



HEALTH QUALITY & SAFETY  
COMMISSION NEW ZEALAND  
*Kupu Taurangi Hauora o Aotearoa*



POMRC

Perioperative Mortality  
Review Committee

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Background Information for the Fourth Report of the  
Perioperative Mortality Review Committee  
Report to the Health Quality & Safety Commission New Zealand

June 2015

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# Introduction

This companion report accompanies the Perioperative Mortality Review Committee's (the POMRC's) fourth report on perioperative mortality in New Zealand during 2008–2012 (POMRC 2015). It presents background information for all clinical areas in the fourth report and also includes mortality findings for the clinical areas presented in previous reports.

The POMRC is a statutory committee that reviews and reports on perioperative deaths with a view to reducing perioperative mortality and morbidity, and supporting quality and safety improvements in New Zealand health and disability services.

The POMRC's definition of *perioperative deaths* includes:

- deaths that occurred after an operative procedure, either within 30 days after the operative procedure, or after 30 days of the procedure but before discharge from hospital to a home or rehabilitation facility
- deaths that occurred whilst under the care of a surgeon in hospital even though an operation was not undertaken.

For the purposes of the POMRC's definition of perioperative deaths, an *operative procedure* refers to any procedure that requires anaesthetic (local, regional or general) or sedation. This includes a broad range of diagnostic and therapeutic procedures such as gastroscopies, colonoscopies and cardiovascular angiographic procedures carried out in designated endoscopy or radiology rooms.

## Perioperative mortality and hospital admissions 2008–2012

Background information on hospital admissions is presented for the five new clinical areas reviewed in the fourth report of the POMRC. These include:

1. Coronary artery bypass graft (CABG)
2. Percutaneous transluminal coronary angioplasty (PTCA)
3. Bariatric surgery
4. Admissions with an American Society of Anesthesiologists (ASA) score of 4 or 5
5. Severe post-operative sepsis.

In addition, this companion report presents information on perioperative mortality and hospital admissions during 2008–2012 for a number of clinical areas presented in previous POMRC reports. These include:

1. Cholecystectomy
2. General anaesthesia
3. Hip arthroplasty
4. Knee arthroplasty
5. Mortality in elective/waiting list admissions with an ASA score of 1 or 2 and who received a general anaesthetic or neuraxial block
6. Pulmonary embolus-associated and attributed mortality.



Patterns in the data observed for these clinical areas are compared with those seen in previous reporting time periods (2005–2009, 2006–2010 and 2007–2011).

Key perioperative mortality findings, for both the new and previously reported clinical areas, are summarised in the fourth report of the POMRC.

#### *Data limitations*

Data in this report was sourced from the National Minimum Dataset (NMDS) and the National Mortality Collection (NMC). The NMDS and NMC datasets have limitations associated with coding accuracy and data completeness. Both datasets are dependent on the quality of clinical records and classification systems.

Many privately funded surgical and procedural day-stay or outpatient hospitals, facilities and in-rooms do not report any events to the NMDS. The Ministry of Health is unable to estimate the extent to which the NMDS undercounts events from private surgical, procedural day-stay or outpatient hospital, and facility or in-room hospitalisations. For this report the data presented are likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify.

Small variation in the datasets across time can also result in slight variations in the mortality and hospitalisation rates included in each annual report. This variation can be caused by lapses in the time it takes for the data from each year to be entered into the NMDS and NMC databases, and also through changes in coding over the years. Such variation limits the ability to compare findings between time periods of interest.

Additional information on data sources, methods and data limitations is provided in Appendix 2 of this report.

# Background: Hospital Admissions for Coronary Artery Bypass Graft (CABG) Procedures

Information from the NMDS was used to review hospital admissions related to CABG procedures.

## CABG hospital admissions by admission type and procedure type

CABG involving the left internal mammary artery was the most common procedure performed on those admitted for CABG during 2008–2012, although a smaller number had more than one graft procedure during the operation. The proportion of admissions where more than one graft procedure was undertaken during the operation was similar across the three types of admissions (27% of acute and elective/waiting list admissions, 24% of arranged in public admissions) (Table 1).

Table 1: Hospital Admissions for CABG by Main Initial Procedure Types and Admission Type, New Zealand 2008–2012

CABG PROCEDURE TYPE	ADMISSION TYPE		
	Acute	Arranged in Public	Elective/Waiting List
<b>Number</b>			
Saphenous Vein Only	56	31	198
LIMA Only	1,101	614	1,882
RIMA Only	5	2	9
Radial Artery Only	4	7	23
One Other Only	6	39	14
Two Initial Procedures	346	177	637
Three or More	93	45	147
<b>Total</b>	<b>1,611</b>	<b>915</b>	<b>2,910</b>
<b>Annual Average</b>			
Saphenous Vein Only	11.2	6.2	39.6
LIMA Only	220.2	122.8	376.4
RIMA Only	1.0	0.4	1.8
Radial Artery Only	0.8	1.4	4.6
One Other Only	1.2	7.8	2.8
Two Initial Procedures	69.2	35.4	127.4
Three or More	18.6	9.0	29.4

**Data source:** NMDS: Hospital admissions with a CABG listed in any of the first 90 procedures.

LIMA: Left internal mammary artery.

RIMA: Right internal mammary artery.



### CABG admissions by primary diagnosis

In New Zealand during 2008–2012, acute myocardial infarction was the most common primary diagnosis among acute CABG admissions and arranged in public (semi-acute) CABG admissions. For elective/waiting list admissions, angina pectoris was the most frequent initial primary diagnosis (Table 2). Diagnoses unrelated to the cardiovascular system were all rare across all admission types.

Table 2: Hospital Admissions for CABG by Primary Diagnosis and Admission Type, New Zealand 2008–2012

PRIMARY DIAGNOSIS BY ADMISSION TYPE	Total	Annual Average	Admissions in Category (%)
<b>Acute</b>			
Angina Pectoris	416	83.2	25.8
AMI Only	965	193.0	59.9
Chronic IHD	50	10.0	3.1
Other Circulatory	138	27.6	8.6
Other, Not Above	42	8.4	2.6
<b>Total Acute</b>	<b>1,611</b>	<b>322.2</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Angina Pectoris	248	49.6	27.1
AMI Only	433	86.6	47.3
Chronic IHD	137	27.4	15.0
Other Circulatory	64	12.8	7.0
Other, Not Above	33	6.6	3.6
<b>Total Arranged in Public</b>	<b>915</b>	<b>183</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Angina Pectoris	1,550	310.0	53.3
AMI Only	96	19.2	3.3
Chronic IHD	627	125.4	21.5
Other Circulatory	532	106.4	18.3
Other, Not Above	105	21.0	3.6
<b>Total Elective/Waiting List</b>	<b>2,910</b>	<b>582.0</b>	<b>100.0</b>

Data source: NMDS: Hospital admissions with a CABG listed in any of the first 90 procedures.

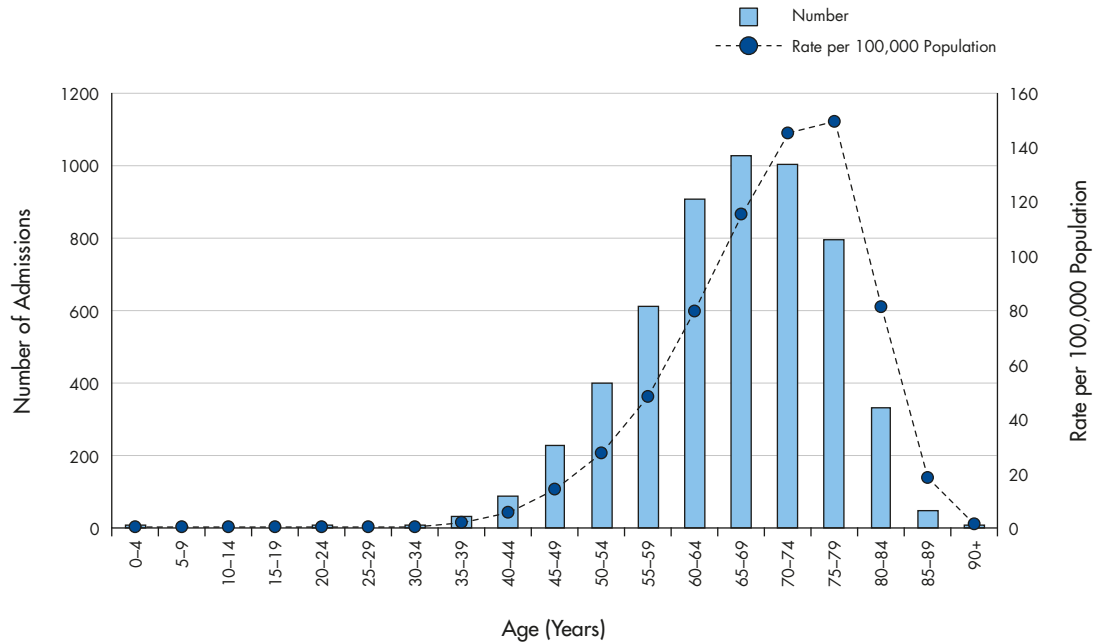
AMI = Acute myocardial infarction.

IHD = Ischaemic heart disease.

### CABG admissions by age

While the number of CABG admissions during 2008–2012 peaked in those aged 65–69 years, the underlying age structure of the New Zealand population meant that the highest proportion of admissions was seen in those aged 75–79 years (Figure 1).

Figure 1: Hospital Admissions for CABG by Age, New Zealand 2008–2012

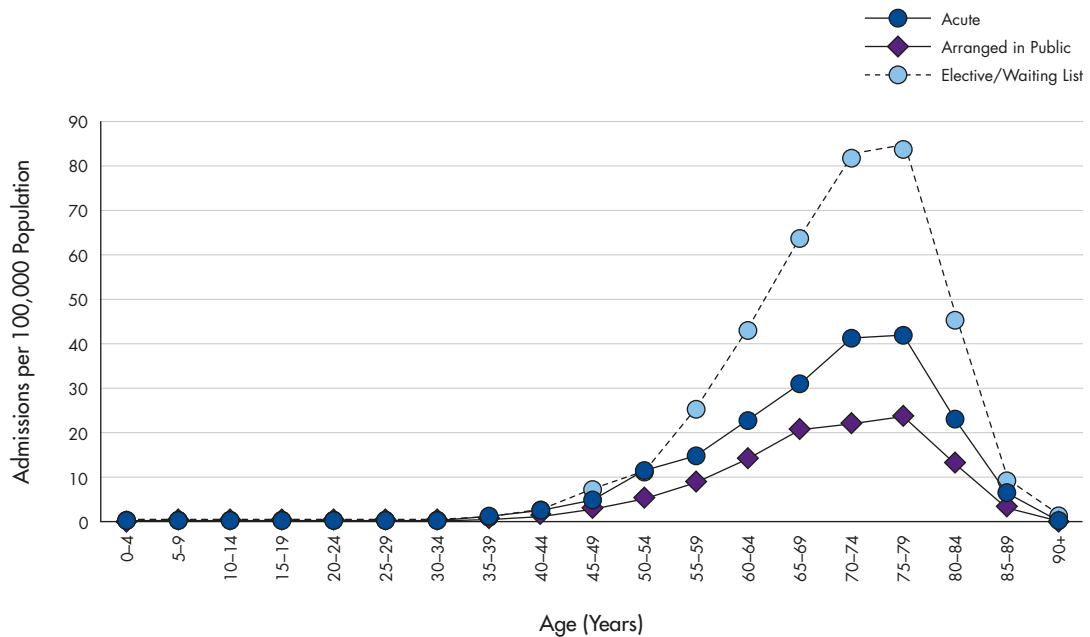


**Numerator:** NMDS: Hospital admissions with one or more CABGs listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### CABG admissions by age and admission type

During 2008–2012, admissions for CABG were infrequent in people younger than 34 years, but increased thereafter, peaking for all admission types in those aged 70–79 years (Figure 2). Admission rates then declined rapidly for those aged in their 80s and 90s. Acute admission rates were lower than elective/waiting list rates for those aged over 50 years.

