Following Colorectal Resection by Admission Type and ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of a colorectal resection, as recorded in the NMDS.
Denominator: NMDS admissions with a colorectal resection listed in any of the first 90 procedures.
* Care should be taken when interpreting ASA 5 rates for Elective/Waiting List and Semi-Acute admissions as they are based on <3 deaths.

Mortality following colorectal resection by socio-demographic factors and ASA score

Acute Admissions: In New Zealand during 2005-2009, mortality following an acute admission for colorectal resection was significantly higher for those aged 65-79 and 80+ years (vs. those 45-64 years) and those with ASA Score of 3, 4 or 5 (vs. those with ASA Score of 1-2). These differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). While at the univariate level, mortality was significantly higher for those living in NZDep decile 9-10 areas, these differences did not persist in the multivariate model. Similarly, mortality was significantly higher for Māori than for European people, only once other demographic factors and ASA Score had been adjusted for (Table 16).

Elective/Waiting List Admissions: In New Zealand during 2005-2009, mortality rates following an elective/waiting list admission for colorectal resection was significantly higher for males, those aged 65-79 and 80+ years (vs. those 45-64 years) and those with ASA Score of 3 or 4 (vs. those with ASA Score of 1-2). These differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). Mortality was also significantly higher for Māori and Asian/MELAA/other peoples and for those living in the least deprived (NZDep decile 1-2) areas, once factors such as age, gender, ASA Score and NZDep deprivation were taken into account (Table 17).

Table 16. Mortality Following Acute Admission for Colorectal Resection by Age Group, Gender, ASA Score, Ethnicity and NZ Deprivation Index Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Colorectal Resection									
Acute									
Age Group	45-64 years	55	1,382	3,979.7	3.98	1.00		1.00	
	65-79 years	180	1,903	9,458.8	9.46	2.52*	1.85 - 3.44	2.16*	1.55 - 3.01
	80+ years	181	952	19,012.6	19.0	5.66*	4.14 - 7.76	4.26*	3.01 - 6.01
Gender	Male	191	1,997	9,564.4	9.56	1.00		1.00	
	Female	225	2,240	10,044.6	10.0	1.06	0.86 - 1.29	0.98	0.79 - 1.23
ASA Score	1-2	50	1,584	3,156.6	3.16	1.00		1.00	
	3	135	1,393	9,691.3	9.69	3.29*	2.36 - 4.59	2.48*	1.75 - 3.51
	4	142	542	26,199.3	26.2	10.9*	7.75 - 15.3	7.84*	5.47 - 11.2
	5	20	48	41,666.7	41.7	21.9*	11.6 - 41.6	13.9*	7.03 - 27.6
	Not Stated	69	670	10,298.5	10.3	3.52*	2.42 - 5.13	3.06*	2.08 - 4.52
Ethnicity	European	347	3,585	9,679.2	9.7	1.00		1.00	
	Māori	32	245	13,061.2	13.1	1.40	0.95 - 2.07	1.60*	1.04 - 2.46
	Pacific	8	96	8,333.3	8.33	0.85	0.41 - 1.76	0.94	0.42 - 2.12
	Asian/ MELAA/ Other	13	201	6,467.7	6.47	0.65	0.36 - 1.14	0.72	0.39 - 1.32
NZ Deprivation Index Decile	Decile 1-2	52	600	8,666.7	8.67	1.00		1.00	
	Decile 3-4	64	714	8,963.6	8.96	1.04	0.71 - 1.52	1.00	0.66 - 1.51
	Decile 5-6	87	923	9,425.8	9.43	1.10	0.77 - 1.57	1.07	0.72 - 1.57
	Decile 7-8	100	1,059	9,442.9	9.44	1.10	0.77 - 1.56	1.05	0.72 - 1.53
	Decile 9-10	110	904	12,168.1	12.2	1.46*	1.03 - 2.07	1.35	0.92 - 1.97

Numerator: National Mortality Collection: Deaths occurring within 30 days of an acute colorectal resection, as recorded in the NMDS.
Denominator: NMDS Acute admissions with a colorectal resection listed in any of the first 90 procedures.
* significantly different from reference category. MELAA: Middle Eastern/Latin American/African.

Table 17. Mortality Following Elective/Waiting List Admission for Colorectal Resection by Age Group, Gender, ASA Score, Ethnicity and NZ Deprivation Index Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Colorectal Resection									
Elective/Waiting List									
Age Group	45-64 years	15	2,991	501.5	0.50	1.00		1.00	
	65-79 years	92	4,621	1,990.9	1.99	4.03*	2.33 - 6.97	1.68*	1.67 - 1.68
	80+ years	84	1,670	5,029.9	5.03	10.5*	6.05 - 18.3	6.16*	6.13 - 6.18
Gender	Male	117	4,595	2,546.3	2.55	1.00		1.00	
	Female	74	4,687	1,578.8	1.58	0.61*	0.46 - 0.82	0.61*	0.60 - 0.61
ASA Score	1-2	46	4,203	1,094.5	1.09	1.00		1.00	
	3	96	2,060	4,660.2	4.66	5.87*	5.84 - 5.89	4.04*	4.02 - 4.05
	4	15	203	7,389.2	7.39	22.7*	22.5 - 22.9	14.8*	14.6 - 14.9
	5	<3	s	s	s	s	s	s	s
	Not Stated	33	2,814	1,172.7	1.17	1.04*	1.03 - 1.05	1.04*	1.03 - 1.04
Ethnicity	European	171	8,205	2,084.1	2.08	1.00		1.00	
	Māori	10	339	2,949.9	2.95	1.43	0.75 - 2.73	1.58*	1.56 - 1.60
	Pacific	<3	s	s	s	s	s	s	s
	Asian/ MELAA/ Other	7	315	2,222.2	2.22	1.07	0.50 - 2.29	1.38*	1.36 - 1.40
NZ Deprivation Index Decile	Decile 1-2	35	1,563	2,239.3	2.24	1.00		1.00	
	Decile 3-4	22	1,739	1,265.1	1.27	0.56*	0.33 - 0.96	0.58*	0.57 - 0.58
	Decile 5-6	37	2,056	1,799.6	1.80	0.80	0.50 - 1.28	0.68*	0.67 - 0.68
	Decile 7-8	54	2,292	2,356.0	2.36	1.05	0.69 - 1.62	0.81*	0.81 - 0.82
	Decile 9-10	43	1,615	2,662.5	2.66	1.19	0.76 - 1.88	0.93*	0.93 - 0.94

Numerator: National Mortality Collection: Deaths occurring within 30 days of an elective/waiting list colorectal resection, as recorded in the NMDS.
Denominator: NMDS elective/waiting list admissions with a colorectal resection listed in any of the first 90 procedures.
* significantly different from reference category; s rates suppressed due to small numbers. MELAA: Middle Eastern/Latin American/African.

Cataract surgery

The following section uses information from the NMDS and the NMC, to review hospital admissions for cataract surgery, as well as mortality in the first 30 days following these procedures in adults 45+ years of age.

Data source and methods

Definition

1. Hospital Admissions for Cataract Surgery (All Age Groups)
2. Mortality in the First 30 Days Following Cataract Surgery in Adults 45+ Years of Age

Data Sources

Hospital Admissions for Cataract Surgery

Numerator: NMDS: All hospital admissions with a cataract related procedure listed in any of the first 90 procedure codes (see Appendix).

Denominator: Statistics New Zealand Estimated Resident Population

Mortality Following Cataract Surgery

Numerator: NMC: All those who died within 30 days of cataract surgery (with cases being selected from the cohort of those undergoing cataract surgery, as identified in the NMDS).

Denominator: NMDS: All hospital admissions with a cataract-related procedure listed in any of the first 90 procedure codes.

Notes on Interpretation

Re-admissions: As it is common practice to perform cataract surgery sequentially (eg, to perform cataract surgery on the first eye, and then to repeat the procedure on the second eye after a short interval (eg, weeks-months)), re-admissions within 30 days for the same procedure were not considered to be due to complications arising from the first procedure, as they were for other procedure types. As a result, each admission (even if occurring within 30 days of the last) was counted as a separate event in both the numerator and the denominator, with outcomes (eg, mortality) following the procedure being attributed to the most recent event.

Acute, Arranged (Semi-Acute) and Waiting List Admissions: The NMDS defines an acute admission as an unplanned admission occurring on the day of presentation, while an arranged admission is a non-acute admission with an admission date less than seven days after the date the decision was made by the specialist that the admission was necessary. Similarly waiting list admissions arise when the planned admission date is seven or more days after the date the decision was made that the admission was necessary. These definitions are inconsistently used by private hospitals uploading their data to the NMDS however, with a significant proportion of private hospital admissions being coded as arranged when in reality they meet the criteria for a waiting list admission as outlined above. As a result, in the sections which follow, all arranged private hospital cases have been included in the elective/waiting list category, while arranged admissions occurring in public hospitals have been included in the public hospital semi-acute admission category. Thus unless otherwise specified, acute and elective/waiting list admissions include both public and private cases, while semi-acute admissions are confined to public hospital cases only.

Privately Funded 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 are publicly funded maternity events. As NMDS reporting is not legally mandated for New Zealand healthcare 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 is unable to provide any estimate of the extent to which the NMDS undercounts private surgical or procedural day-stay or outpatient hospitals, facilities or in-room events, although it notes that the data most likely to be missing is privately funded or ACC funded events, or publicly funded long-stay geriatric cases. Thus in the section which follows, it must be remembered that the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

Hospital admissions for cataract surgery

Cataract surgery admissions by admission type

In New Zealand during 2005-2009, acute and publicly funded semi-acute admissions made only a very minor contribution to overall admissions for cataract surgery, with 98.9 percent of admissions being elective/admitted from the waiting list. As a consequence, all of the analyses of admission rates which follow consider cataract surgery admissions as a group, with no further breakdown provided by admission type (Table 18).

Table 18. Hospital Admissions for Cataract Surgery by Admission Type, New Zealand 2005-2009

ADMISSION TYPE	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Cataract Surgery			
Acute	412	82.4	0.48
Public Hospital Semi-Acute	575	115.0	0.66
Elective/Waiting List	85,527	17,105.4	98.9
Total Admissions	86,514	17,302.8	100.0

Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures.

Cataract surgery admissions by primary diagnosis

In New Zealand during 2005-2009, cataract was the most common primary diagnosis listed for those being admitted for cataract related procedures, with ophthalmic complications arising from non-insulin dependent diabetes being the second most frequently listed reason for admission (Table 19).

Table 19. Hospital Admissions for Cataract Surgery by Primary Diagnosis, New Zealand 2005-2009

PRIMARY DIAGNOSIS	Total admission events 2005-2009	Annual average	Percent of admissions (%)
Cataract Surgery			
Cataract	70,030	14,006	80.9
Non-Insulin Dependent Diabetes with Ophthalmic Complications	12,877	2,575	14.9
Insulin Dependent Diabetes with Ophthalmic Complications	588	118	0.7
Other Diagnoses	3,022	604	3.5
Total Admissions	86,517	17,303	100.0

Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures. Acute, Semi-Acute and Elective/Waiting List Admissions Combined.

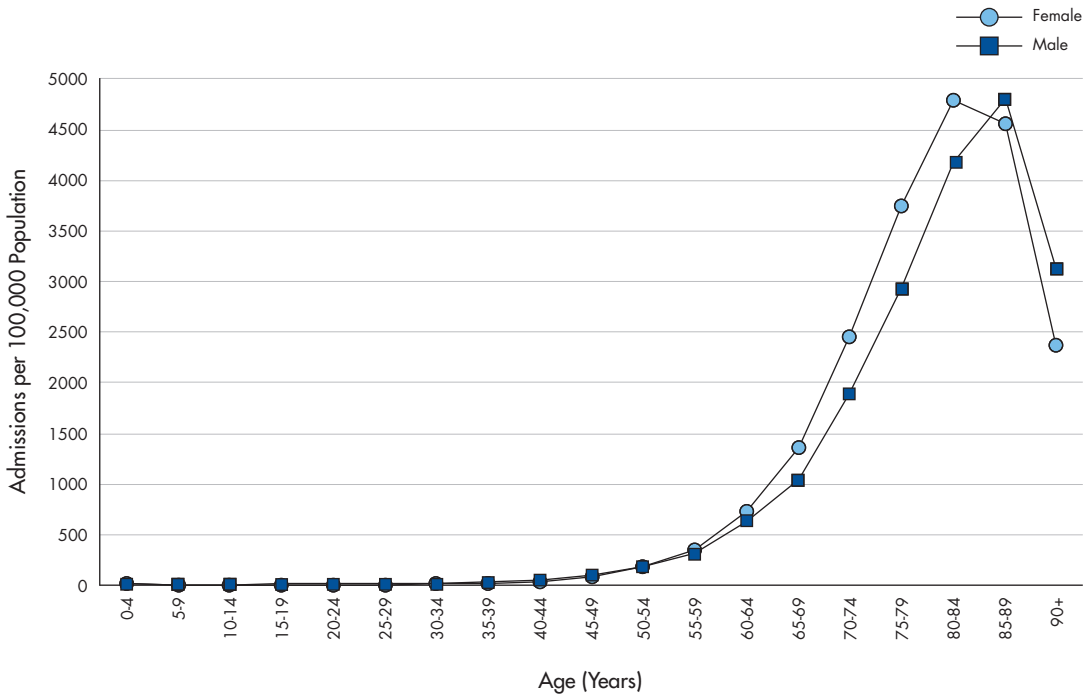
Cataract surgery admissions by age and gender

In New Zealand during 2005-2009, hospital admission rates for cataract surgery increased with increasing age for both males and females, with rates reaching a peak at 80-84 years for females and at 85-89 years for males (Figure 28).