Figure 2: Hospital Admissions for CABG by Age and Admission Type, New Zealand 2008–2012



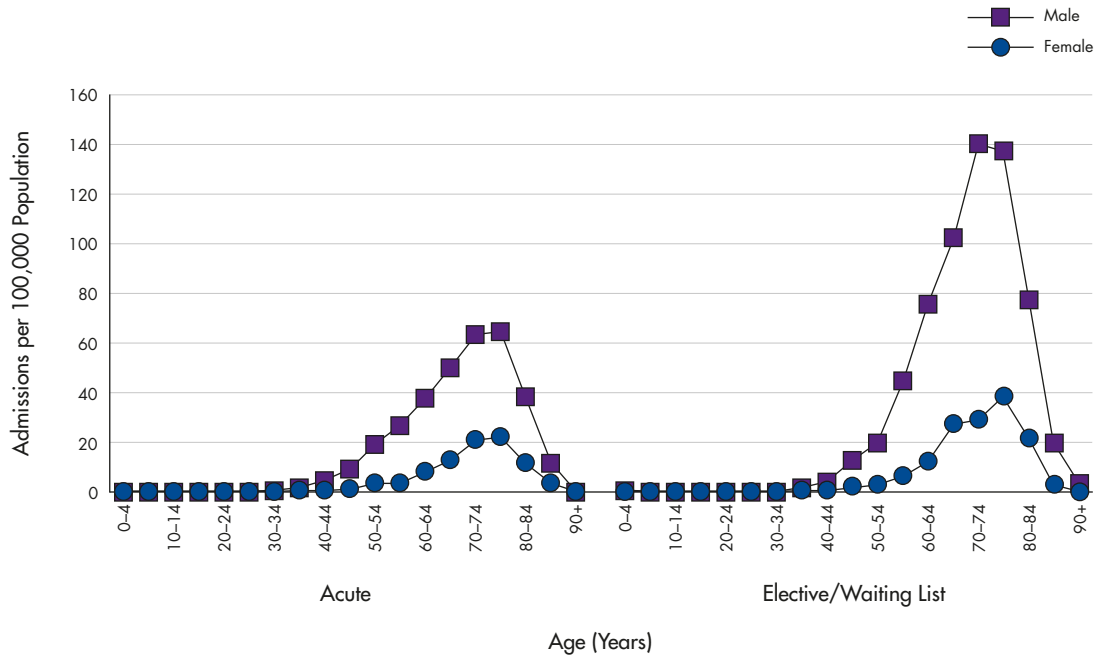
**Numerator:** NMDS: Hospital admissions with one or more CABGs listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).



### CABG admissions by age, admission type and gender

When broken down by gender, admission rates for CABG were higher for males than females across all ages for both acute and elective/waiting list admissions (Figure 3). Admission rates for males and females peaked at 75–79 years for acute admissions and 70–79 years for elective/waiting list admissions.

Figure 3: Hospital Admissions for CABG by Age, Admission Type and Gender, New Zealand 2008–2012



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

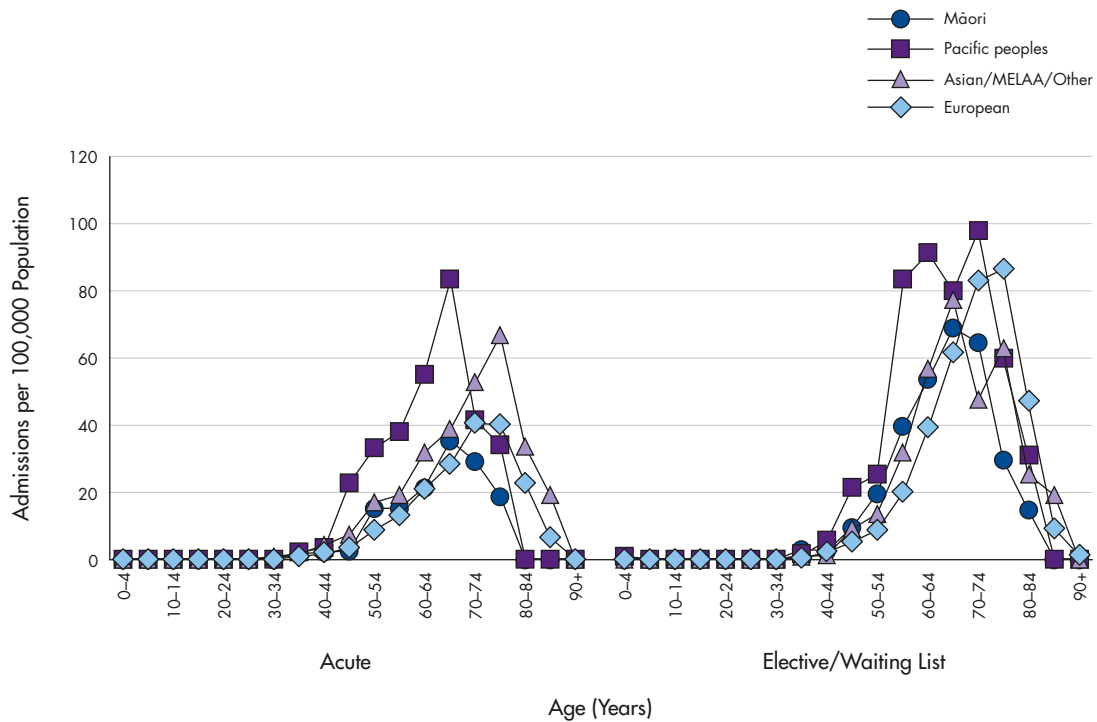
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### CABG admissions by age, admission type and ethnicity

From 2008–2012, acute admission rates for CABG were higher for Pacific peoples than for those of other ethnicities from 40 years up to 69 years (Figure 4). In those aged over 70 years admission rates for Asian/Middle Eastern/Latin American/African (MELAA)/Other peoples were higher than for the other ethnic groups. This pattern was similar for elective/waiting list admission rates but rates across all the ethnic groups were higher than rates for acute admissions, particularly for peoples from non-Pacific ethnicities.



Figure 4: Hospital Admissions for CABG by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with one or more CABGs listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).  
 MELAA: Middle Eastern/Latin American/African.



# Background: Hospital Admissions for Percutaneous Transluminal Coronary Angioplasty (PTCA)

Data from the NMDS were used to review hospital admissions related to PTCA.

## PTCA hospital admissions by admission type and procedure type

In New Zealand during 2008–2012, most admissions for PTCA involved the insertion of a single stent in one artery (Table 3). Sixty percent of acute admissions and 56% of arranged in public/elective/waiting list admissions combined included single-artery, single-stent procedures. PTCA procedures without any stent were infrequent, especially among acute admissions. Multiple angioplasty procedures occurring in the same operation were rare.

Table 3: Hospital Admissions for PTCA by Main Initial Procedure Type and Admission Type, New Zealand 2008–2012

PROCEDURE TYPE	ADMISSION TYPE	
	Acute	Arranged in Public/ Elective/Waiting List
<b>Number</b>		
1 Stent into 1 Artery	8,395	4,620
>1 Stent into 1 Artery	2,466	1,463
>1 Stent into >1 Artery	2,430	1,691
PTCA Only	487	382
Multiple Procedures	151	126
<b>Total</b>	<b>13,929</b>	<b>8,282</b>
<b>Annual Average</b>		
Stent into 1 Artery	1,679.0	924.0
>1 Stent into 1 Artery	493.2	292.6
>1 Stent into >1 Artery	486.0	338.2
PTCA Only	97.4	76.4
Multiple Procedures	30.2	20.4

Data source: NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.

## PTCA admissions by primary diagnosis

In New Zealand during 2008–2012, acute myocardial infarction was the most common primary diagnosis among those admitted acutely for PTCA (Table 4). For arranged in public/elective/waiting list admissions combined, angina pectoris was the most frequent initial primary diagnosis. Diagnoses unrelated to the cardiovascular system were rare across all admission types.

Table 4: Hospital Admissions for PTCA by Primary Diagnosis and Admission Type, New Zealand 2008–2012

PRIMARY DIAGNOSIS BY ADMISSION TYPE	Total	Annual Average	Admissions in Category (%)
<b>Acute</b>			
Angina Pectoris	2,176	435.2	15.60
AMI Only	11,034	2,206.8	79.20
Chronic IHD	209	41.8	1.50
Other Circulatory	320	64	2.30
Other, Not Above	190	38	1.40
<b>Total Acute</b>	<b>13,929</b>	<b>2,785.8</b>	<b>100.00</b>
<b>Arranged in Public/Elective/Waiting List</b>			
Angina Pectoris	3,640	728	43.95
AMI Only	2,437	487.4	29.43
Chronic IHD	1,863	372.6	22.49
Other Circulatory	109	21.8	1.32
Other, Not Above	233	46.6	2.81
<b>Total Arranged in Public/Elective/Waiting List</b>	<b>8,282</b>	<b>1,656.4</b>	<b>100.00</b>

Data source: NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.

AMI = Acute myocardial infarction.

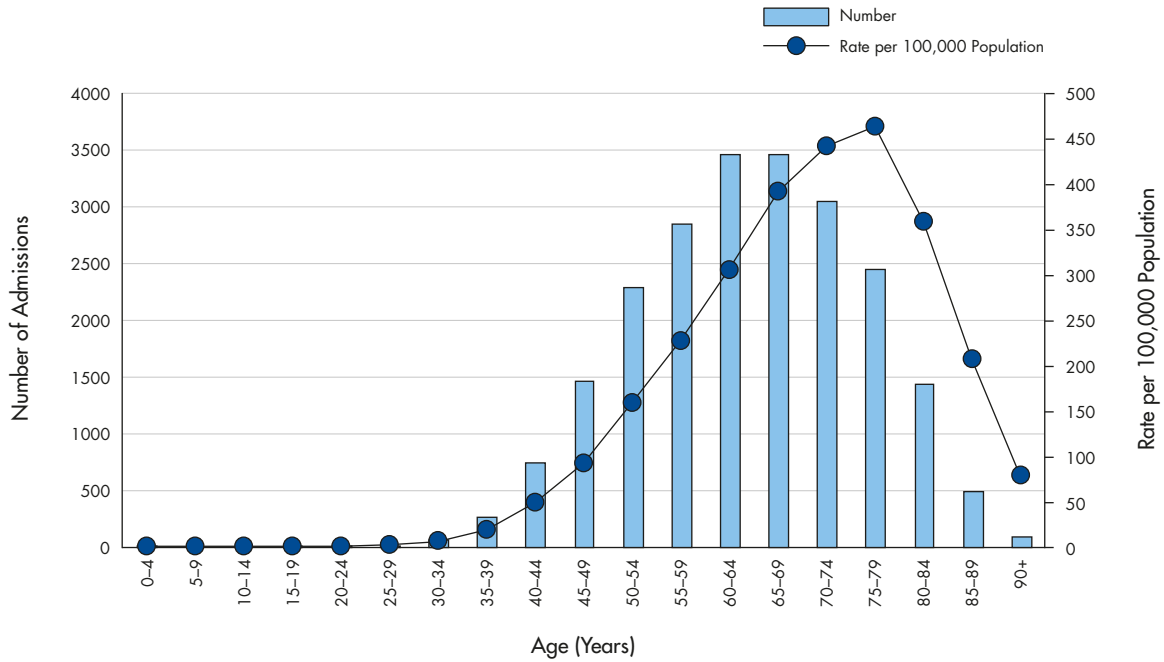
IHD = Ischaemic heart disease.

### PTCA admissions by age

While the number of PTCA admissions during 2008–2012 peaked in those aged 60–69 years, the underlying age structure of the New Zealand population meant that the highest proportion of admissions was seen in those aged 75–79 years (Figure 5).



Figure 5: Hospital Admissions for PTCA by Age, New Zealand 2008–2012

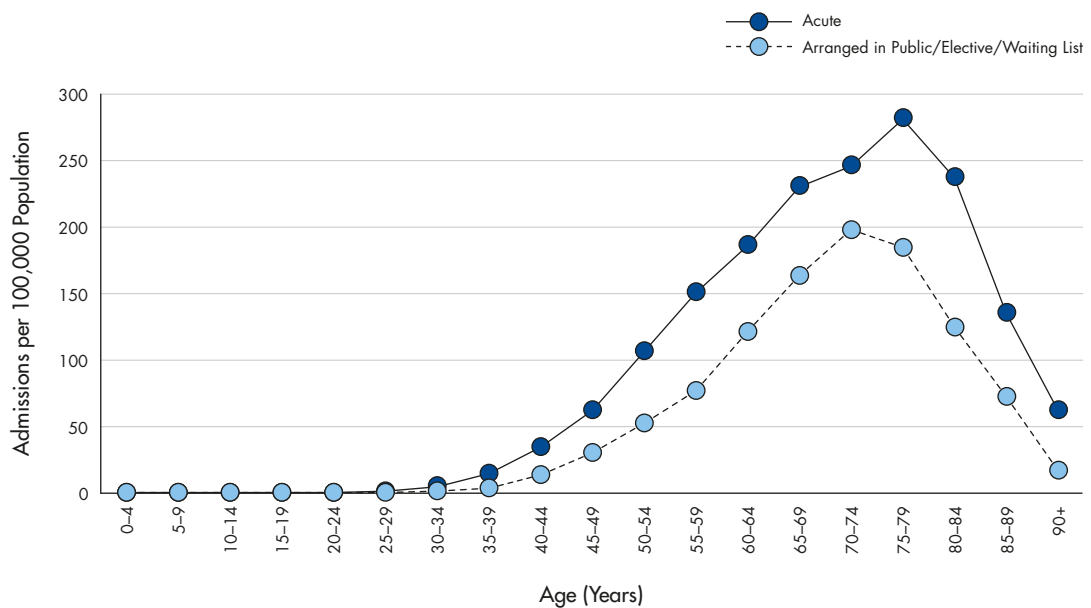


**Numerator:** NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### PTCA admissions by age and admission type

During 2008–2012, admissions in New Zealand for PTCA were infrequent in people younger than 35 years, but increased thereafter, peaking for all admission types in those aged 70–79 years (Figure 6). Admission rates then declined rapidly for those aged in their 80s and 90s. Acute admission rates were higher than arranged in public/elective/waiting list rates for all age groups.

Figure 6: Hospital Admissions for PTCA by Age and Admission Type, New Zealand 2008–2012

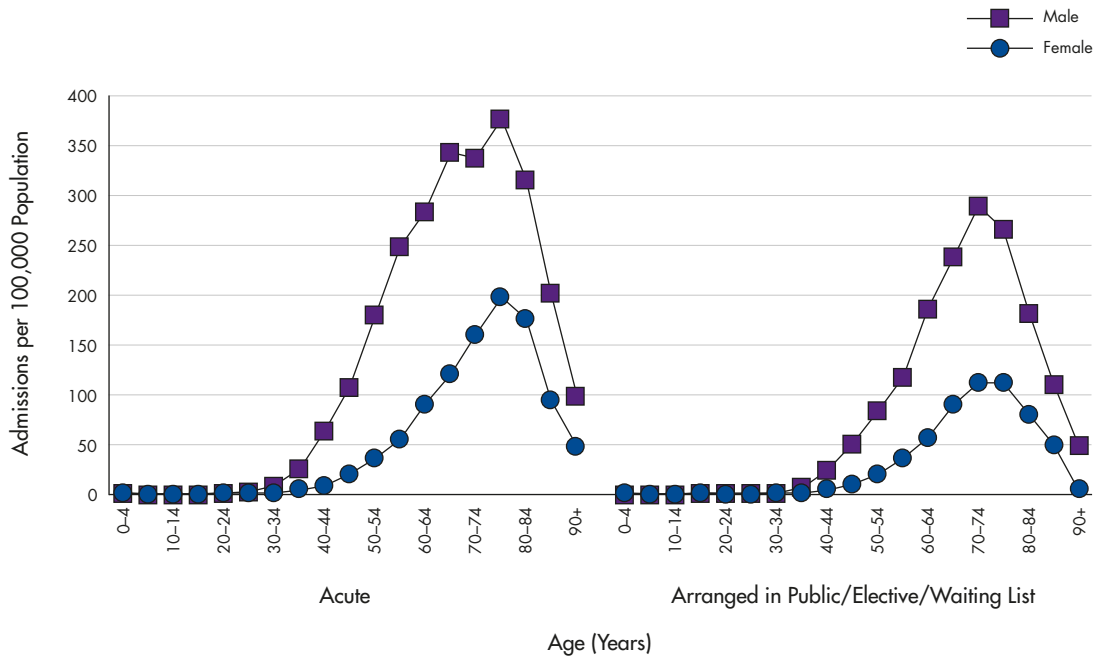


**Numerator:** NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### PTCA admissions by age, admission type and gender

When broken down by gender, admission rates for PTCA in New Zealand during 2008–2012 were higher for males than females across all ages for both acute and arranged in public/elective/waiting list admissions (Figure 7). Admission rates for males and females peaked at 75–79 years for acute admissions and 70–74 years for arranged in public/elective/waiting list admissions.

Figure 7: Hospital Admissions for PTCA by Age, Admission Type and Gender, New Zealand 2008–2012



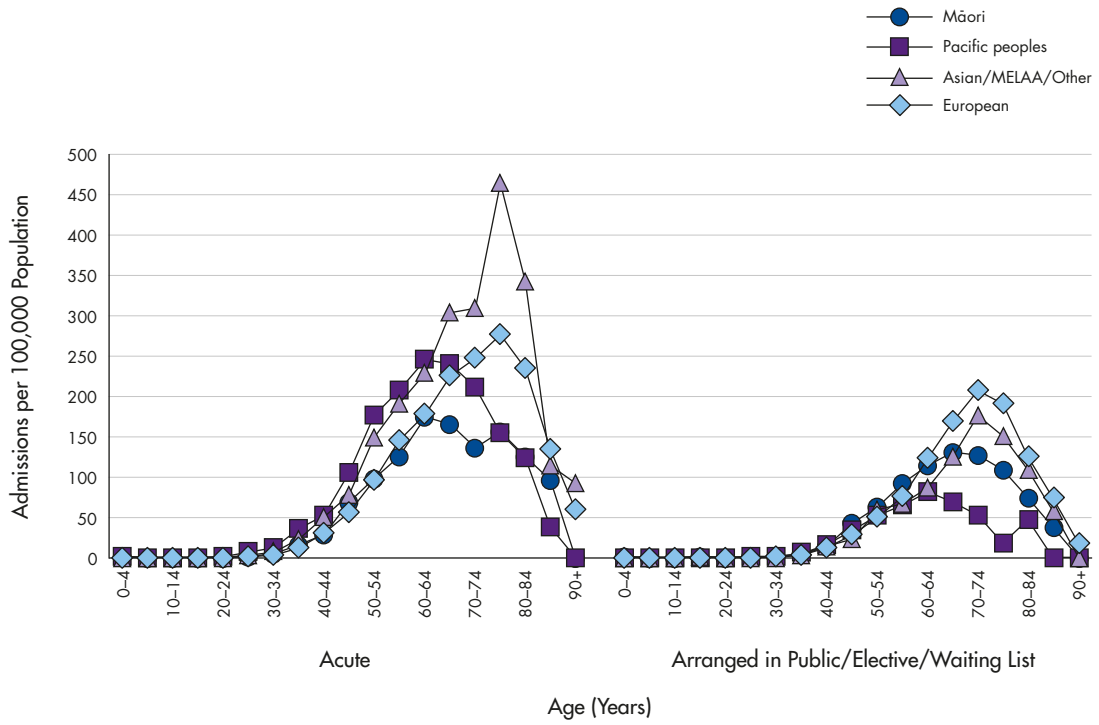
**Numerator:** NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### PTCA admissions by age, admission type and ethnicity

In New Zealand during 2008–2012, acute admission rates for PTCA were generally similar across all ethnic groups and low until age 40, after which rates increased for all groups. Acute admission rates for Asian/MELAA/Other and Pacific peoples were higher up to age 60, after which Pacific rates started to decline, while Asian rates continued to increase and peak at ages 75–79 years. European rates also climbed up to ages 75–79 years but remained lower than Asian/MELAA/Other rates. Rates declined for all ethnicities among those aged 80+ years (Figure 8). Arranged in public/elective/waiting list admission rates were low for all ethnic groups until age 40 years, where they began to climb and peak at ages 70–74 years. Admission rates for Māori and Pacific peoples aged 60–80 years peaked at a lower rate than Asian/MELAA/Other and European ethnicities.



Figure 8: Hospital Admissions for PTCA by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with a PTCA listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).  
MELAA: Middle Eastern/Latin American/African.

# Background: Hospital Admissions for Bariatric Surgery

Data from the NMDS were used to review hospital admissions for bariatric surgery.

## Bariatric surgical hospital admissions by primary diagnosis

In New Zealand during 2008–2012, obesity was the most common primary diagnosis for those admitted for bariatric surgery (Table 5).