Cataract surgery admissions by age and ethnicity

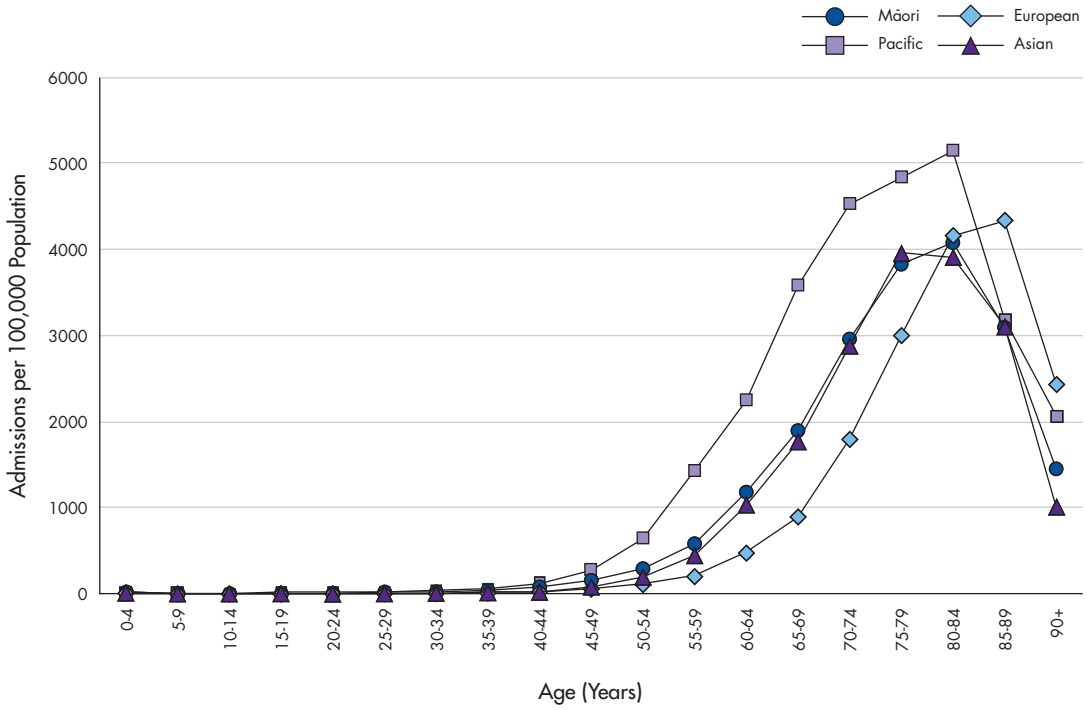
In New Zealand during 2005-2009, hospital admission rates for cataract surgery increased with increasing age for each of New Zealand's largest four ethnic groups, with admission rates for those in their 50s to 70s being higher for Pacific > Māori and Asian > European peoples. Amongst those aged 80+ years however, ethnic differences were less consistent (Figure 29).

Figure 28. Hospital Admissions for Cataract Surgery by Age and Gender, New Zealand 2005-2009



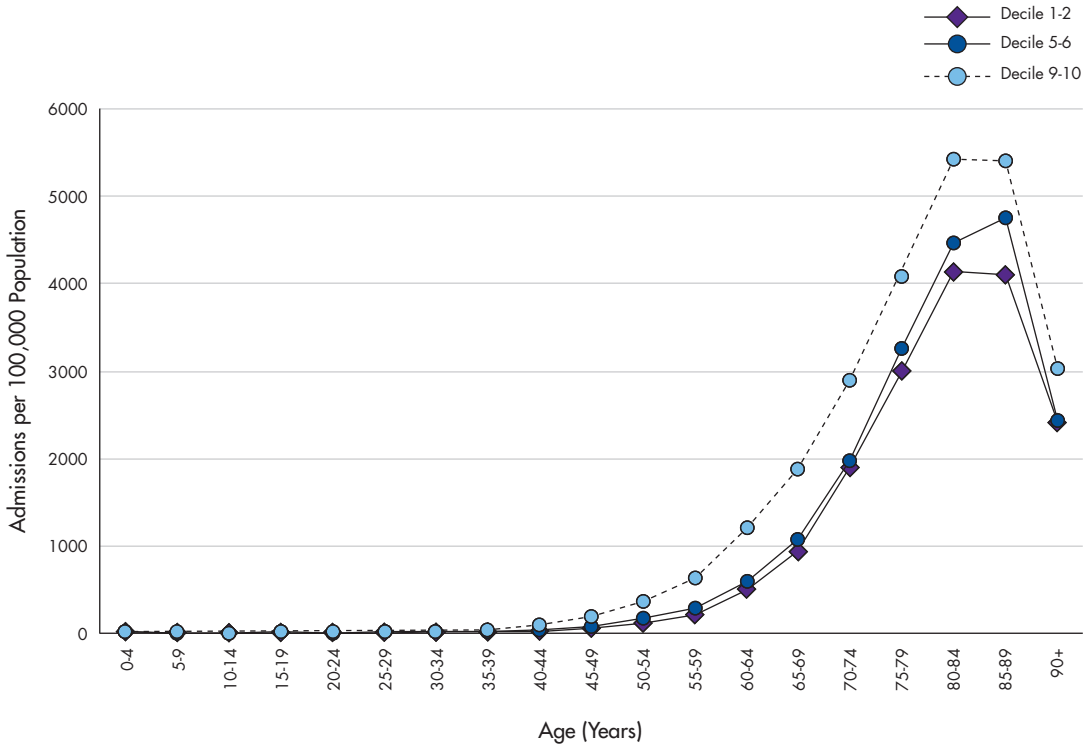
Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined.

Figure 29. Hospital Admissions for Cataract Surgery by Age and Ethnicity, New Zealand 2005-2009



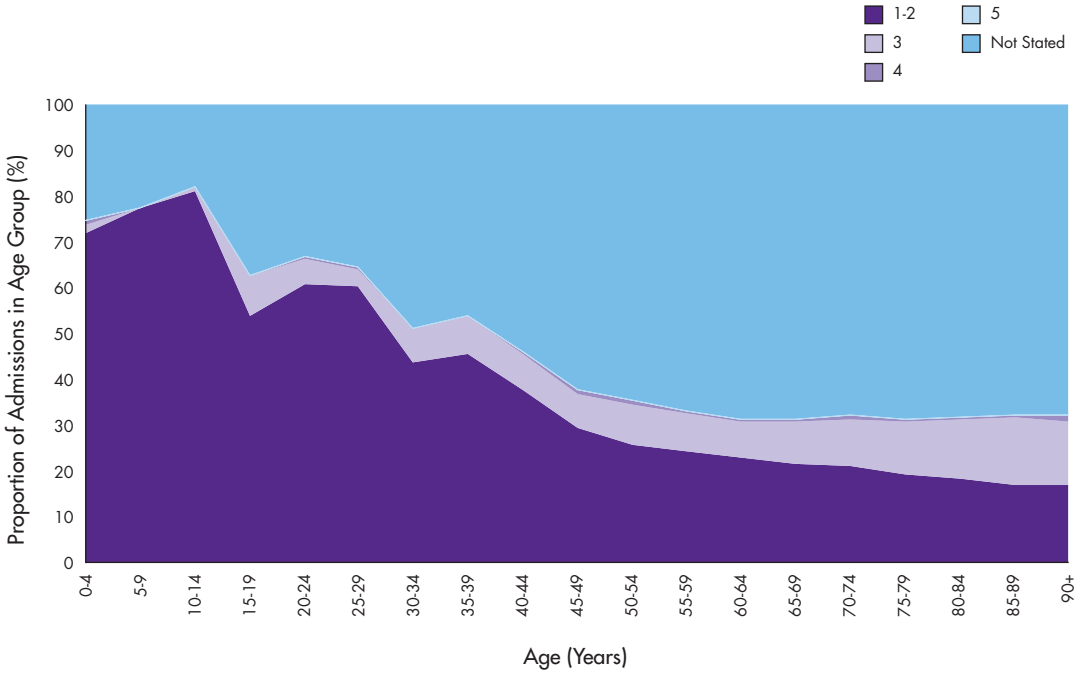
Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined. Ethnicity is Level 1 Prioritised.

Figure 30. Hospital Admissions for Cataract Surgery by Age and NZ Deprivation Index Decile, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Acute, Semi-Acute and Elective/Waiting List Admissions Combined. Decile is NZDep2001.

Figure 31. Proportion of Hospital Admissions for Cataract Surgery by Age and ASA Score, New Zealand 2005-2009



Numerator: NMDS Hospital admissions with cataract surgery listed in any of the first 90 procedures; Acute, Semi-Acute and Elective/Waiting List Admissions Combined.

Cataract surgery admissions by age and NZDep decile

In New Zealand during 2005-2009, hospital admission rates for cataract surgery increased with increasing age for each NZDep2001 deprivation quintile, with rates reaching a peak amongst those in their eighties, before declining again. Once broken down by age, admissions for those living in the most deprived (NZDep decile 9-10) areas were higher than those living in average and the least deprived (NZDep decile 1-2 and 5-6) areas from 30 years of age onwards (Figure 30).

Cataract surgery admissions by age and ASA score

In New Zealand during 2005-2009, the proportion of hospital admissions for cataract surgery with an ASA Score of three or higher increased with increasing age. However a very high proportion of admissions did not have any information on ASA Score available, with this proportion being highest in older patients (Figure 37).

Mortality following cataract surgery

Because of the potential for higher mortality rates following acute and semi-acute procedures (as compared to elective/waiting list procedures), and the small number of cataract surgery patients being admitted acutely, the following analysis is restricted to a review of 30-day mortality for adults 45+ years following elective/waiting list admissions for cataract surgery.

Mortality following cataract surgery by cause of death

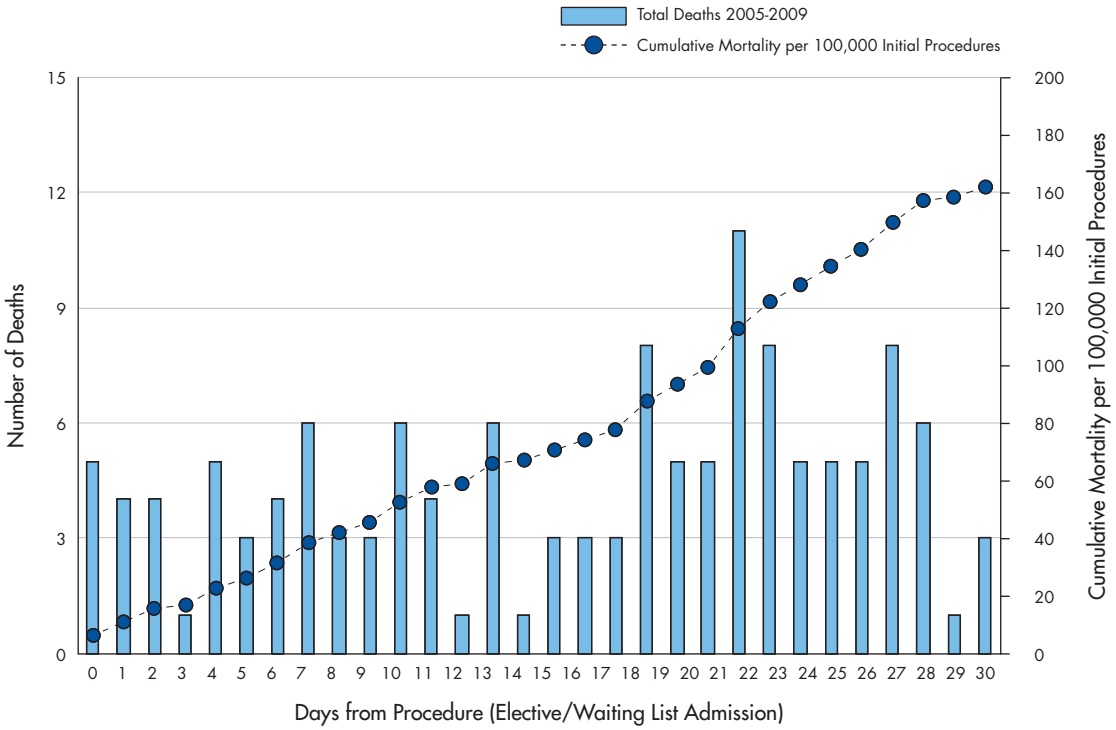
In New Zealand during 2005-2009, myocardial infarctions and other forms of ischaemic heart and cardiovascular disease were the most frequently listed main underlying causes of death for those dying within 30 days of cataract surgery, with other forms of cardiovascular disease also making a significant contribution. Neoplasms and emphysema/COPD were other frequently listed main underlying causes of death (Table 20).

Table 20. Mortality Following Elective/Waiting List Admission for Cataract Surgery by Main Underlying Cause of Death in Adults 45+ Years, New Zealand 2005-2009

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2005-2009	Annual average	Percent of Deaths in Category (%)
Cataract Surgery			
Elective/Waiting List Admissions			
Myocardial Infarction	16	3.2	11.9
Other Ischaemic Heart Disease	27	5.4	20.0
Other Cardiovascular Causes	32	6.4	23.7
Neoplasms	15	3.0	11.1
Emphysema and COPD	14	2.8	10.4
Other Respiratory Diseases	4	0.8	3.0
Non-Insulin Dependent Diabetes	9	1.8	6.7
Other Causes	18	3.6	13.3
Total	135	27.0	100.0

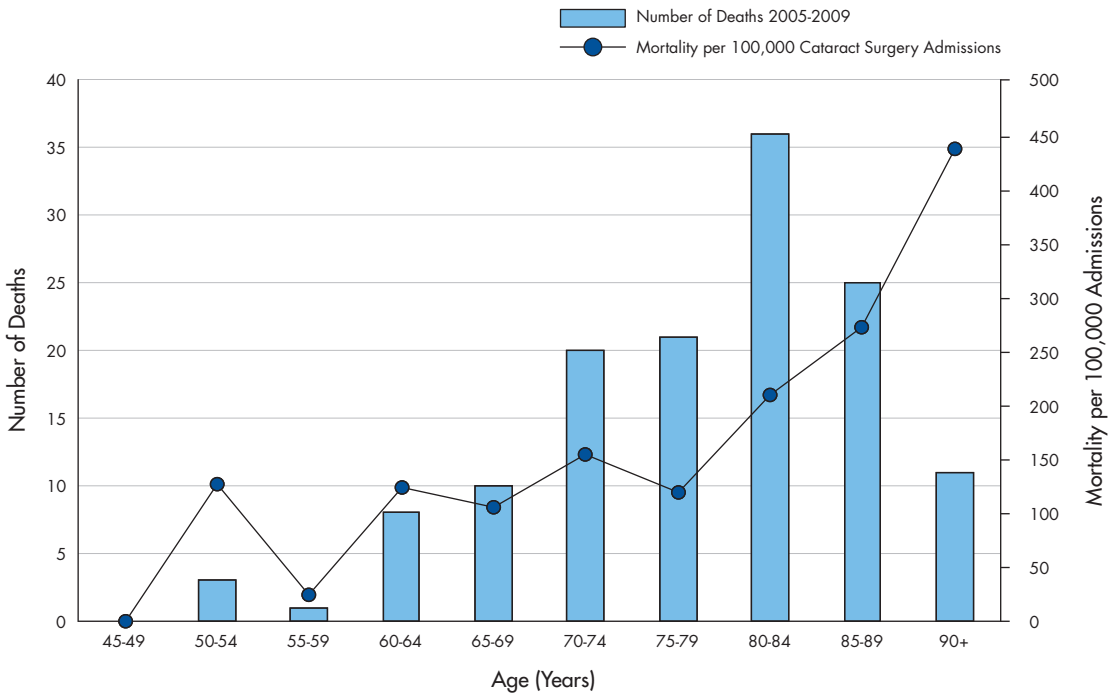
Numerator: National Mortality Collection: Deaths occurring within 30 days of elective/waiting list cataract surgery, as recorded in the NMDS.

Figure 32. Mortality Following Elective/Waiting List Admission for Cataract Surgery by Day from Procedure in Adults 45+ Years, New Zealand 2005-2009



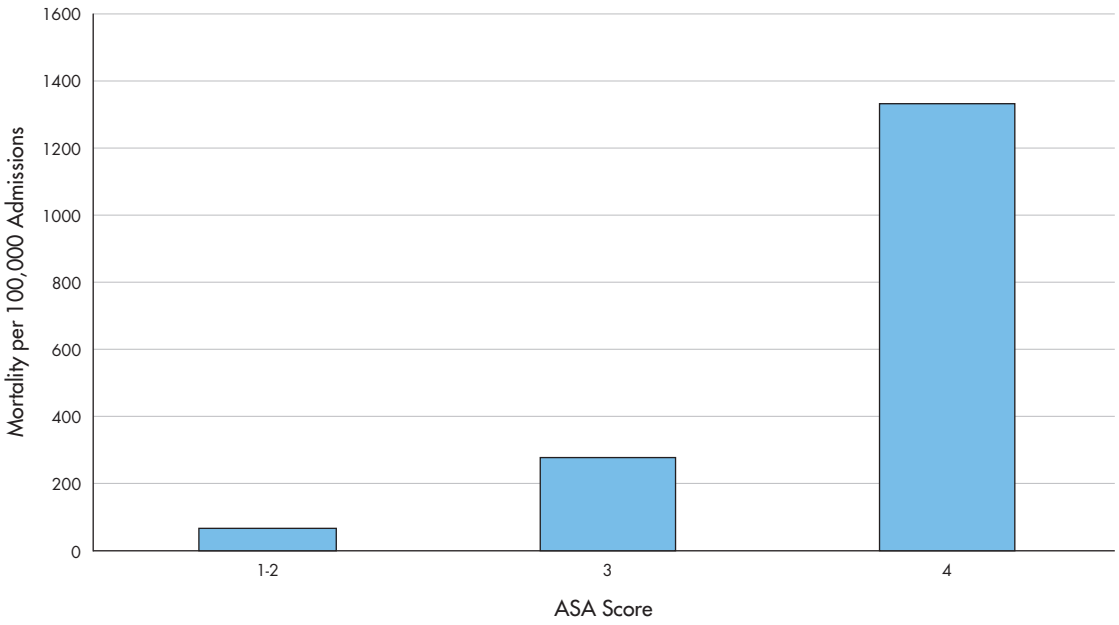
Numerator: National Mortality Collection: Deaths occurring within 30 days of elective/waiting list cataract surgery, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with cataract surgery listed in any of the first 90 procedures.

Figure 33. Mortality Following Elective/Waiting List Admission for Cataract Surgery by Age in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of elective/waiting list cataract surgery, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with cataract surgery listed in any of the first 90 procedures.

Figure 34. Mortality Following Elective/Waiting List Admission for Cataract Surgery by ASA Score in Adults 45+ Years, New Zealand 2005-2009



Numerator: National Mortality Collection: Deaths occurring within 30 days of elective/waiting list cataract surgery, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with cataract surgery listed in any of the first 90 procedures.

Mortality following cataract surgery by day from procedure

In New Zealand during 2005-2009, mortality following cataract surgery was reasonably evenly distributed by day, in the first 30 days post-surgery, with a number of deaths continuing to occur 20+ days following the initial procedure. Cumulative 30-day mortality was 161.7 per 100,000 procedures, or 0.2 percent (Figure 32).

Mortality following cataract surgery by age

In New Zealand during 2005-2009, mortality rates following an elective/waiting list admission for cataract surgery increased with increasing age, with the highest rates being seen in those 90+ years. In absolute terms however, the largest number of deaths occurred in those 80-84 years of age (Figure 33).

Mortality following cataract surgery by ASA score

In New Zealand during 2005-2009, mortality rates following an elective/waiting list admission for cataract surgery increased with increasing ASA Score, with the highest rates being seen in those with an ASA Score of 4. In absolute terms however, the highest number of deaths occurred in those with an ASA Score of 3. Very few (n=3) patients were admitted on an elective basis with an ASA Score of 5, making mortality risk in this category difficult to assess (given that an ASA Score of 5 is assigned to moribund patients who are not expected to survive longer than 24 hours without surgical intervention, the paucity of elective admissions with an ASA Score of 5 would seem clinically appropriate) (Figure 34).

Mortality following cataract surgery by socio-demographic factors and ASA score

In New Zealand during 2005-2009, mortality following an elective/waiting list admission for cataract surgery was significantly higher for males, those 80+ years (vs. those 45-64 years) and those with ASA Score of 3 or 4 (vs. those with ASA Score of 1-2). These differences persisted, even when the risk was adjusted for the other socio-demographic factors and ASA Score (ie, age, gender, ethnicity, NZDep deprivation and ASA Score). There were no significant ethnic or socio-economic differences in mortality for those undergoing elective cataract surgery (Table 21).

Table 21. Mortality Following Elective/Waiting List Admission for Cataract Surgery by Age Group, Gender, ASA Score, Ethnicity and NZDep Decile in Adults 45+ Years, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
Cataract Surgery									
Elective/Waiting List									
Age Group	45-64 years	12	14,385	83.4	0.08	1.00		1.00	
	65-79 years	51	40,132	127.1	0.13	1.52	0.81 - 2.86	1.87	0.94 - 3.74
	80+ years	72	28,975	248.5	0.25	2.98*	1.62 - 5.50	3.77*	1.88 - 7.57
Gender	Male	69	33,829	204.0	0.20	1.00		1.00	
	Female	66	49,663	132.9	0.13	0.65*	0.46 - 0.91	0.66*	0.47 - 0.92
ASA Score	1-2	12	16,660	72.0	0.07	1.00		1.00	
	3	28	9,305	300.9	0.30	4.19*	2.13 - 8.24	3.52*	1.78 - 6.93
	4	8	559	1,431.1	1.43	20.1*	8.20 - 49.5	16.6*	6.75 - 41.0
	5	0	3	-	-	-	-	-	-
	Not Stated	87	56,965	152.7	0.15	2.12*	1.16 - 3.88	1.99*	1.08 - 3.64
Ethnicity	European	109	62,482	174.5	0.17	1.00		1.00	
	Māori	13	5,765	225.5	0.23	1.29	0.73 - 2.30	1.77	0.95 - 3.29
	Pacific	6	4,349	138.0	0.14	0.79	0.35 - 1.80	1.20	0.51 - 2.86
	Asian/ MELAA/ Other	4	6,113	65.4	0.07	0.38	0.14 - 1.02	0.52	0.19 - 1.41
NZ Deprivation Index Decile	Decile 1-2	15	12,156	123.4	0.12	1.00		1.00	
	Decile 3-4	18	14,098	127.7	0.13	1.04	0.52 - 2.05	1.03	0.51 - 2.08
	Decile 5-6	34	17,391	195.5	0.20	1.59	0.86 - 2.91	1.49	0.80 - 2.79
	Decile 7-8	39	20,461	190.6	0.19	1.55	0.85 - 2.80	1.42	0.77 - 2.63
	Decile 9-10	29	19,240	150.7	0.15	1.22	0.66 - 2.28	1.14	0.59 - 2.21

Numerator: National Mortality Collection: Deaths occurring within 30 days of elective/waiting list cataract surgery, as recorded in the NMDS.
Denominator: NMDS Elective/waiting list admissions with cataract surgery listed in any of the first 90 procedures.
* significantly different from reference category. MELAA: Middle Eastern/Latin American/African.

General anaesthesia

The following section uses information from the NMDS and the NMC, to review hospital admissions where one or more general anaesthetic was performed, as well as same and next day mortality following a general anaesthetic.

Data source and methods

Definition

1. Hospital Admissions Where One or More General Anaesthetic Was Performed
2. Same Day (Day 0) or Next Day (Day 1) Mortality Following a General Anaesthetic

Data Sources

Hospital Admissions with One or More General Anaesthetic

Numerator: NMDS: All hospital admissions with a General Anaesthetic (ICD-10-AM ACHI 92514XX) listed in any of the first 90 procedure codes.

Denominator: Statistics New Zealand Estimated Resident Population.

Same or Next Day Mortality Following a General Anaesthetic

Numerator: NMC: All those who died on the same day (Day 0) or the day following (Day 1) a General Anaesthetic (GA as recorded in the NMDS).

Denominator: NMDS: All hospital admissions with a General Anaesthetic (ICD-10-AM ACHI 92514XX) listed in any of the first 90 procedure codes.

Notes on Interpretation

Multiple Anaesthetics Within an Admission, Re-admissions and the Unit of Analysis: While in the majority of cases only one general anaesthetic was performed per hospital admission, in 2.38 percent of admissions, two or more general anaesthetics were performed, with the maximum number of general anaesthetics performed during any one admission being 41. Further, in a number of cases, two or more anaesthetics were performed within a day of the death, resulting in both anaesthetic events being eligible for inclusion in the numerator. Finally in a number of cases, two separate hospital admission events occurred within a day of each other, with both admission events including a general anaesthetic which occurred within a day of the death. As a result of these complexities, mortality rates in the section which follow have been calculated per 100,000 admission events where one or more anaesthetics were performed, rather than per 100,000 anaesthetics (ie, the denominator is the number of admission events rather than the number of anaesthetics). Where two eligible admissions occurred within a day of the death, both admission events have been counted in the denominator (number of hospital admissions) but the death has only been counted once, in the most recent admission event prior to the death.

ASA and Emergency Suffixes: All ICD-10-AM ACHI anaesthesia codes require a two character extension, with the first digit indicating the American Society of Anaesthesiologist's (ASA) 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
Emergency	Modifier Description
0	Procedure being performed as an emergency
9	Non-emergency or not known

Unless otherwise specified, the ASA Score referred to throughout this report, is the ASA Score 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 Score reflects most closely, the ASA Score of the patient at the time of admission. However, in Table 26 the ASA Score and Emergency status of the last listed anaesthesia code has been used, in order to better reflect the factors associated with the last anaesthetic prior to death (with the order of procedure codes again being determined by the diagnosis sequence in the NMDS).