Table 5: Hospital Admissions for Bariatric Surgery by Primary Diagnosis, New Zealand 2008–2012

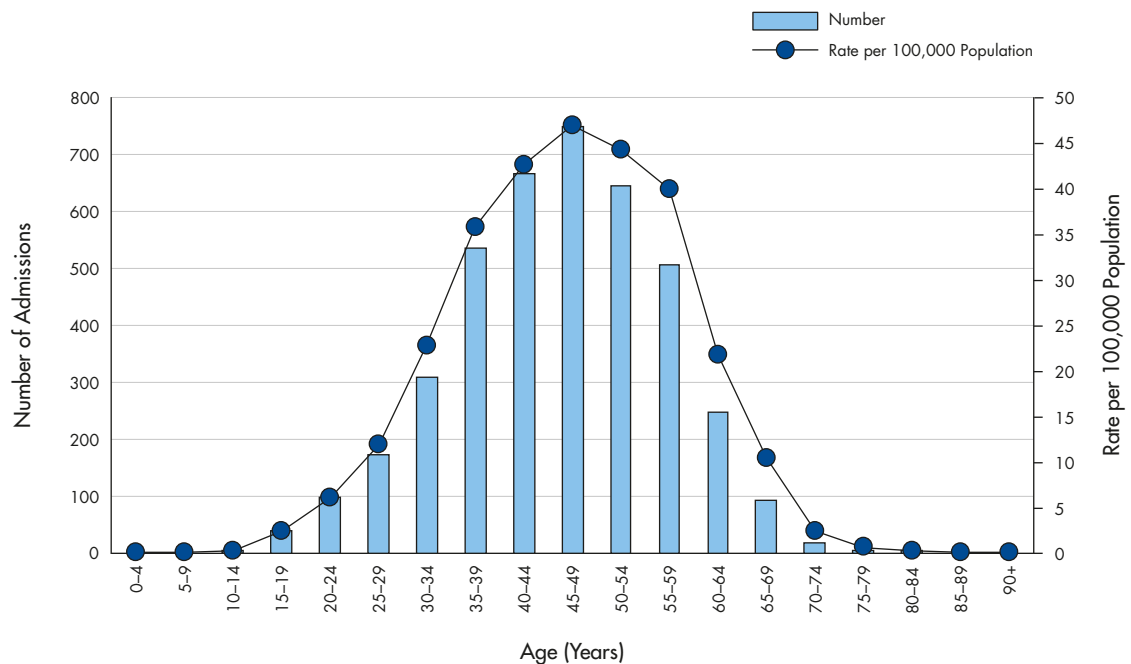
PRIMARY DIAGNOSIS	Admission Numbers	Admissions in Category (%)
Obesity	3,284	80.7
Other Endocrine	479	11.8
Other, Not Endocrine	304	7.5
Total	4,067	100.0

Data source: NMDS: Hospital admissions with a bariatric procedure listed in any of the first 90 procedures.

## Bariatric surgical admissions by age

In New Zealand during 2008–2012, both the number of bariatric surgery admissions and the admission rate per 100,000 population peaked in those aged 45–49 years (Figure 9). Admissions among those either aged under 15 years or over 75 years were uncommon.

Figure 9: Hospital Admissions for Bariatric Surgery by Age, New Zealand 2008–2012



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

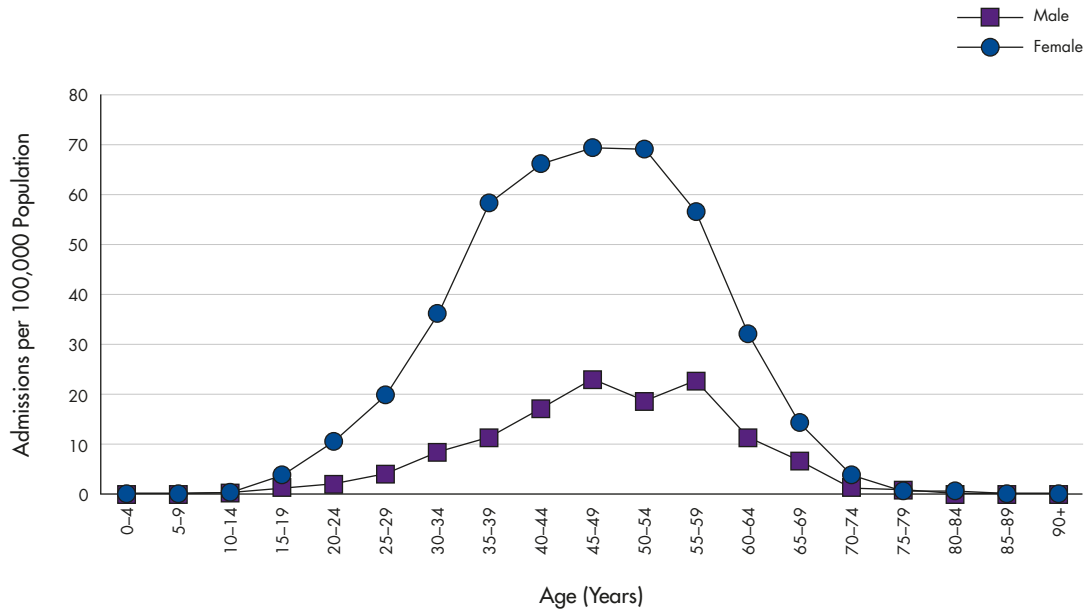
Denominator: Statistics New Zealand: Estimated Resident Population (projected from 2008).



### Bariatric surgical admissions by age and gender

When broken down by gender, age-specific admission rates for bariatric surgery were higher for females than males (Figure 10).

Figure 10: Hospital Admissions for Bariatric Surgery by Age and Gender, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with a bariatric procedure listed in any of the first 90 procedures.

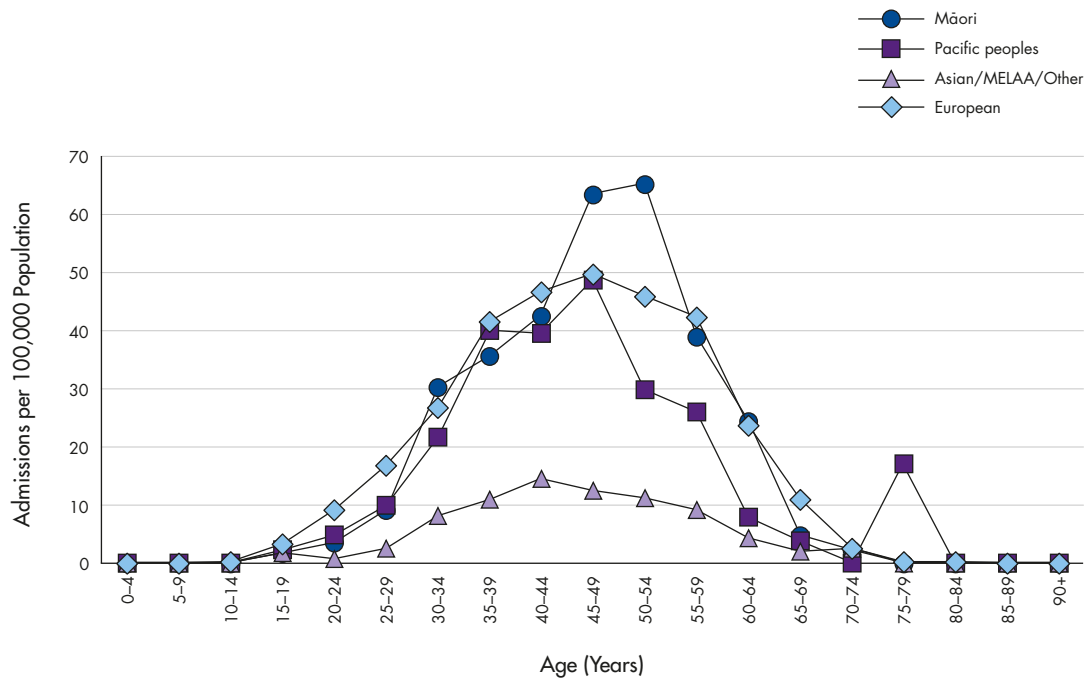
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Bariatric surgical admissions by age and ethnicity

From 2008–2012, bariatric surgery admission rates were lower for those with Asian/MELAA/Other ethnicity but similar across the other ethnic groups. Māori rates in ages 45–54 years exhibited a spike increase (Figure 11).



Figure 11: Hospital Admissions for Bariatric Surgery by Age and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with a bariatric procedure listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).  
 MELAA: Middle Eastern/Latin American/African.



## Background: Hospital Admissions with an ASA Score of 4 or 5

Information from the NMDS was used to review hospital admissions for any operative procedure that included a general anaesthetic or neuraxial block, in those admitted with an initial ASA score of 4 or 5. General anaesthetics or neuraxial blocks for maternity procedures were not included in the dataset reviewed for this chapter. Among the elective/waiting list admissions, some were admitted for procedures and initially assigned an ASA score of 4, but then subsequently became unwell and were assigned an ASA score of 5. Additional background information on ASA scores is provided in Appendix 2.

### Hospital admissions with an ASA score of 4 or 5 by admission type

In New Zealand during 2008–2012, most admissions assigned an ASA score of 4 or 5 were acute admissions (59%) (Table 6). There were relatively few ASA 5 admissions (3.6%) among the ASA 4 and 5 admissions.

Table 6: Hospital Admissions for ASA Score 4 or 5 by ASA Procedure Type and Admission Type, New Zealand 2008–2012

ASA SCORE 4 OR 5 PROCEDURE TYPE	ADMISSION TYPE		
	Acute	Arranged in Public	Elective/Waiting List
<b>Number</b>			
Single Emergency ASA 4	4,811	311	411
Single Unknown ASA 4	3,270	1,122	3,951
Single Emergency ASA 5	370	16	29
Single Unknown ASA 5	99	3	18
Max ASA=4 in Multiple	512	45	322
Max ASA=5 in Multiple	23	4	2
<b>Total</b>	<b>9,085</b>	<b>1,501</b>	<b>4,733</b>
<b>Annual Average</b>			
Single Emergency ASA 4	962.2	62.2	82.2
Single Unknown ASA 4	654.0	224.4	790.2
Single Emergency ASA 5	74.0	3.2	5.8
Single Unknown ASA 5	19.8	0.6	3.6
Max ASA=4 in Multiple	102.4	9.0	64.4
Max ASA=5 in Multiple	4.6	0.8	0.4

Data source: NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or a neuraxial block.

### Admissions with an ASA score of 4 or 5 by primary diagnosis

In New Zealand, during 2008–2012 injuries and poisoning was the most common primary diagnosis for acute admissions (Table 7). Cardiovascular diseases were the most common primary diagnosis for publicly arranged (semi-acute) and elective/waiting list admissions.

Table 7: Hospital Admissions for ASA Score 4 or 5 by Primary Diagnosis and Admission Type, New Zealand 2008–2012

PRIMARY DIAGNOSIS BY ADMISSION TYPE	Total	Annual Average	Admissions in Category (%)
<b>Acute</b>			
Neoplasms	536	107.2	5.90
Cardiovascular	2,121	424.2	23.30
Gastrointestinal	1,514	302.8	16.70
Injuries, Poisoning	3,114	622.8	34.30
Other	1,800	360.0	19.80
<b>Total Acute</b>	<b>9,085</b>	<b>1,817.0</b>	<b>100.00</b>
<b>Arranged in Public</b>			
Neoplasms	111	22.2	7.40
Cardiovascular	500	100	33.30
Gastrointestinal	54	10.8	3.60
Injuries, Poisoning	116	23.2	7.70
Other	720	144	48.00
<b>Total Arranged in Public</b>	<b>1,501</b>	<b>300.2</b>	<b>100.00</b>
<b>Elective/Waiting List</b>			
Neoplasms	1,085	217	22.90
Cardiovascular	1,598	319.6	33.80
Gastrointestinal	359	71.8	7.60
Injuries, Poisoning	171	34.2	3.60
Other	1,520	304.0	32.10
<b>Total Elective/Waiting List</b>	<b>4,733</b>	<b>946.6</b>	<b>100.00</b>

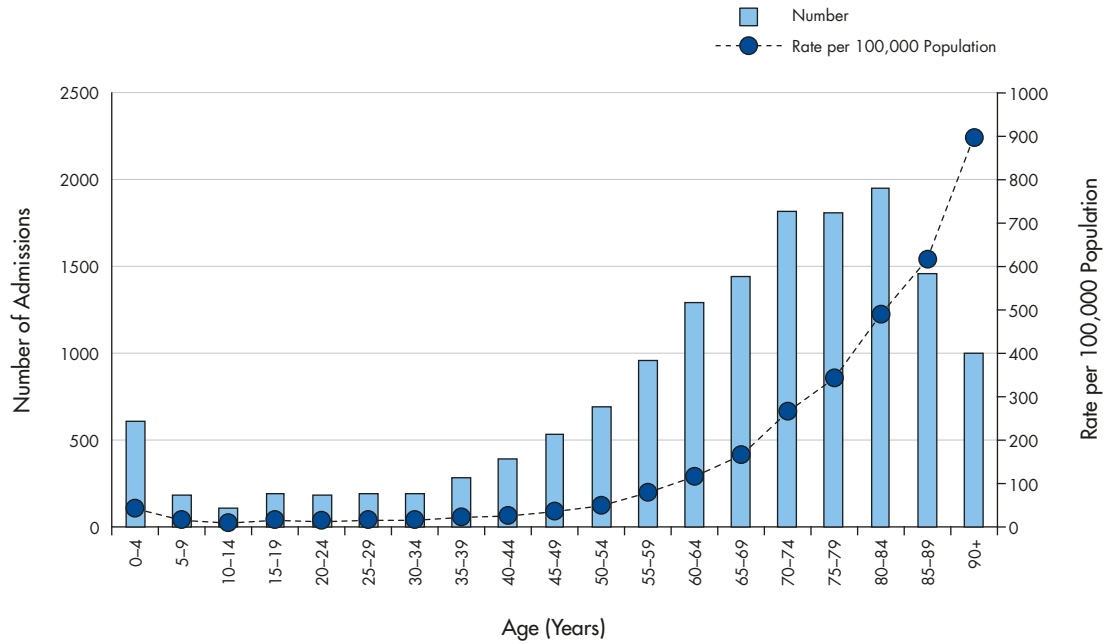
Data source: NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or a neuraxial block.