Acute, Arranged (Semi-Acute) and Waiting List Admissions: The NMDS defines an acute admission as an unplanned admission occurring on the day of presentation, while an arranged admission is a non-acute admission with an admission date less than seven days after the date the decision was made by the specialist that the admission was necessary. Similarly waiting list admissions arise when the planned admission date is seven or more days after the date the decision was made that the admission was necessary. These definitions are inconsistently used by private hospitals uploading their data to the NMDS however, with a significant proportion of private hospital admissions being coded as arranged when in reality they meet the criteria for a waiting list admission as outlined above. As a result, in the sections which follow, all arranged private hospital cases have been included in the elective/waiting list category, while arranged admissions occurring in public hospitals have been included in the public hospital semi-acute admission category. Thus unless otherwise specified, acute and elective/waiting list admission include both public and private cases, while semi-acute admissions are confined to public hospital cases only.

Privately Funded 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 are publicly funded maternity events. As NMDS reporting is not legally mandated for New Zealand healthcare 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 is unable to provide any estimate of the extent to which the NMDS undercounts private surgical or procedural day-stay or outpatient hospitals, facilities or in-room events, although it notes that the data most likely to be missing are privately funded or ACC funded events, or publicly funded long-stay geriatric cases. Thus in the section which follows, it must be remembered that the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

Hospital admissions with one or more general anaesthetic

Admissions with one or more general anaesthetic by admission type

In New Zealand during 2005-2009, 24.0 percent of hospital admissions with one or more general anaesthetic were acute events, 7.9 percent were semi-acute (occurring within seven days of referral), and 68.0 percent were drawn from the waiting list (Table 22).

Table 22. Hospital Admissions with One or More General Anaesthetic by Admission Type, New Zealand 2005-2009

ADMISSION TYPE	Total admission events 2005-2009	Annual average	Percent of admissions (%)
One or More General Anaesthetic			
Acute	280,048	56,010	24.0
Public Hospital Semi-Acute	92,102	18,420	7.9
Elective/Waiting List	792,614	158,523	68.0
Total Admissions	1,164,764	232,953	100.0

Numerator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.

Admissions with one or more general anaesthetic by age and admission type

In New Zealand during 2005-2009, acute admissions with one or more general anaesthetic decreased during middle to late childhood, before increasing amongst those in their late teens and twenties. Rates then declined, reaching their lowest point in those 50-54 years, before increasing again to reach their highest level in those aged 90+ years. Similarly, elective/waiting list admission rates in children and young people were highest for those 0-4 years, with rates then declining during childhood to reach their lowest point at 10-14 years of age. Rates then increased again, reaching their highest point in those 70-74 years, before declining again, after 75 years of age (Figure 35).

Admissions with one or more general anaesthetic by age, admission type and gender

In New Zealand during 2005-2009, acute hospital admissions with one or more general anaesthetic in males decreased during childhood, with rates reaching their lowest point at 5-9 years, before increasing again to a small peak in the late teens and early twenties. Rates then declined again, reaching their lowest point in those in their 40s and 50s, before increasing again to reach their highest point in those 90+ years. While similar patterns were seen for females, the initial peak was shifted to the right, with higher rates being seen in women in their 20s and 30s, and then again after 60 years of age. Elective/waiting list admission rates in children and young people were highest in those 0-4 years, with rates in both genders then declining to a nadir at 10-14 years of age. Rates then increased, to a peak at 70-74 years, and then declined again, with admission rates being higher for women than men during their 20s-40s and higher for men than women after 65 years of age (Figure 36).

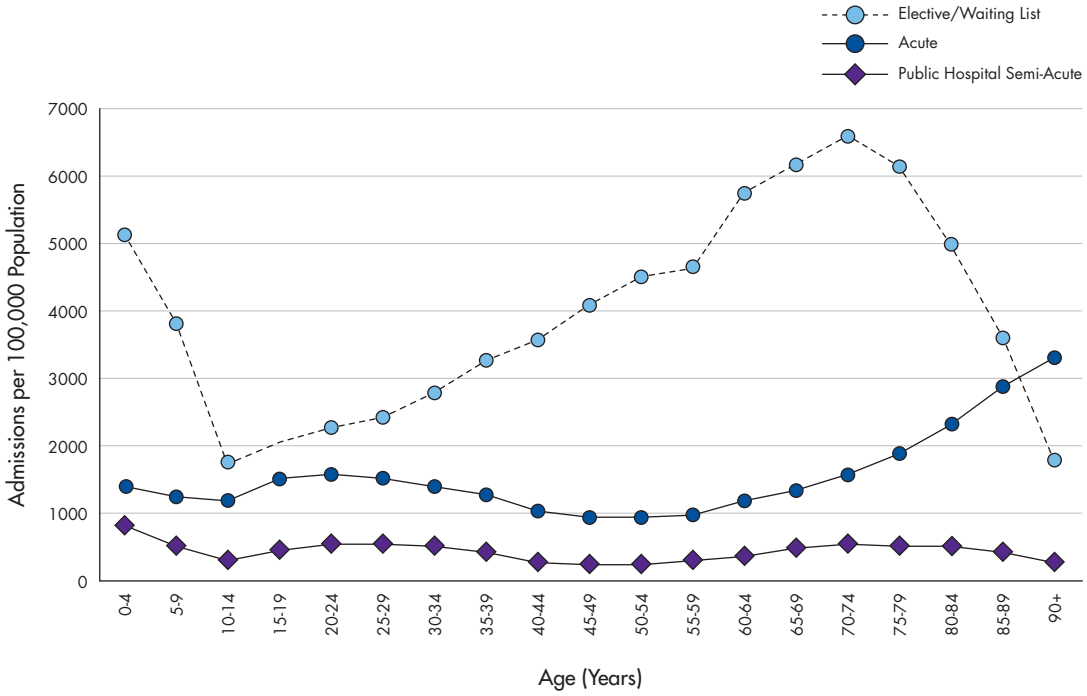
Admissions with one or more general anaesthetic by age, admission type and ethnicity

In New Zealand during 2005-2009, acute hospital admissions with one or more general anaesthetic were generally higher for Māori and Pacific peoples than for European and Asian peoples up until 70 years of age. After this age ethnic differences became less consistent. Elective/waiting list admissions with one or more general anaesthetic were higher for European than for Māori, Pacific and Asian peoples from 15 years of age onwards, with rates also being higher for European children than for Māori, Pacific and Asian children aged 0-4 years (Figure 37).

Admissions with one or more general anaesthetic by age, admission type and NZDep index decile

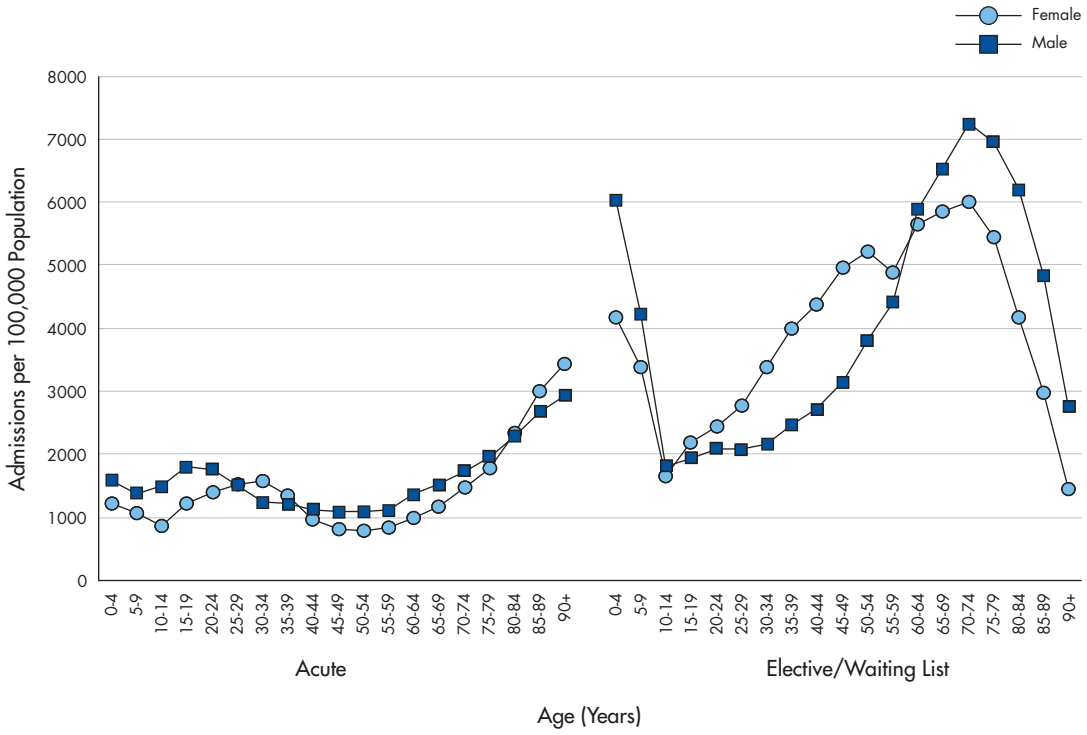
In New Zealand during 2005-2009, acute hospital admissions with one or more general anaesthetic were higher for those living in more deprived (NZDep decile 9-10) areas than for those living in average or less deprived (NZDep deciles 5-6 and 1-2) at all ages, although socioeconomic differences amongst those in their 80s were less marked than at other ages. Socio-economic differences in elective/waiting list admissions with one or more general anaesthetic were not as marked, although amongst those in their 40s to 60s, admission rates were generally lower for those living in the least deprived (NZDep decile 1-2) areas (Figure 38).

Figure 35. Hospital Admissions with One or More General Anaesthetic by Age and Admission Type, New Zealand 2005-2009



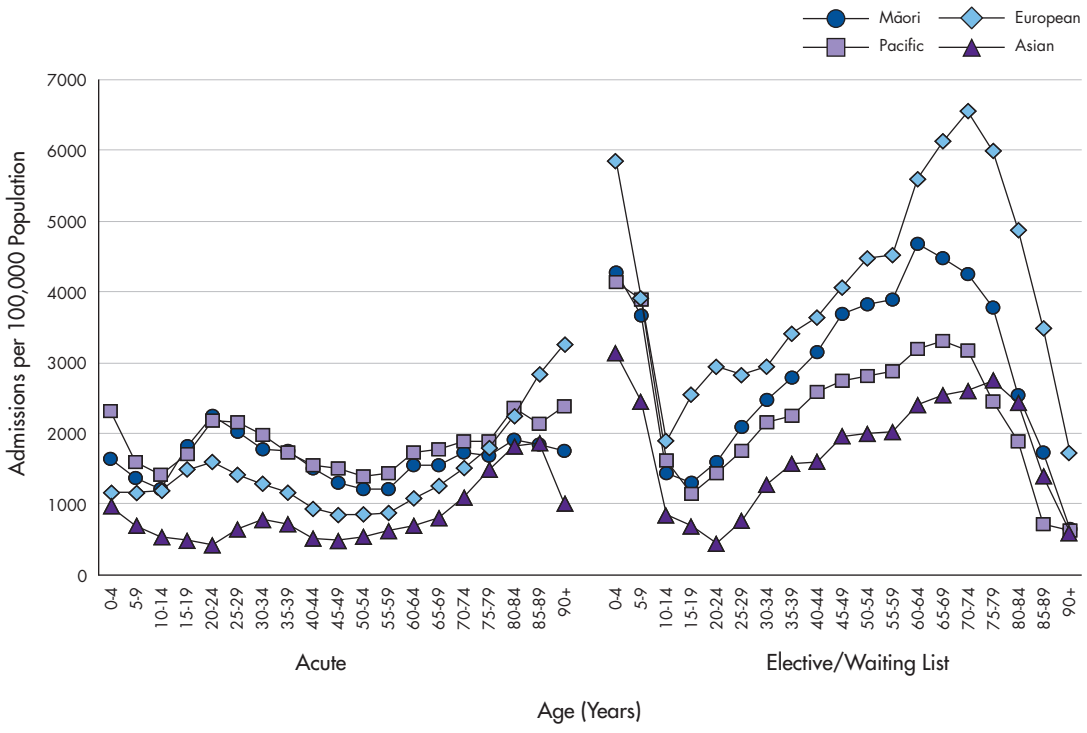
Numerator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Figure 36. Hospital Admissions with One or More General Anaesthetic by Age, Admission Type and Gender, New Zealand 2005-2009