### Admissions with an ASA score of 4 or 5 by age

In New Zealand during 2008–2012, admission numbers in those with an ASA score of 4 or 5 had an initial spike for those aged 0–4 years (Figure 12). Numbers were then relatively low until age 35 years where admissions increased progressively up to ages 80–84 years and then subsequently declined. Because of the underlying age structure of the New Zealand population, admission rates per 100,000 people in each age group reached a maximum at 90+ years.



Figure 12: Hospital Admissions with a First ASA Score of 4 or 5 by Age, New Zealand 2008–2012

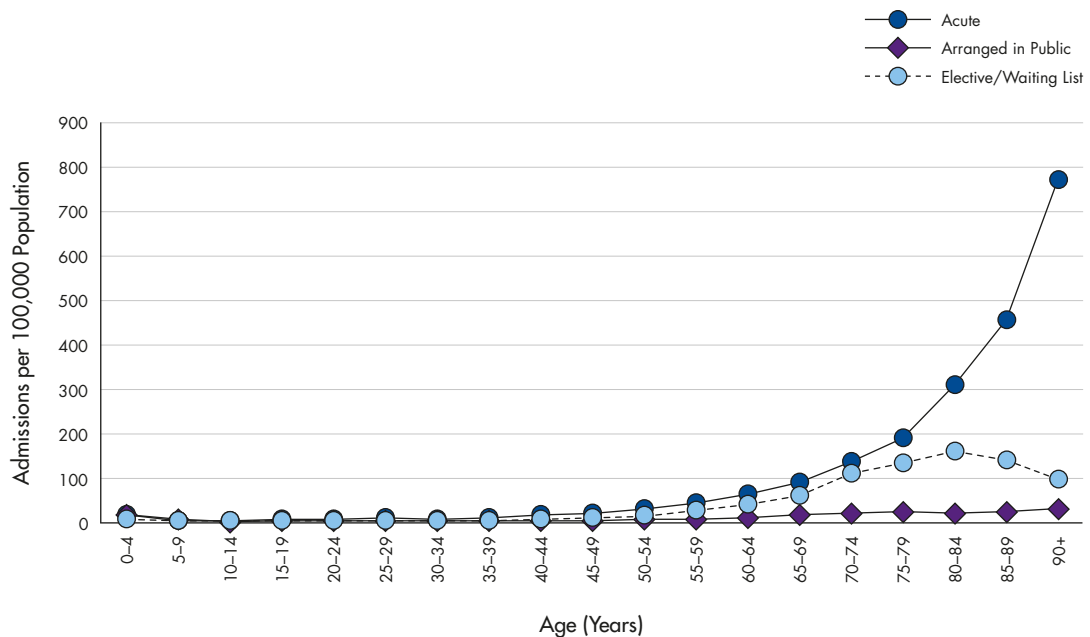


**Numerator:** NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or neuraxial block.  
**Denominator:** Statistics New Zealand Estimated Resident Population (projected from 2008).

### Admissions with an ASA score of 4 or 5 by admission type and age

In New Zealand during 2008–2012, admission rates in those with an ASA score of 4 or 5 were relatively low among all admission types until ages 40–50 years where they began to climb (Figure 13). The rise was steepest for acute admissions, especially ages 75+ years. In contrast, elective/waiting list admissions increased to a maximum for ages 80–84 years and then declined. Semi-acute (arranged in public) admissions rose gradually over the age groups.

Figure 13: Hospital Admissions with a First ASA Score of 4 or 5 by Admission Type and Age, New Zealand 2008–2012

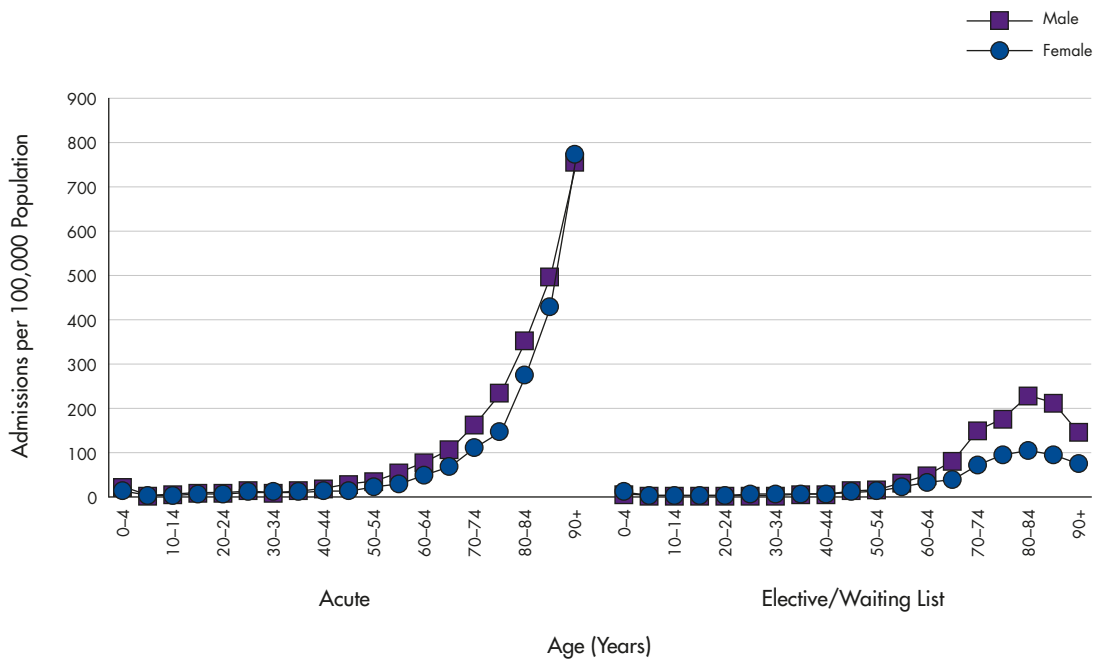


**Numerator:** NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or neuraxial block.  
**Denominator:** Statistics New Zealand Estimated Resident Population (projected from 2008).

### Admissions with an ASA score of 4 or 5 by age and gender

In New Zealand during 2008–2012, acute admission rates with a first ASA score of 4 or 5 increased rapidly for both males and females from age 45 (Figure 14). Elective/Waiting list admissions for those with a first ASA score of 4 or 5 increased from age 55 for both males and females; however, the rise was steeper for males. Admission rates for males and females then reached a plateau at ages 80–84 before declining.

Figure 14: Hospital Admissions with a First ASA Score of 4 or 5 by Age, Admission Type and Gender, New Zealand 2008–2012



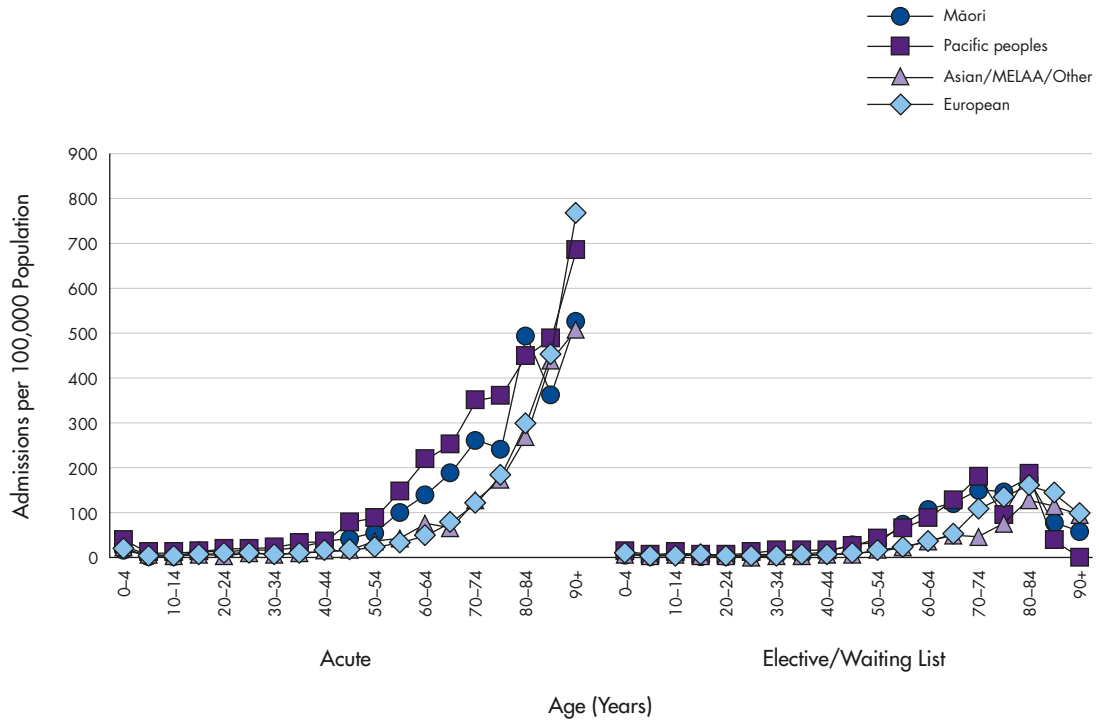
**Numerator:** NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or a neuraxial block.  
**Denominator:** Statistics New Zealand Estimated Resident Population (projected from 2008).

### Admissions with an ASA score of 4 or 5 by age, admission type and ethnicity

During 2008–2012, between the ages of 0 and 44 years, there were no consistent differences for hospital admission rates between acute or elective/waiting list admissions, or for those of different ethnic groups who had an initial ASA score of 4 or 5 (Figure 15). Māori and Pacific peoples had higher acute admission rates than other ethnic groups from the age of 45 years up to 84 years, after which point differences in acute rates between ethnic groups became less distinct. Rates increased from age 45 years for all ethnic groups and peaked among those aged 80+ years. Admission rates for elective/waiting list admissions increased from age 45 for all ethnic groups, but the rise was most pronounced among Māori and Pacific peoples. Admission rates then decreased from age 85 years.



Figure 15: Hospital Admissions with a First ASA Score of 4 or 5 by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with an ASA score of 4 or 5 and either a general anaesthetic or a neuraxial block.

**Denominator:** Statistics New Zealand Estimated Resident Population (projected from 2008).

Ethnicity is Level 1 prioritised.

MELAA: Middle Eastern/Latin American/African.

## Background: Hospital Admissions for Severe Post-operative Sepsis following General or Neuraxial Anaesthesia

Information from the NMDS was used to review hospital admissions for severe post-operative sepsis in the 30 days following general or neuraxial anaesthesia. Patients with a primary diagnosis of severe sepsis and those with cancer, immunocompromise, or pregnancy-related admissions were excluded from analyses.

### Hospital admissions with severe sepsis following one or more general anaesthetics by admission type

In New Zealand during 2008–2012, the majority of admissions with severe sepsis following one or more general/neuraxial anaesthetics were acute admissions (76%). Publicly arranged admissions (semi-acute admissions occurring within seven days of referral) were the least common admission type (3.3%) (Table 8).

Table 8: Hospital Admissions with Severe Sepsis following One or More General/Neuraxial Anaesthetics by Admission Type, New Zealand 2008–2012

SEVERE SEPSIS ADMISSIONS	ADMISSION TYPE		
	Acute	Arranged in Public	Elective/Waiting List
Number	1,068	47	291
Annual Average	213.6	9.4	58.2

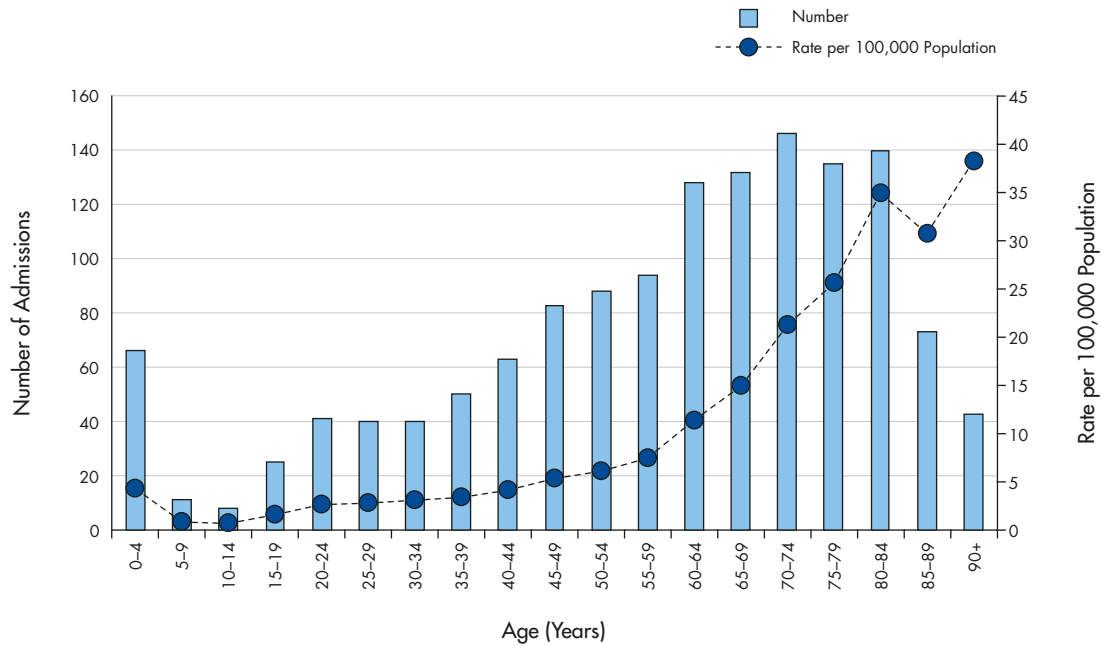
Data source: NMDS: Hospital admissions with severe sepsis following a general/neuraxial anaesthetic.

### Admissions with severe sepsis following one or more general anaesthetics by age

In New Zealand during 2008–2012, the number of admissions related to severe sepsis following one or more general or neuraxial anaesthetics initially peaked at ages 0–4 years before declining by ages 10–14 years and then increasing again to reach the highest number at ages 70–74 years (Figure 16). Admission numbers then decreased after age 84 years. The underlying age structure of New Zealand resulted in the admission rate following a similar pattern but the highest peak was among those aged 90+ years.



Figure 16: Hospital Admissions for Severe Sepsis following One or More General/Neuraxial Anaesthetics by Age, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions related to severe sepsis following one or more general/neuraxial anaesthetics listed in a secondary diagnosis field.

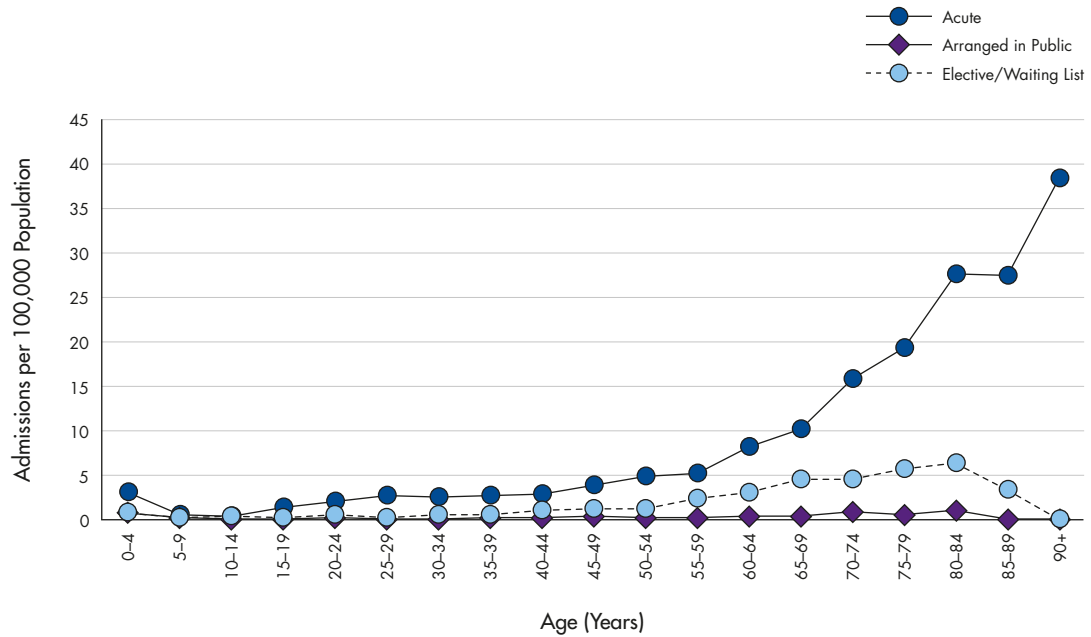
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions with severe sepsis following one or more general anaesthetics by age and admission type

In New Zealand during 2008–2012, the rate of acute admissions related to severe sepsis following one or more general or neuraxial anaesthetics initially peaked at ages 0–4 years before declining by ages 10–14 years and then increasing again at age 60 years, where the rate then increased sharply for the older age groups, reaching the highest rate at ages 90+ years (Figure 17). The admission rates for arranged in public (semi-acute) and elective/waiting list admissions exhibited a similar pattern but declined after age 80 years. Admission rates for acute admissions were generally higher than rates for semi-acute admissions and semi-acute admission rates were higher than elective/waiting list rates.



Figure 17: Hospital Admissions for Severe Sepsis following One or More General/Neuraxial Anaesthetics by Age and Admission Type, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions related to severe sepsis following one or more general/neuraxial anaesthetics listed in a secondary diagnosis field.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions with severe sepsis following one or more general anaesthetics by age, admission type and gender

#### Acute admissions

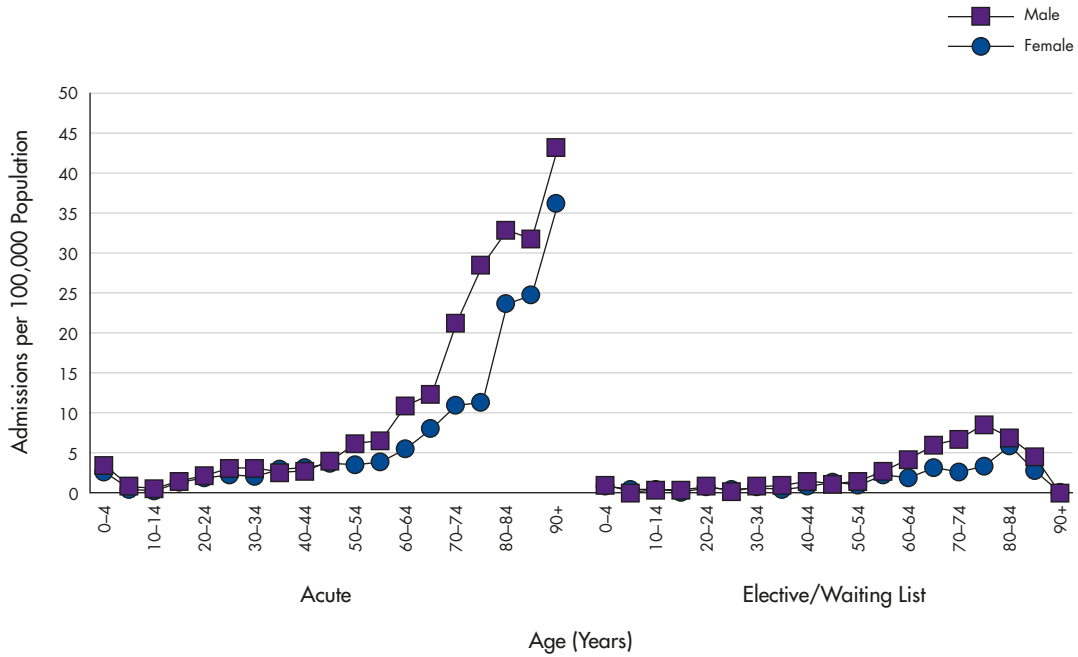
In New Zealand during 2008–2012, acute admission rates for males related to severe sepsis following one or more general/neuraxial anaesthetics decreased during childhood, with rates reaching their low point at ages 10–14 years, before increasing to a small peak in the late 20s (Figure 18). After this age, male acute admissions increased again from age 49 years and reached the highest rate at ages 90+ years. Female rates had a similar pattern but were slightly lower and increased from age 60 to peak at 90+ years.

#### Elective/Waiting list admissions

Elective/Waiting list admissions were low for males and females aged under 50 years. Thereafter the rates increased for both males and females, although the rise was greater for males until age 80 years. After age 80 years the rates for both males and females were similar (Figure 18).