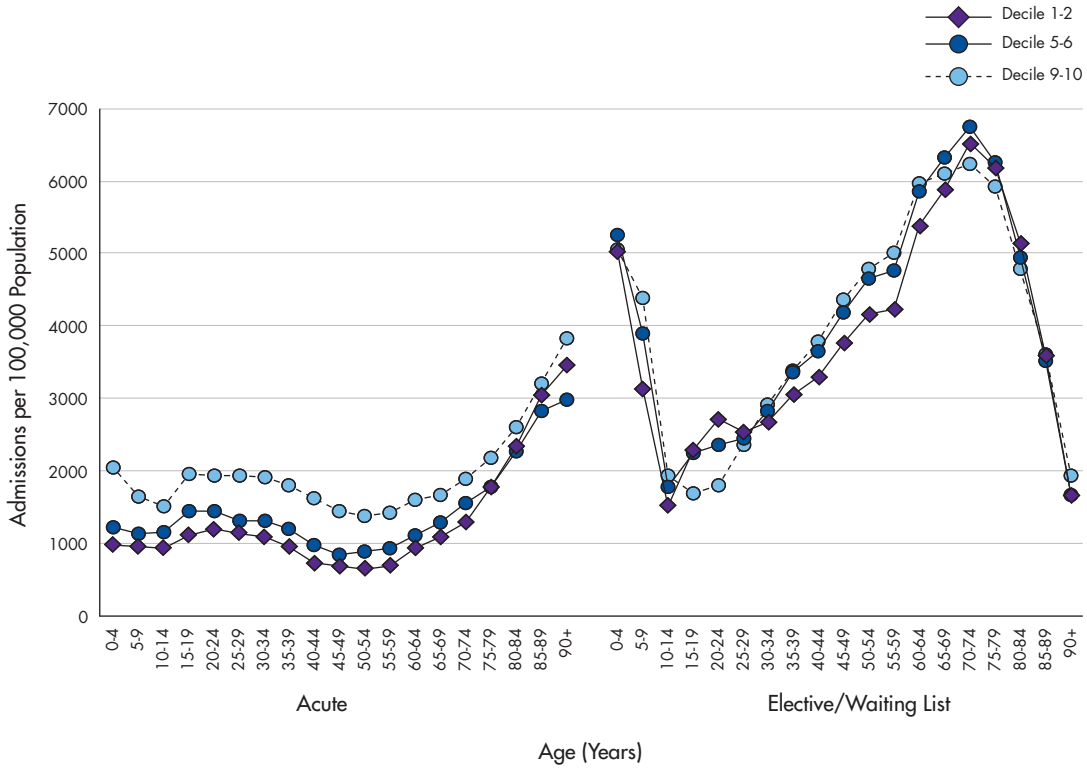
Numerator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population.

Figure 37. Hospital Admissions with One or More General Anaesthetic by Age, Admission Type and Ethnicity, New Zealand 2005-2009



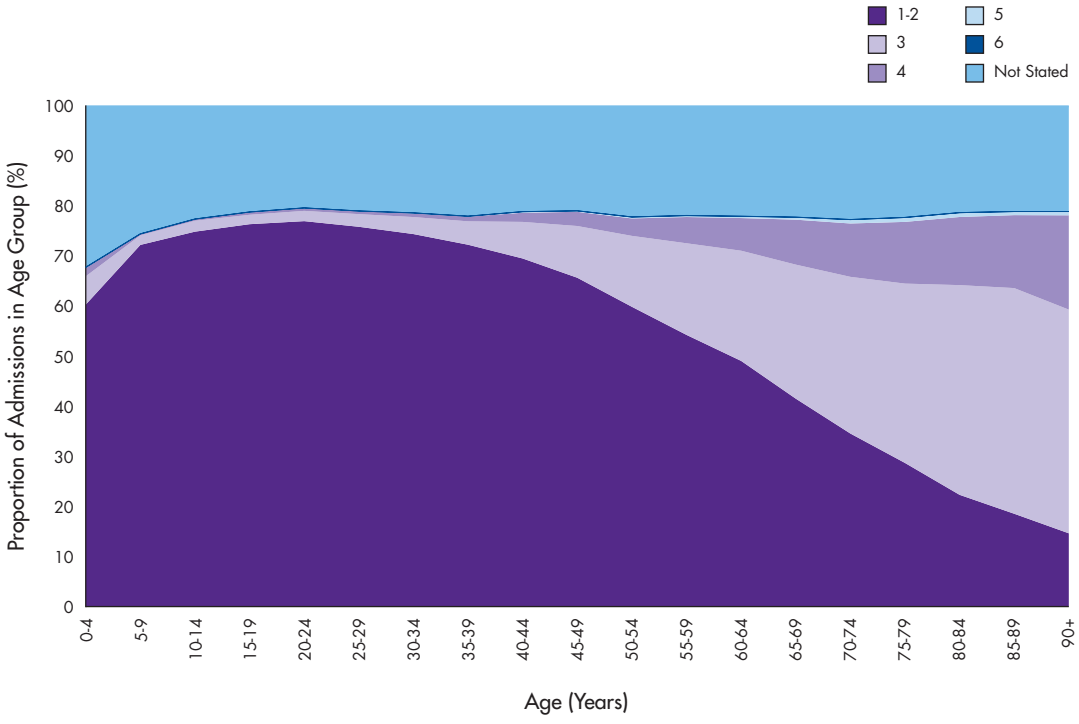
Numerator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Ethnicity is Level 1 Prioritised.

Figure 38. Acute Hospital Admissions with One or More General Anaesthetic by Age, Admission Type and NZ Deprivation Index Decile, New Zealand 2005-2009



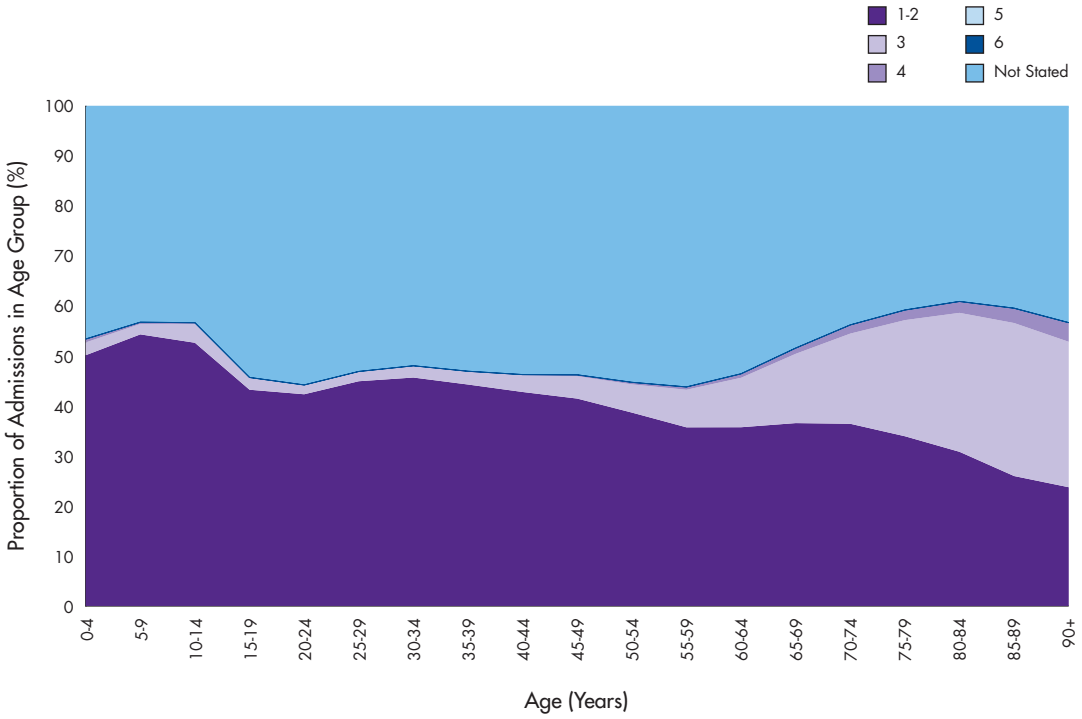
Numerator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.
Denominator: Statistics NZ Estimated Resident Population. Decile is NZDep2001.

Figure 39. Proportion of Acute Hospital Admissions with One or More General Anaesthetic by Age and ASA Score, New Zealand 2005-2009



Numerator: NMDS acute admissions with one or more general anaesthetic listed in any of the first 90 procedures. ASA Score is first listed ASA Score per admission.

Figure 40. Proportion of Elective/Waiting List Admissions with One or More General Anaesthetic by Age and ASA Score, New Zealand 2005-2009



Numerator: NMDS elective/waiting list admissions with one or more general anaesthetic listed in any of the first 90 procedures.
ASA Score is first listed ASA Score per admission.

Proportion of admissions with one or more general anaesthetic by age and ASA score

In New Zealand during 2005-2009, the proportion of acute hospital admissions with one or more general anaesthetic, where the first documented ASA Score was 3 or higher increased progressively after 40 years of age, with 44.7 percent of those aged 90+ years having an ASA Score of 3, and 18.8 percent an ASA Score of 4. The proportion of admissions where the ASA Score was not stated however, was at least 20 percent in all age groups (Figure 39). While similar patterns were seen for elective/waiting list admissions, the proportion of admissions with an ASA Score of 4 was less than for acute admissions. In addition, the ASA Score was not documented in at least 40 percent of cases, across all age groups, making precise interpretation of this data difficult (Figure 40).

Same/next day mortality following one or more general anaesthetic

Mortality following one or more general anaesthetic by cause of death

In New Zealand during 2005-2009, for all admission types, myocardial infarctions and other forms of ischaemic heart and cardiovascular disease were the most frequently listed main underlying causes of death for those dying within a day of a general anaesthetic. Cancers and gastrointestinal conditions also featured prominently (Table 23).

Mortality following one or more general anaesthetic by age

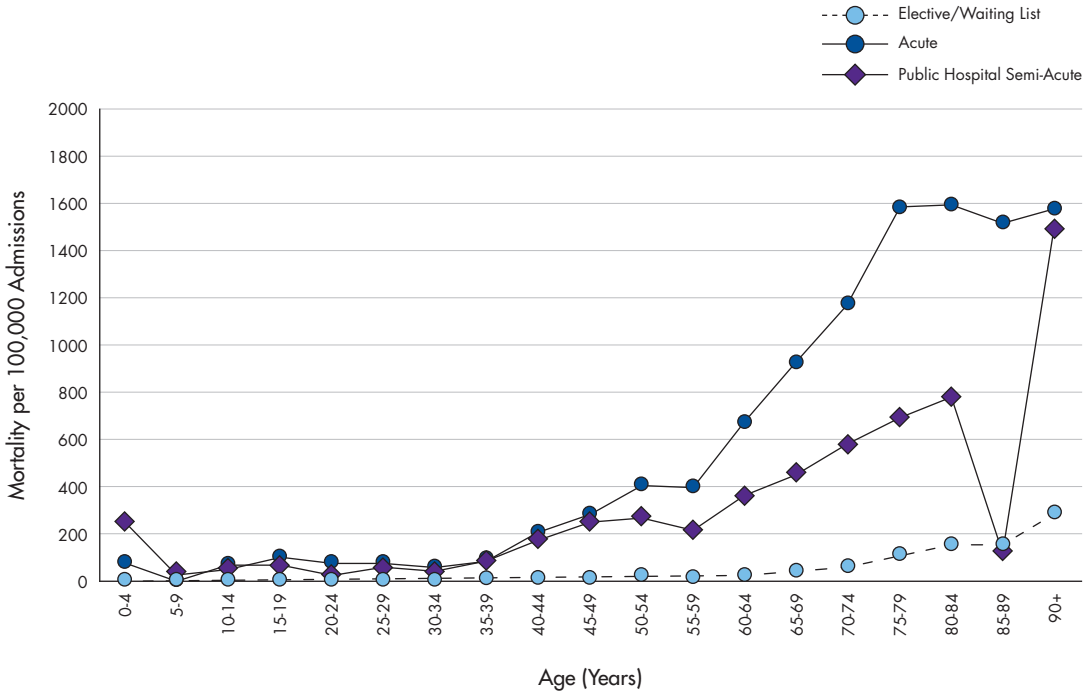
In New Zealand during 2005-2009, same or next day mortality following a general anaesthetic increased with increasing age for all admission types, although a small peak in mortality was also evident in those 0-4 years of age. At each age group, mortality was higher following an acute admission than for those admitted electively/from the waiting list (Figure 41).