Figure 18: Hospital Admissions for Severe Sepsis following One or More General/Neuraxial Anaesthetics by Age, Gender and Admission Type, New Zealand 2008–2012



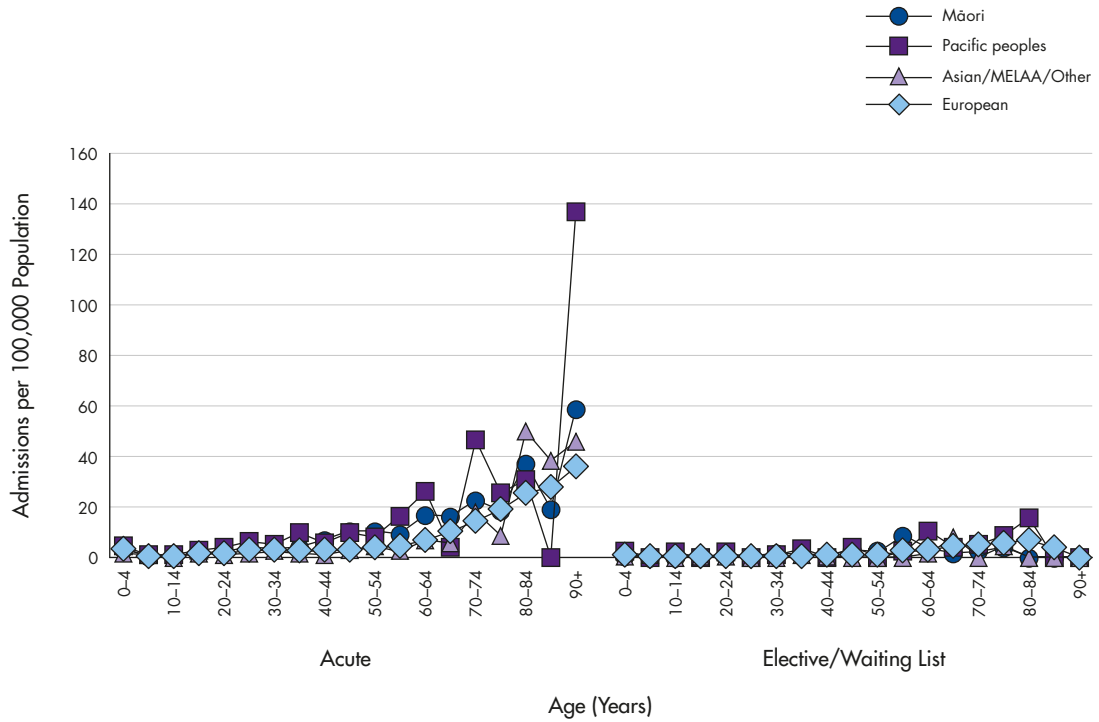
**Numerator:** NMDS: Hospital admissions related to severe sepsis following one or more general/neuraxial anaesthetics listed in a secondary diagnosis field.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions with severe sepsis following one or more general anaesthetics by age, admission type and ethnicity

In New Zealand during 2008–2012, acute admission rates with severe sepsis following procedures where one or more general anaesthetics were administered were generally higher for Māori and Pacific peoples than for people of European ethnicity (Figure 19). Ethnic differences among those aged 80+ years are less consistent and may reflect small numbers. Elective/Waiting list admission rates with severe sepsis following general/neuraxial anaesthesia were comparatively similar across ethnic groups.

Figure 19: Hospital Admissions with Severe Sepsis following One or More General Anaesthetics by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions related to severe sepsis following one or more general/neuraxial anaesthetics listed in a secondary diagnosis field.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

MELAA: Middle Eastern/Latin American/African.



## Background Information on Mortality and Hospital Admissions for Cholecystectomy

Information from the NMDS and the NMC was used to review mortality and hospital admissions in the first 30 days following cholecystectomy. Consistent with the previous report (covering 2007–2011), procedures in which a cholecystectomy was conducted as a minor component of a more extensive operation have been removed from these analyses (approximately 420 cases).

### Background: Mortality following Cholecystectomy

#### Mortality by type of procedure

In New Zealand during 2008–2012, most deaths (67%) were associated with an open procedure (Table 9). The mortality rate for open procedures was 4.25% of admissions. This mortality rate was considerably higher than the rate associated with laparoscopic procedures (0.08% of admissions) and also higher than the rate associated with those laparoscopic procedures that became an open procedure (1.03% of admissions). It is possible that the characteristics of the patients selected for the procedure and the procedure itself may contribute to the higher risk of death following open cholecystectomy.

Table 9: Mortality following Cholecystectomy by Main Procedure Type, New Zealand 2008–2012

MAIN TYPE OF PROCEDURE	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Cholecystectomy</b>			
Laparoscopic	22	4.4	19.5
Laparoscopic Proceeding to Open	15	3.0	13.3
Open	76	15.2	67.3
<b>Total</b>	<b>113</b>	<b>22.6</b>	<b>100.0</b>

Data source: NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.

#### Mortality by admission type and cause of death

In New Zealand during 2008–2012, gastrointestinal causes including gallbladder calculi and other disorders of the gallbladder biliary tract and pancreas were the most frequently listed main underlying cause of death for those dying within 30 days of an acute admission for cholecystectomy (Table 10). Malignant neoplasms as well as myocardial infarction/ischaemic heart disease also featured prominently for acute and elective/waiting list admissions. These trends are consistent with the findings for 2007–2011 and 2006–2010.

Table 10: Mortality following Cholecystectomy by Admission Type and Main Underlying Cause of Death, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Cholecystectomy</b>			
<b>Acute</b>			
Malignant Neoplasms	15	3.0	19.2
Gallbladder Calculi	18	3.6	23.1
Other Disorders Gallbladder, Biliary Tract and Pancreas	12	2.4	15.4
Myocardial Infarction/Other Ischaemic Heart Disease	10	2.0	12.8
Other Cardiovascular Causes	5	1.0	6.4
Other Causes	18	3.6	23.1
<b>Total Acute</b>	<b>78</b>	<b>15.6</b>	<b>100.0</b>
<b>Arranged in Public</b>			
All Causes	2	0.4	100.0
<b>Total Arranged in Public</b>	<b>2</b>	<b>0.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Malignant Neoplasms	13	2.6	40.6
Gallbladder Calculi	7	1.4	21.9
Other Disorders Gallbladder, Biliary Tract and Pancreas	<3	s	s
Myocardial Infarction/Other Ischaemic Heart Disease	8	1.6	25.0
Other Causes	3	0.6	9.4
<b>Total Elective/Waiting List</b>	<b>32</b>	<b>6.4</b>	<b>100.0</b>

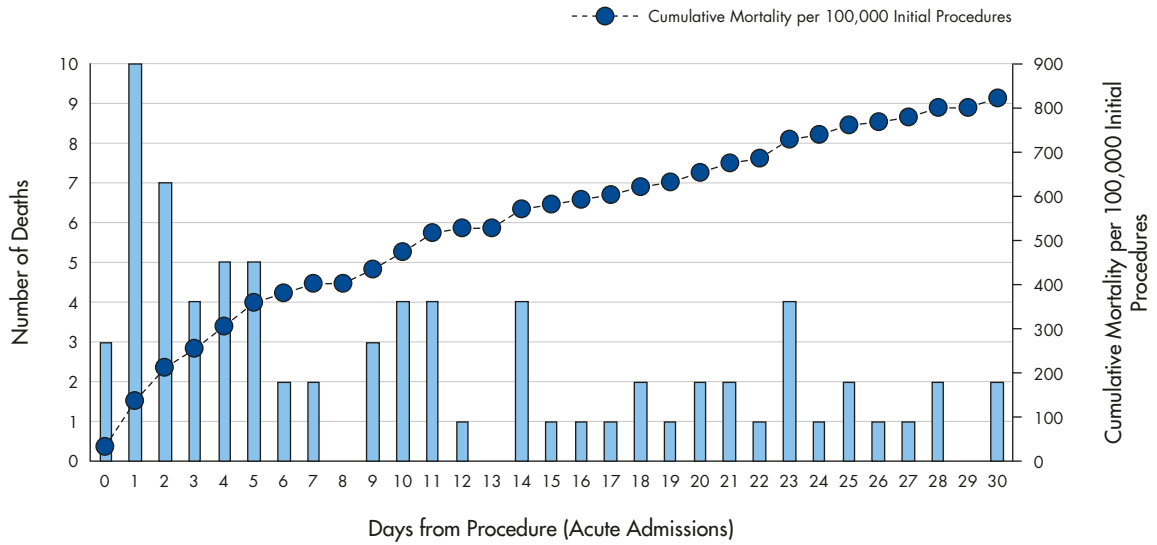
Data source: NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.  
s: Rates suppressed due to small numbers.

### Mortality by day from procedure

Mortality following acute cholecystectomy during 2008–2012 was highest on the first day after surgery (Figure 20), whilst for elective/waiting list admissions, the highest number of deaths occurred seven days after surgery (Figure 21). The number of deaths was more sporadic over the following three weeks for both admission types. Cumulative 30-day mortality was higher for acute admissions (0.82% of initial procedures) than elective/waiting list admissions (0.18% of initial procedures). Compared with 2006–2010, cumulative mortality has decreased slightly for acute admissions and risen slightly for elective/waiting list admissions.

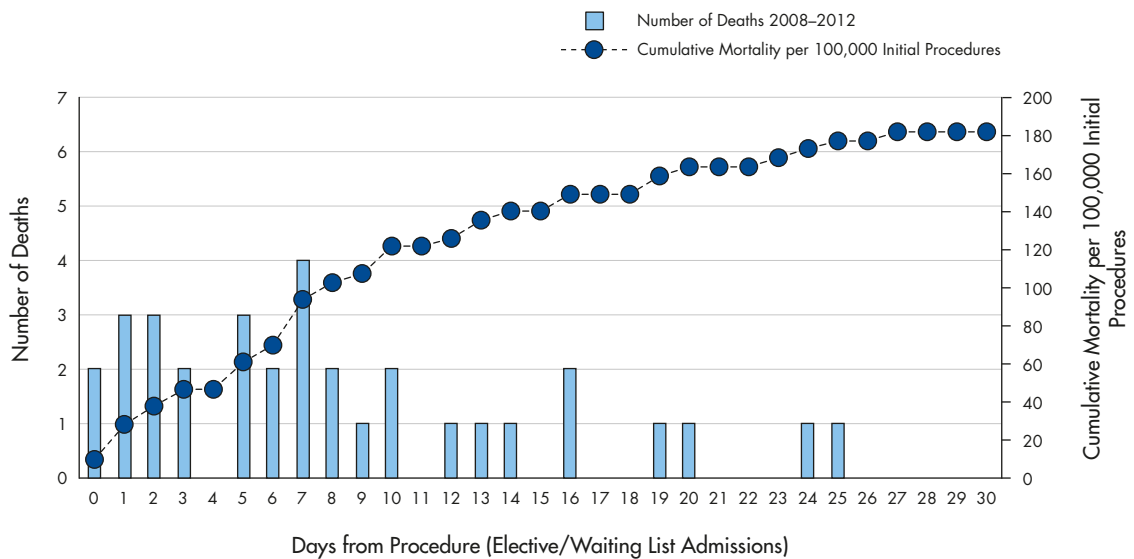


Figure 20: Mortality following Acute Admission for Cholecystectomy by Day from Procedure, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.  
**Denominator:** NMDS: Acute admissions with a cholecystectomy listed in any of the first 90 procedures.