Table 23. Same or Next Day Mortality Following Hospital Admissions with One or More General Anaesthetic by Admission Type and Main Underlying Cause of Death, New Zealand 2005-2009

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2005-2009	Annual average	Percent of Deaths in Category (%)
One or More General Anaesthetic			
Acute			
Myocardial Infarction	102	20.4	9.66
Other Ischaemic Heart Disease	73	14.6	6.91
Other Cardiovascular Causes	293	58.6	27.7
Non-Insulin Dependent Diabetes	18	3.6	1.70
Cancers	112	22.4	10.6
Emphysema and COPD	10	2.0	0.95
Other Respiratory Diseases	10	2.0	0.95
Gastrointestinal Conditions	164	32.8	15.5
Falls	52	10.4	4.92
Other Injuries/External Causes	108	21.6	10.2
Other Causes	114	22.8	10.8
Total Acute	1,056	211.2	100.0
Public Hospital Semi-Acute			
Myocardial Infarction	16	3.2	10.4
Other Ischaemic Heart Disease	16	3.2	10.4
Other Cardiovascular Causes	57	11.4	37.0
Cancers	10	2.0	6.49
Respiratory Diseases	3	0.6	1.95
Gastrointestinal Conditions	10	2.0	6.49
Falls	4	0.8	2.60
Other Injuries/External Causes	14	2.8	9.09
Other Causes	24	4.8	15.6
Total Public Hospital Semi-Acute	154	30.8	100.0
Elective/Waiting List			
Myocardial Infarction	20	4.0	11.3
Other Ischaemic Heart Disease	24	4.8	13.6
Other Cardiovascular Causes	46	9.2	26.0
Cancers	48	9.6	27.1
Gastrointestinal Conditions	11	2.2	6.21
Other Causes	28	5.6	15.8
Total Elective/Waiting List	177	35.4	100.0
Grand Total	1,387	277.4	100.0

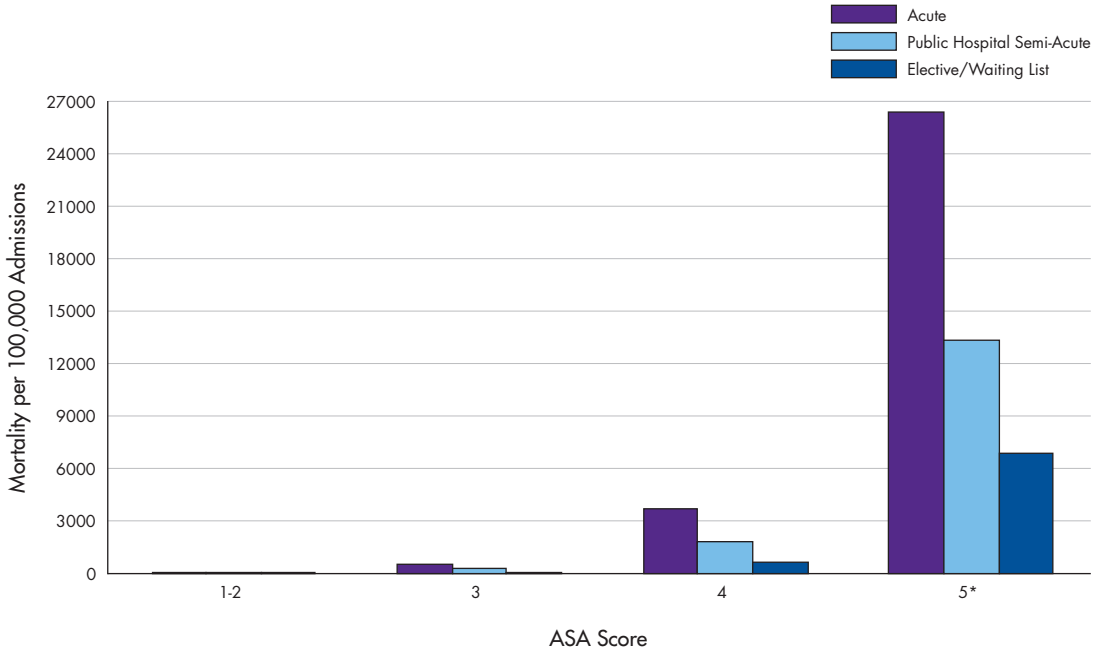
Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic (as recorded in the NMDS).

Figure 41. Same or Next Day Mortality Following Hospital Admissions with One or More General Anaesthetic by Age and Admission Type, New Zealand 2005-2009



Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.
Denominator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.

Figure 42. Same or Next Day Mortality Following Hospital Admissions with One or More General Anaesthetic by Admission Type and ASA Score, New Zealand 2005-2009



Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.
Denominator: NMDS Hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures. ASA Score is first listed ASA Score per admission.
*Caution: Elective ASA 5 deaths based on sample size <3, so care should be taken when interpreting this rate.

Mortality following one or more general anaesthetic by ASA score

In New Zealand during 2005-2009, same or next day mortality following a general anaesthetic increased with increasing ASA Score for all admission types, although at each ASA Score, mortality was higher following an acute admission, than for those admitted electively/from the waiting list (Caution: Elective ASA 5 deaths based on n <3 so care should be taken when interpreting this rate) (Figure 42).

Mortality following one or more general anaesthetic by socio-demographic factors, number of anaesthetics and ASA score

Acute Admissions: In New Zealand during 2005-2009, same or next day mortality following an acute hospital admission with one or more general anaesthetic was significantly higher for those 65-79 and 80+ years (vs. 45-64 years), those with an ASA Score of 3, 4 or 5 (vs. ASA Score 1-2), those with more than one anaesthetic during the admission, and those living in the most deprived (NZDep decile 9-10 vs. decile 1-2) areas. Mortality was significantly lower for those aged 0-24 and 25-44 years (vs. 45-64 years). These differences persisted, even when the risk was adjusted for the other socio-demographic and clinical factors in the multivariate model. While at the univariate level, mortality was significantly lower for Māori and Pacific peoples than for European peoples, once the risk was adjusted for other socio-demographic and clinical factors, differences for Pacific peoples failed to reach statistical significance, while the risk of mortality for Māori became significantly higher than for European peoples (as did the risk for Asian/MELAA peoples) (Table 24).

Elective/Waiting List Admissions: In New Zealand during 2005-2009, same or next day mortality following an elective/waiting list admission with one or more general anaesthetic was significantly higher for those 65-79 and 80+ years (vs. 45-64 years), those with an ASA Score of 3 or 4 (vs. ASA Score 1-2), those with more than one anaesthetic during the admission, and those living in more deprived (NZDep decile 7-10 vs. decile 1-2) areas. Mortality was significantly lower for those aged 0-24 and 25-44 years (vs. 45-64 years). These differences persisted, even when the risk was adjusted for the other socio-demographic and clinical factors in the multivariate model. Ethnic differences in mortality risk however, did not reach statistical significance (Table 25).

Last ASA Score and Emergency Status for All Admissions Combined: In New Zealand during 2005-2009, when the emergency status and ASA Score of the last listed general anaesthetic was considered, same or next day mortality following any admission with one or more general anaesthetic was significantly higher for those with an ASA Score of 3, 4 or 5 (vs. ASA Score 1-2), those with more than one anaesthetic, and those procedures that were undertaken as an emergency. While the magnitude of these risks reduced in the multivariate model (ie, when each of these factors was adjusted for the other), the risk of mortality still remained significantly elevated for each of these categories (Table 26).

Table 24. Same Day or Next Day Mortality Following Acute Admissions with One or More General Anaesthetic by Age Group, Gender, Number of Anaesthetics, ASA Score, Ethnicity and NZDep Decile, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
One or More General Anaesthetic									
Acute									
Age Group	0-24 Years	107	104,299	102.6	0.10	0.24*	0.19 - 0.30	0.40*	0.31 - 0.52
	25-44 Years	82	76,911	106.6	0.11	0.25*	0.19 - 0.32	0.41*	0.31 - 0.53
	45-64 Years	219	50,883	430.4	0.43	1.00		1.00	
	65-79 Years	367	30,052	1,221.2	1.22	2.86*	2.42 - 3.38	1.81*	1.51 - 2.17
	80+ Years	281	17,903	1,569.6	1.57	3.69*	3.09 - 4.41	2.08*	1.70 - 2.55
Gender	Male	570	148,213	384.6	0.38	1.00		1.00	
	Female	486	131,835	368.6	0.37	0.96	0.85 - 1.08	0.99	0.87 - 1.12
Number of Anaesthetics	1	852	260,614	326.9	0.33	1.00		1.00	
	2+	204	19,434	1,049.7	1.05	3.24*	2.78 - 3.77	1.81*	1.53 - 2.14
First ASA Score	1-2	45	176,229	25.5	0.03	1.00		1.00	
	3	162	31,819	509.1	0.51	20.0*	14.4 - 27.9	9.27*	6.52 - 13.2
	4	360	9,820	3,666.0	3.67	148.8*	109.1 - 203.0	63.0*	45.1 - 88.1
	5	176	666	26,426.4	26.43	>999.9*		651.8*	453.9 - 936.1
	Not Stated	307	61,498	499.2	0.50	19.6*	14.4 - 26.8	16.4*	11.9 - 22.7
Ethnicity	European	737	180,076	409.3	0.41	1.00		1.00	
	Māori	156	50,825	306.9	0.31	0.75*	0.63 - 0.89	1.35*	1.10 - 1.64
	Pacific	61	23,502	259.6	0.26	0.63*	0.49 - 0.82	1.11	0.83 - 1.48
	Asian/ MELAA/ Other	69	21,023	328.2	0.33	0.80	0.63 - 1.03	1.32*	1.01 - 1.72
NZ Deprivation Index Decile	Decile 1-2	122	40,190	303.6	0.30	1.00		1.00	
	Decile 3-4	162	44,190	366.6	0.37	1.21	0.96 - 1.53	1.15	0.90 - 1.47
	Decile 5-6	195	51,939	375.4	0.38	1.24	0.99 - 1.55	1.16	0.91 - 1.47
	Decile 7-8	251	62,566	401.2	0.40	1.32*	1.07 - 1.64	1.20	0.95 - 1.51
	Decile 9-10	309	77,778	397.3	0.40	1.31*	1.06 - 1.62	1.43*	1.14 - 1.80

Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.
Denominator: NMDS Acute hospital admissions with one or more general anaesthetic listed in any of the first 90 procedures.
ASA Score is first listed ASA Score per admission.
* significantly different from reference category. MELAA: Middle Eastern/Latin American/African.

Table 25. Same or Next Day Mortality Following Elective/Waiting List Admissions with One or More General Anaesthetic by Age Group, Gender, Number of Anaesthetics, ASA Score, Ethnicity and NZ Deprivation Index Decile, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
One or More General Anaesthetic									
Elective/Waiting List									
Age Group	0-24 Years	3	222,889	1.4	0.00	0.09*	0.03-0.29	0.11*	0.03 - 0.36
	25-44 Years	10	181,339	5.5	0.01	0.37*	0.18-0.74	0.47*	0.22 - 0.98
	45-64 Years	36	238,752	15.1	0.02	1.00		1.00	
	65-79 Years	82	121,485	67.5	0.07	4.48*	3.03-6.63	3.24*	2.13 - 4.94
	80+ Years	46	28,149	163.4	0.16	10.9*	7.02-16.8	6.72*	4.15 - 10.9
Gender	Male	101	370,823	27.2	0.03	1.00		1.00	
	Female	76	421,789	18.0	0.02	0.66*	0.49 - 0.89	0.92	0.68 - 1.26
Number of Anaesthetics	1	90	787,176	11.4	0.01	1.00		1.00	
	2+	87	5,438	1,599.9	1.60	142.2*	105.8 - 191.2	54.9*	39.3 - 76.6
First ASA Score	1-2	28	332,999	8.4	0.01	1.00		1.00	
	3	64	55,943	114.4	0.11	13.6*	8.74 - 21.2	3.51*	2.20 - 5.62
	4	31	4,934	628.3	0.63	75.2*	45.1 - 125.4	12.9*	7.41 - 22.5
	5	<3	29	s	s	s	s	s	s
	Not Stated	52	398,698	13.0	0.01	1.55	0.98 - 2.46	2.20*	1.37 - 3.54
Ethnicity	European	134	582,771	23.0	0.02	1.00		1.00	
	Māori	20	89,622	22.3	0.02	0.97	0.61 - 1.55	1.50	0.90 - 2.51
	Pacific	10	32,600	30.7	0.03	1.34	0.70 - 2.54	1.99	0.98 - 4.01
	Asian/ MELAA/ Other	9	47,415	19.0	0.02	0.83	0.42 - 1.62	1.47	0.74 - 2.94
NZ Deprivation Index Decile	Decile 1-2	18	146,303	12.3	0.01	1.00		1.00	
	Decile 3-4	27	148,213	18.2	0.02	1.48	0.82 - 2.69	1.43	0.76 - 2.67
	Decile 5-6	25	162,376	15.4	0.02	1.25	0.68 - 2.29	1.15	0.61 - 2.16
	Decile 7-8	54	174,462	31.0	0.03	2.52*	1.48 - 4.29	1.94*	1.10 - 3.43
	Decile 9-10	53	158,900	33.4	0.03	2.71*	1.59 - 4.63	2.10*	1.17 - 3.78

Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.
Denominator: NMDS Elective/Waiting List admissions with one or more general anaesthetic listed in any of the first 90 procedures.
ASA Score is first listed ASA Score per admission.
* significantly different from reference category; s = cells suppressed due to small numbers. MELAA: Middle Eastern/Latin American/African.

Table 26. Same or Next Day Mortality Following Hospital Admissions with One or More General Anaesthetic by Age Group, Gender, Number of Anaesthetics, Last Documented ASA Score and Emergency Status, New Zealand 2005-2009

VARIABLE	CATEGORY	Number of Deaths	Number of Admissions	Mortality per 100,000 Admissions	Mortality per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
One or More General Anaesthetic									
Acute, Publicly Funded Semi-Acute and Elective/Waiting List Combined									
Age Group	0-24 Years	129	366,308	35.2	0.04	0.36*	0.30-0.45	0.58*	0.47-0.72
	25-44 Years	113	284,211	39.8	0.04	0.41*	0.33-0.51	0.58*	0.46-0.72
	45-64 Years	294	303,920	96.7	0.10	1.00		1.00	
	65-79 Years	504	161,307	312.5	0.31	3.24*	2.80-3.74	1.94*	1.66-2.26
	80+ Years	347	49,067	707.2	0.71	7.36*	6.30-8.59	2.86*	2.40-3.39
Gender	Male	750	556,033	134.9	0.13	1.00		1.00	
	Female	637	608,778	104.6	0.10	0.78*	0.70-0.86	0.93	0.83-1.04
Number of Anaesthetics	1	1042	1,137,055	91.6	0.09	1.00		1.00	
	2+	345	27,758	1,242.9	1.24	13.7*	12.1-15.5	3.44*	2.97-3.98
Last ASA Score	1-2	48	557,488	8.6	0.01	1.00		1.00	
	3	191	97,620	195.7	0.20	22.8*	16.6-31.2	10.7*	7.72-14.8
	4	437	17,187	2,542.6	2.54	302.9*	224.7-408.1	85.3*	62.3-116.6
	5	246	785	31,337.6	31.34	>999.9*		974.5*	693.0->999
	Not Stated	439	491,652	89.3	0.09	10.4*	7.70-14.0	13.6*	10.1-18.5
Emergency Status	Non-Emergency/ Not Stated	682	1,032,114	66.1	0.07	1.00		1.00	
	Emergency Procedure	705	132,699	531.3	0.53	8.08*	7.27-8.98	4.03*	3.46-4.69

Numerator: National Mortality Collection: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.
Denominator: NMDS Acute, publicly funded semi-acute and elective/waiting list admissions with one or more general anaesthetic listed in any of the first 90 procedures.
ASA Score is last listed ASA Score for admission.
* significantly different from reference category. MELAA: Middle Eastern/Latin American/African.

New Zealand's Perioperative Mortality Data and International Comparison

Regional and international comparisons of perioperative mortality

The preceding chapters have demonstrated that existing national data sets can provide a sound basis for collecting and assessing whole of health care system perioperative mortality information. This approach provides important information for patients, health-care professionals and health-care providers. It will be important that benchmarking information can be provided as this work is developed in future years. This would facilitate comparisons between regions and against internationally reported data from other jurisdictions. The Committee intends to look at the best way of analysing and reporting the data in a way that would enable these comparisons.

International benchmarking is not as straightforward as might be expected. There are relatively few international reports that consider mortality across a national system especially in relation to specific surgical procedures. Valid comparisons between countries, regions or hospitals also require methods that adjust for the varying mortality risks that occur at each level with different mixes of illnesses and other characteristics. Major differences also exist between countries with how health services and hospitals are organised and how data are collected.

Contrasting with the lack of national reporting a large number of published reports have examined mortality rates for groups of admissions or specific conditions in order to provide comparisons between hospitals within a region or country.[xx] Some international experience is emerging around the use of risk adjusted hospital mortality ratios to enable comparisons between hospitals.[xx] A number of countries are now using risk adjusted mortality ratios to compare hospitals usually at the local provider level although infrequently in relation to specific surgical procedures.

Hip & knee replacement surgery

Dr Foster's Hospital Guide in the UK provides a rare example of system based information about mortality after hip and knee replacement surgery.[xxi] They report this information using risk adjusted (standardised) mortality ratios at the hospital trust level. Dr Foster Intelligence also provides a national (UK) estimate for hip fracture mortality which at 10% is a bit higher than the 7.3% featured in this report. However, in Dr Fosters' report the mortality rate was based on acute admissions for hip fracture while the estimate in this report is based on acute admissions that underwent a hip replacement which may include people admitted for other reasons aside from fracture. Recent international literature provides other estimates for mortality after hip or hip or knee replacement that suggest a rate of approximately 0.3% in the United States[xxii] and slightly higher in Japan.[xxiii] This report indicates that the elective hip surgery mortality rate in NZ is about 0.24%. On the basis of the information currently available it appears that the NZ perioperative mortality rates included in this report related to hip and knee surgery are comparable or may even be slightly lower that similar international reports.

Colorectal surgery

As with hip and knee replacement surgery there are few whole of system reports available to describe mortality following colorectal surgery. A recent Hong Kong based study provided an estimate of 15% mortality following emergency surgery[xxiv] and a UK based study reported the rate to be 18%. Another report from Denmark[xxv] that looked at data collected from a national database demonstrated significant variation between providers in 30 day mortality following acute colon resection (between 3.5 - 44%). For elective surgery they reported 30 day mortality of 8.4% for colon resections and 6.2% for rectal resection; this compares with the New Zealand mortality rate of just over 2% in this report. Finally a large United States study examined mortality following colorectal surgery at 142 hospitals and reported 30 day elective mortality of 1.9% compared to 15.3% for emergency operations.[xxv] These figures are similar to those presented in this report for elective surgery but somewhat higher than those for emergency surgery. As with the data reported here, the Danish and American studies emphasised the importance of the ASA score in predicting mortality. Once again though there are major differences between countries in their populations and hospitals and considerable variations in how the data have been reported that make comparisons very difficult. However, it appears that for colorectal resection New Zealand postoperative mortality rates are similar to or may even be slightly better than internationally comparable published information.

Cataract surgery

In relation to cataract surgery, there has not been any recently published estimate of perioperative mortality within 30 days of the procedure. However, the results from a number of studies have previously suggested that mortality may be increased when assessed over longer follow up periods than 30 days following the procedure in comparison with the rate for people who have not undergone cataract surgery.[xxvi-xxx] More recently a large study also conducted over a relatively long follow up period conversely reported there was no difference in mortality between those who underwent surgery and the general population.[xxxi] The authors suggested that the elevation in mortality risk observed by the earlier studies may at least in part be because people who had cataracts also had a number of other conditions that were associated with higher mortality risk. The authors attributed any benefits in survival to new techniques in phacoemulsification. Further research is needed to resolve this issue as the recent study by Blundell et al. was based at just one hospital and no comorbidity information was presented.

Conclusion

Major difficulties exist with any attempts to compare perioperative mortality rates between regions. However, based on broadly comparable studies, New Zealand rates appear similar or may even be somewhat lower than those published in other locations. Future work by the Committee will further explore the best methods to undertake regional and international comparisons.

Conclusions

The initial work of the Committee suggests that for New Zealand it should be feasible to establish a whole-of-system approach to the measurement and analysis of perioperative mortality.

For carefully identified procedures the current systems provide a framework for the collection of very significant information describing the quantitative aspects of perioperative mortality. There are, however, a number of deficiencies in the current system that would require correction if we are to successfully build upon the NMDS system as the basis for a national perioperative mortality review methodology.

- Firstly, the entire public and private system would need to return the relevant information.
- Secondly, we would need to establish a clear coding flag that identified this admission as being one of interest to the Committee (ie, a qualifying procedure was performed).
- Thirdly, the system must clearly differentiate between pre-existing conditions and those that resulted in the post-operative death of the patient. For example, whilst a colorectal cancer may have resulted in the admission and ultimate death of a patient following surgery, the fact that the patient developed overwhelming sepsis post-operatively is far more relevant to any system aimed at quality improvement.
- Finally, the existing quantitative data will require supplementation with information gained from qualitative peer review if we are to truly understand the cause of death, its potential for preventability and ultimately to enhance the system.

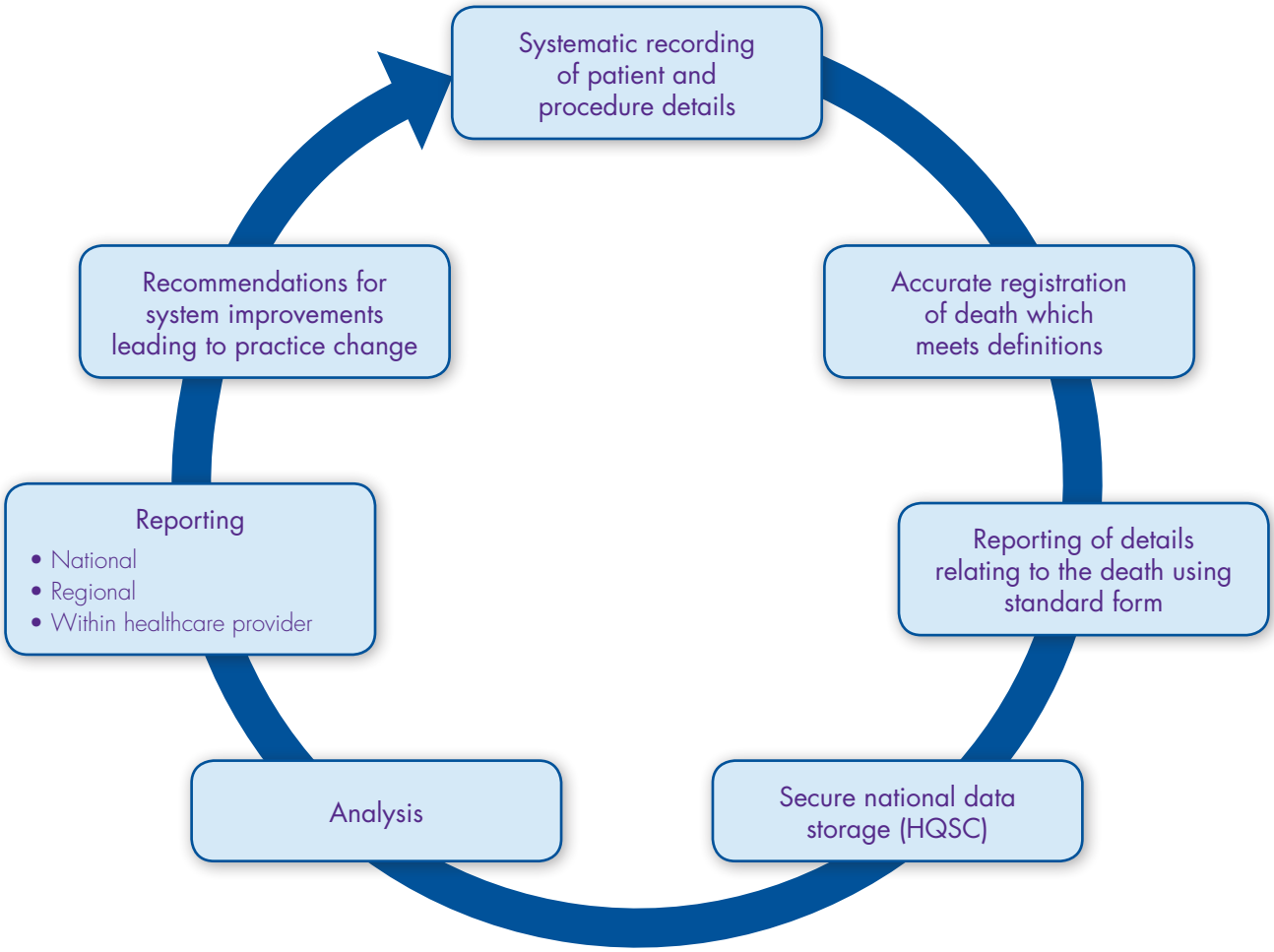
Based upon this analysis and the Committee's considerations of the options available we are strongly of the view that it is possible for New Zealand to develop a whole system approach for the evaluation of perioperative mortality. This system will build upon established systems, enhanced by additional information where appropriate.

The following diagram illustrates the components of the national system that the Committee recommends be established. It is pivotal to our recommendations that this system be seen as an integral component of quality improvement, supporting the work of the Health Quality & Safety Commission.

What do we know?
What don't we know?
Where should we focus our efforts?

POMRC's Quality Improvement Cycle

A national system for understanding and reducing mortality following an operative procedure



Systematic recording of patient and procedure details

The systematic recording of patient and procedure details means more support at the local and regional level for clinicians and coders to accurately record patient and procedure details, building upon the existing resources of the NMDS and mortality collection. Improvements in recording of patient and procedure include a focus on ensuring that an anaesthetic code is assigned to all procedures and cause of death information reflects clinical findings. Systematic recording also means that all healthcare facilities and practitioners are reporting and have the necessary support.

Accurate registration of death which meets definitions

Parallel to this, a flag indicating that a death following a procedure meets the definition of an operative procedure and this information is linked from the coronial system to a national perioperative mortality review system needs to be developed. The flag would also need to include deaths within 30 days of an operative procedure or after 30 days but before discharge from hospital to home or a rehabilitation facility.

Reporting of details relating to the death using a standard form

The development of a form to be completed by clinicians should be implemented to facilitate a national data collection system for perioperative mortality. The Committee views this form as being as pre-populated as possible, reducing workload and minimising the possibility of data entry error. In addition, it is envisaged that this form will be used in all healthcare facilities.

Secure national data storage

Secure national data storage means the ability for a national database to be under the guardianship of Health Quality & Safety Commission that can securely interface with other administrative datasets to capture all necessary perioperative mortality data but without the need to build a completely new database.

Analysis

With the development of a national perioperative mortality review system, the epidemiology of perioperative mortality can be developed alongside the qualitative component (i.e. expert, peer-reviewed opinion). Analysis will be responsive to the needs of New Zealand's health system and focus on improving health quality and safety.

Reporting – national, regional, within healthcare provider

Methodologies for reporting will be developed for analysing and reporting perioperative mortality at national, regional and local levels. National reporting will be the starting point, but provider-specific reporting will follow. Reporting will also include consumers and the wider community.

Recommendations

The Committee therefore recommends:

1. That a whole-of-system perioperative mortality review process is developed which builds on the National Minimum Dataset (NMDS) and National Mortality Collection (NMC). This would include the accurate and systematic recording of patient and procedure details from all healthcare facilities and practitioners. The key components of this system would be:
    a. the enhancement and standardisation of existing data collections and current mortality review processes to ensure a uniform, efficient and meaningful national methodology
    b. a coding mechanism that recognises both procedures and deaths within the remit of this Committee. This will require investigation to determine optimal methodology
    c. the development of a national standardised perioperative mortality review form that will be common to all healthcare facilities and practitioners. This form will enable and facilitate additional data collection and peer review processes
    d. secure national data storage hosted by, and under the guardianship of, the Health Quality & Safety Commission
    e. the ability to carry out whole-of-system and focussed (sub-group) analysis of both qualitative and quantitative data
    f. the ability to report at a number of levels (national, regional, within healthcare facility) and to a variety of audiences, including consumers and the wider community
    g. the ability to generate evidence-based, peer-reviewed recommendations for reinforcing current 'good practice' or system improvements leading to practice change.
2. That a formalised memorandum of understanding between the Committee and Coronial Services to enable enhanced and standardised data access.
3. That the Committee works with the National Health Board to ensure that the NMDS and NMC collections are enhanced and standardised by:
    a. ensuring that an ASA score is recorded for all procedures
    b. identifying existing conditions from those acquired during that admission
    c. ensuring that the immediate cause of death can be identified from the data collections.
4. That submission of data to the NMDS is mandatory for all healthcare facilities.

Future Directions

The Committee intends to consult with a range of stakeholders around its future directions and its contribution to improving the quality and safety of the New Zealand healthcare system.

The Committee is interested in gaining feedback about the type of reporting that would be useful for the sector in future reports. We will use this feedback to inform our work plan for 2012 and onwards as we work to implement a national perioperative mortality review system.

1. As a patient what type of information about risk do you need from your doctor in order to make an informed decision regarding surgery?
2. As a healthcare practitioner or provider, what type of perioperative mortality and morbidity information would help you in your practice or your facility to improve patient care?
3. How should perioperative mortality data be used to improve health outcomes?
4. The Committee is recommending a whole-of-system perioperative mortality review system.
   a. do you agree with this assessment? If not, why not?
   b. would you support a generic core data set for all surgical and anaesthetic mortality and morbidity?
   c. would you support a standardised mortality and morbidity review process across the entire sector?
5. Where should the emphasis for perioperative mortality review be?
   a. case peer review
   b. system wide epidemiological analysis.
6. What role should the professional colleges and societies play in perioperative mortality data collection and dissemination?
7. If the recommended system were to be adopted, what would the implications be for your practice or facility?
   a. what additional resources or activities would be required?
   b. what current resources or activities could be utilised for this purpose?
   c. what, if any, process(es) for the review of perioperative mortality do you or your facility currently use? (Please include copies of any standard forms you currently use.)
8. Do you have any further comments or feedback?

Please direct all feedback to:

Deon York (deon.york@hqsc.govt.nz)
Health Quality & Safety Commission
PO Box 25496, Wellington, 6146
Phone: 04 901 6060

Deadline: 11 April, 2012

Appendix

Australian Classification of Health Interventions (ACHI) ICD-10-AM Codes

In the hospital admission data set, health interventions were coded using the ICD-10-AM (3rd Edition) Australian Classification of Health Interventions (ACHI). The tables below list the ACHI codes used to define each of the intervention categories reviewed in this report.

1. Hip and Knee Arthroplasty
2. Cataract Surgery
3. Colorectal Resections

Table 27. ACHI (ICD-10-AM 3rd Edition) Codes Used to Define Hip Arthroplasty

ACHI BLOCK	BLOCK DESCRIPTION	ACHI CODE	CODE DESCRIPTION
Hip Arthroplasty			
1489	Arthroplasty of hip	4752200	Hemiarthroplasty of femur
		4931200	Excision arthroplasty of hip
		4931500	Partial arthroplasty of hip
		4931800	Total arthroplasty of hip, unilateral
		4931900	Total arthroplasty of hip, bilateral
1492	Revision arthroplasty of hip	4932400	Revision of total arthroplasty of hip
		4932700	Revision of total arthroplasty of hip with bone graft to acetabulum
		4933000	Revision of total arthroplasty of hip with bone graft to femur
		4933300	Revision of total arthroplasty of hip with bone graft to acetabulum and femur
		4933900	Revision of total arthroplasty of hip with anatomic specific allograft to acetabulum
		4934200	Revision of total arthroplasty of hip with anatomic specific allograft to femur
		4934500	Revision of total arthroplasty of hip with anatomic specific allograft to acetabulum and femur
		4934600	Revision of partial arthroplasty of hip

Table 28. ACHI (ICD-10-AM 3rd Edition) Codes Used to Define Knee Arthroplasty

ACHI BLOCK	BLOCK DESCRIPTION	ACHI CODE	CODE DESCRIPTION
Knee Arthroplasty			
1518	Arthroplasty of knee	4951700	Hemiarthroplasty of knee
		4951800	Total arthroplasty of knee, unilateral
		4951900	Total arthroplasty of knee, bilateral
1519	Arthroplasty of knee with bone graft to femur or tibia	4952100	Total arthroplasty of knee with bone graft to femur, unilateral
		4952101	Total arthroplasty to knee with bone graft to femur, bilateral
		4952102	Total arthroplasty to knee with bone graft to tibia, unilateral
		4952103	Total arthroplasty to knee with bone graft to tibia, bilateral
		4952400	Total arthroplasty of knee with bone graft to femur and tibia, unilateral
		4952401	Total arthroplasty of knee with bone graft to femur and tibia, bilateral
		4953400	Total replacement arthroplasty of patellofemoral joint of knee
1523	Revision of total arthroplasty of knee with bone graft to femur or tibia	4953000	Revision of total arthroplasty of knee with bone graft to femur
		4953001	Revision of total arthroplasty of knee with bone graft to tibia
		4953300	Revision of total arthroplasty of knee with bone graft to femur and tibia
		4955400	Revision of total arthroplasty of knee with anatomic specific allograft
1524	Other revision procedures on knee	4952700	Revision of total arthroplasty of knee

Table 29. ACHI (ICD-10-AM 3rd Edition) Codes Used to Define Cataract Surgery (Table 1 of 2)

ACHI BLOCK	BLOCK DESCRIPTION	ACHI CODE	CODE DESCRIPTION
Cataract Surgery			
193	Insertion of intra-ocular lens prosthesis	4270100	Insertion of foldable artificial lens
		4270101	Insertion of other artificial lens
		4270300	Insertion of artificial lens into posterior chamber and suture to iris and sclera
194	Replacement or removal of artificial lens	4270400	Removal of artificial lens
		4270700	Replacement of artificial lens
		4271000	Replacement of artificial lens by posterior chamber insertion and suture to iris and sclera
195	Intracapsular crystalline lens extraction	4269800	Intracapsular extraction of crystalline lens
		4270200	Intracapsular extraction of crystalline lens with insertion of foldable artificial lens
		4270201	Intracapsular extraction of crystalline lens with insertion of other artificial lens
196	Extracapsular crystalline lens extraction by aspiration alone	4269801	Extracapsular extraction of crystalline lens by simple aspiration (and irrigation) technique
		4270202	Extracapsular extraction of crystalline lens by simple aspiration (and irrigation) technique with insertion of foldable artificial lens
		4270203	Extracapsular extraction of crystalline lens by simple aspiration (and irrigation) technique with insertion of other artificial lens
197	Extracapsular crystalline lens extraction by phacoemulsification	4269802	Extracapsular extraction of crystalline lens by phacoemulsification and aspiration of cataract
		4270204	Extracapsular extraction of crystalline lens by phacoemulsification and aspiration of cataract with insertion of foldable artificial lens
		4270205	Extracapsular extraction of crystalline lens by phacoemulsification and aspiration of cataract with insertion of other artificial lens
198	Extracapsular crystalline lens extraction by mechanical phacofragmentation	4269803	Extracapsular extraction of crystalline lens by mechanical phacofragmentation and aspiration of cataract
		4270206	Extracapsular extraction of crystalline lens by mechanical phacofragmentation and aspiration of cataract with insertion of foldable artificial lens
		4270207	Extracapsular extraction of crystalline lens by mechanical phacofragmentation and aspiration of cataract with insertion of other artificial lens

Table 30. ACHI (ICD-10-AM 3rd Edition) Codes Used to Define Cataract Surgery (Table 2 of 2)

ACHI BLOCK	BLOCK DESCRIPTION	ACHI CODE	CODE DESCRIPTION
Cataract Surgery			
198	Extracapsular crystalline lens extraction by mechanical phacofragmentation	4270207	Extracapsular extraction of crystalline lens by mechanical phacofragmentation and aspiration of cataract with insertion of other artificial lens
199	Other extracapsular crystalline lens extraction	4269804	Other extracapsular extraction of crystalline lens
		4270208	Other extracapsular extraction of crystalline lens with insertion of foldable artificial lens
		4270209	Other extracapsular extraction of crystalline lens with insertion of other artificial lens
200	Other extraction of crystalline lens	4269805	Other extraction of crystalline lens
		4270210	Other extraction of crystalline lens with insertion of foldable artificial lens
		4270211	Other extraction of crystalline lens with insertion of other artificial lens
		4273101	Extraction of crystalline lens by posterior chamber sclerotomy with removal of vitreous
201	Removal of after cataract	4271900	Capsulectomy of lens
		4271902	Mechanical fragmentation of secondary membrane
		4272200	Capsulectomy of lens by posterior chamber sclerotomy
		4273100	Capsulectomy of lens by posterior chamber sclerotomy with removal of vitreous
		4273400	Capsulotomy of lens
		4273700	Needling of posterior capsule of lens
		4278800	Capsulotomy of lens by laser
		4279102	Corticolysis of lens material by laser
202	Other application, insertion or removal procedures on lens	4271600	Removal of juvenile cataract
203	Other procedures on lens	4270401	Repositioning of artificial lens
		4271300	Repositioning of artificial lens with suture of lens

Table 31. Australian Classification of Health Interventions (ICD-10-AM 3rd Edition) Codes Used to Define Colorectal Resection

ACHI BLOCK	BLOCK DESCRIPTION	ACHI CODE	CODE DESCRIPTION
Colorectal Resection			
913	Colectomy	3200000	Limited excision of large intestine with formation of stoma
		3200001	Right hemicolectomy with formation of stoma
		3200300	Limited excision of large intestine with anastomosis
		3200301	Right hemicolectomy with anastomosis
		3200400	Sub-total colectomy with formation of stoma
		3200401	Extended right hemicolectomy with formation of stoma
		3200500	Subtotal colectomy with anastomosis
		3200501	Extended right hemicolectomy with anastomosis
		3200600	Left hemicolectomy with anastomosis
		3200601	Left hemicolectomy with formation of stoma
		3200900	Total colectomy with ileostomy
		3201200	Total colectomy with ileorectal anastomosis
934	Rectosigmoidectomy or proctectomy	3203000	Rectosigmoidectomy with formation of stoma
		3203900	Abdominoperineal proctectomy
		3204700	Perineal proctectomy
		3206000	Restorative proctectomy
		3211200	Perineal rectosigmoidectomy
		4399301	Definitive intestinal resection and pull-through anastomosis
935	Anterior resection of rectum	3202400	High restorative anterior resection of rectum with intraperitoneal anastomosis
		3202500	Low restorative anterior resection of rectum with extraperitoneal anastomosis
		3202600	Low restorative anterior resection of rectum with coloanal anastomosis
		3202800	Ultra low restorative anterior resection of rectum with sutured coloanal anastomosis
936	Total proctocolectomy	3201500	Total proctocolectomy with ileostomy
		3205100	Total proctocolectomy with ileo-anal anastomosis
		3205101	Total proctocolectomy with ileo-anal anastomosis and formation of temporary ileostomy

List of Abbreviations

ACC	Accident Compensation Corporation
ACHI	Australian Classification of Health Interventions
AMAC	Anaesthetic Mortality Assessment Committee
ANZCA	Australian and New Zealand College of Anaesthetists
ASA	American Society of Anesthesiologists
CMC	Council of Medical Colleges
CMS	Coroner's Case Management System
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disease
DHB	District Health Board
HQSC	Health Quality & Safety Commission
NCEPOD	National Confidential Enquiry into Patient Outcome and Death
NMC	National Mortality Collection
NMDS	National Minimum Dataset
NNPAC	National Non-Admitted Patient Collection
NSQIP	National Surgical Quality Improvement Program
NZCR	New Zealand Cancer Registry
NZDep	New Zealand Deprivation Index
NZPHDA	New Zealand Public Health and Disability Act
NZPODS	New Zealand Perioperative Death Survey
MELAA	Middle Eastern/Latin American/African
POMRC	Perioperative Mortality Review Committee
RACS	Royal Australasian College of Surgeons
RANZCOG	Royal Australian and New Zealand College of Obstetrics & Gynaecology
SASM	Scottish Audit of Surgical Mortality

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