Figure 21: Mortality following Elective/Waiting List Admissions for Cholecystectomy by Day from Procedure, New Zealand 2008–2012

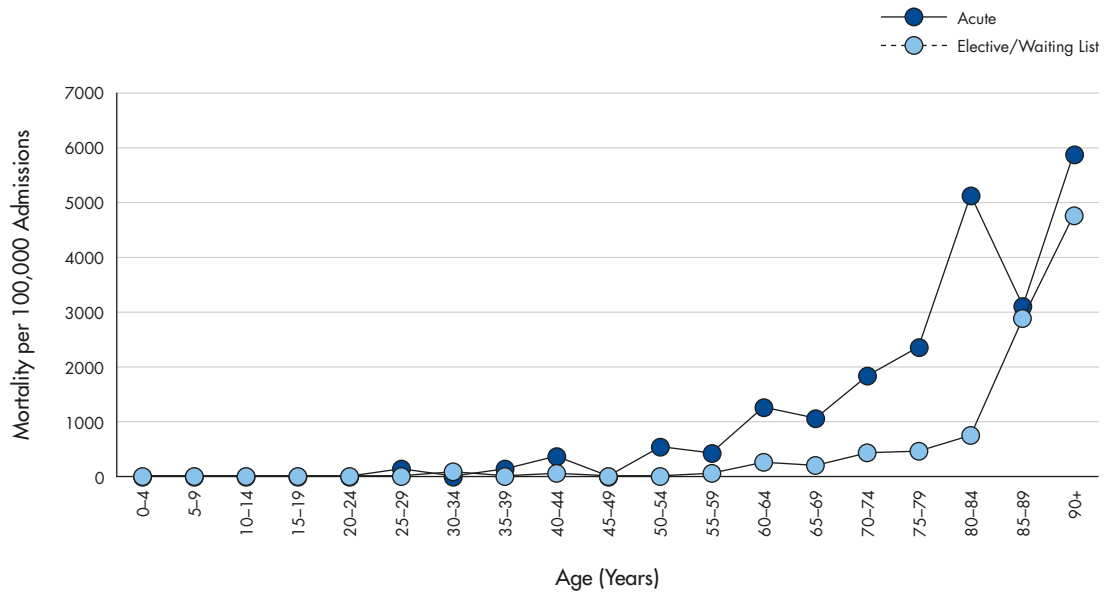


**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.  
**Denominator:** NMDS: Elective/Waiting list admissions with a cholecystectomy listed in any of the first 90 procedures.

### Mortality by age

From 2008–2012, mortality following cholecystectomy for acute admissions was relatively infrequent in those younger than 60 years, after which rates increased to reach a maximum at 90+ years (Figure 22). There were relatively low rates of mortality among elective/waiting list admissions until the age of about 70 years where the rates increased, reaching their highest point at age 90+ years. At most ages, mortality rates were generally lower among elective/waiting list admissions than rates among acute admissions. The pattern of increasing mortality with age is consistent with the findings noted in previous reports.

Figure 22: Mortality following Cholecystectomy by Admission Type and Age, New Zealand 2008–2012

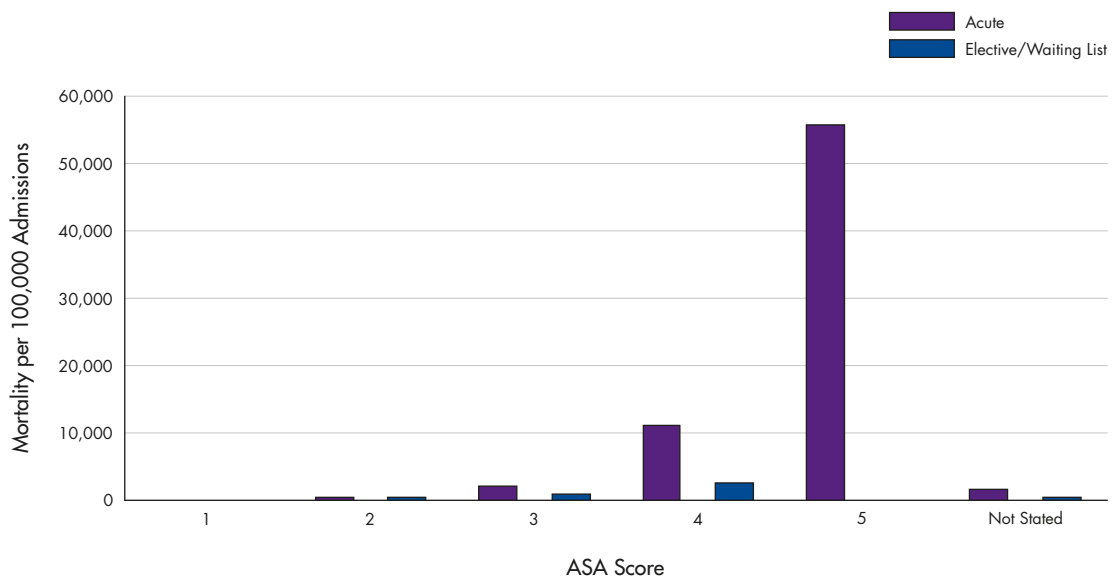


**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.  
**Denominator:** NMDS: Admissions with a cholecystectomy listed in any of the first 90 procedures.

### Mortality by ASA score

Mortality rates following cholecystectomy during 2008–2012 generally increased with increasing ASA score for all admission types (Figure 23). Higher rates of mortality were observed for those admitted acutely in each ASA score category. Mortality among acute admissions with ASA 5 was particularly high (55.6%). These patterns are consistent with those previously observed in the earlier reports with data from 2006–2010 and 2007–2011.

Figure 23: Mortality following Cholecystectomy by Admission Type and ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.  
**Denominator:** NMDS: Hospital admissions with a cholecystectomy listed in any of the first 90 procedures.



## Mortality by socio-demographic factors and ASA score

### *Acute admissions*

Mortality rates following acute admissions for cholecystectomy in New Zealand during 2008–2012 were significantly higher for those groups aged over 45 years of age (compared to 0–44 years), and for those with a first ASA score of 3 or more (compared with an ASA score 1–2) (Table 11). These differences were evident when the model was adjusted for other socio-demographic risk factors (age, gender, ethnicity and New Zealand Deprivation Index (NZDep) decile) and ASA score. These trends were consistent with the findings from 2006–2010 and 2007–2011. However, by contrast, the increase in mortality associated with deciles 9–10 for the NZDep was no longer statistically significant in the 2007–2011 and 2008–2012 multivariate models compared with the previous report that included 2006–2010 data.

### *Elective/Waiting list admissions*

From 2008–2012, mortality following elective/waiting list admissions for cholecystectomy was significantly higher for those groups aged 65+ years (vs. 0–44 years), those with an ASA score of 3 or 4 (vs. ASA score 1 or 2) and for those of Māori ethnicity (compared to Europeans) (Table 12), when other socio-demographic and clinical risk factors (age, gender, ethnicity, NZDep decile and ASA score) were accounted for. Compared with 2007–2011, the findings were generally similar except Pacific peoples were no longer at a statistically significant increased odds of death. During 2006–2010, there was a significant difference between males and females that did not show up at the multivariate level for 2007–2011 and 2008–12.



Table 1 1: Mortality following Acute Admissions for Cholecystectomy by Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>Cholecystectomy</b>									
<b>Acute</b>									
Age Group	0–44 Years	5	4,054	123.33	0.12	1.00		1.00	
	45–64 Years	16	3,051	524.42	0.52	4.27*	1.56–11.67	3.09*	1.07–8.89
	65–79 Years	30	1,770	1,694.92	1.69	13.96*	5.41–36.05	6.47*	2.29–18.31
	80+ Years	27	580	4,655.17	4.66	39.54*	15.16–103.09	14.64*	4.93–43.52
Gender	Male	47	3,124	1,504.48	1.50	1.00		1.00	
	Female	31	6,331	489.65	0.49	0.32	0.20–0.51	0.65	0.40–1.05
First ASA Score	1–2	9	6,791	132.53	0.13	1.00		1.00	
	3	28	1,429	1,959.41	1.96	15.10*	7.09–31.99	6.14*	2.77–13.60
	4	21	194	10,824.74	10.82	91.65*	41.27–203.04	29.72*	12.72–69.44
	5	5	9	55,555.56	55.56	H*	H*	H*	H*
	Not Stated	15	1,070	1,401.87	1.40	10.69*	4.67–24.49	7.76*	3.35–17.98
Ethnicity	European	59	6,197	952.07	0.95	1.00		1.00	
	Māori	12	1,470	816.33	0.82	0.86	0.46–1.60	1.69	0.80–3.56
	Pacific	6	844	710.90	0.71	0.75	0.32–1.73	1.69	0.68–4.21
	Asian/MELAA/ Other	<3	824	s	s	s	s	s	s
NZDep Decile	Decile 1–2	8	1,377	580.97	0.58	1.00		1.00	
	Decile 3–4	10	1,407	710.73	0.71	1.22	0.48–3.11	1.22	0.46–3.23
	Decile 5–6	17	1,806	941.31	0.94	1.63	0.70–3.78	1.71	0.71–4.16
	Decile 7–8	23	2,153	1,068.28	1.07	1.84	0.82–4.13	1.70	0.73–3.97
	Decile 9–10	20	2,669	749.34	0.75	1.29	0.57–2.94	1.32	0.54–3.26

**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.

**Denominator:** NMDS: Acute admissions with a cholecystectomy listed in any of the first 90 procedures.

\*: Significantly different to reference category, CI: Confidence interval, H: Odds ratios suppressed due to high mortality rates, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, s: Rates suppressed due to small numbers. Caution should be used in interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).



Table 12: Mortality following Elective/Waiting List Admissions for Cholecystectomy by Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>Cholecystectomy</b>									
<b>Elective/Waiting List</b>									
Age Group	0–44 Years	<3	7,891	\$	\$	1.00		1.00	
	45–64 Years	6	8,174	73.40	0.07	2.90	0.57–8.59	3.09	0.61–15.56
	65–79 Years	14	4,267	328.10	0.33	12.98*	2.95–57.16	12.07*	2.57–56.70
	80+ Years	11	765	1,437.91	1.44	57.55*	12.73–260	46.76*	9.06–241.37
Gender	Male	14	5,763	242.93	0.24	1.00		1.00	
	Female	19	15,334	123.91	0.12	0.51	0.26–1.02	0.93	0.45–1.92
First ASA Score	1–2	13	11,428	113.76	0.11	1.00		1.00	
	3	16	1,994	802.41	0.80	7.72*	3.38–17.62	3.55*	1.46–8.63
	4	2	87	2,298.85	2.30	27.30*	5.89–126.54	8.25*	1.66–41.04
	Not Stated	8	7,944	100.70	0.10	1.13	0.45–2.87	1.51	0.57–3.96
Ethnicity	European	23	16,234	141.68	0.14	1.00		1.00	
	Māori	6	2,475	242.42	0.24	1.71	0.70–4.21	2.96*	1.09–8.03
	Pacific	<3	583	\$	\$	\$	\$	\$	\$
	Asian/MELAA/Other	<3	1,257	\$	\$	\$	\$	\$	\$
	NZDep Decile	Decile 1–2	4	3,679	108.73	0.11	1.00		1.00
	Decile 3–4	4	3,724	107.41	0.11	1.32	0.30–5.92	0.76	0.15–3.80
	Decile 5–6	10	4,414	226.55	0.23	2.78	0.76–10.10	1.99	0.54–7.33
	Decile 7–8	9	5,225	172.25	0.17	1.17	0.28–4.92	0.83	0.20–3.54
	Decile 9–10	12	4,380	273.97	0.27	3.07	0.86–11.01	2.11	0.56–7.97

**Numerator:** NMC: Deaths occurring within 30 days of a cholecystectomy, as recorded in the NMDS.

**Denominator:** NMDS: Elective/Waiting list admissions with a cholecystectomy listed in any of the first 90 procedures.

\*: Significantly different to reference category. Ci: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, \$: Rates suppressed due to small numbers.

## Background: Hospital Admissions for Cholecystectomy

### Hospital admissions for cholecystectomy by admission type, hospital type and procedure

Laparoscopic cholecystectomy was the most common procedure performed on those admitted for cholecystectomy during 2008–2012 (Table 13), although a small number went on to open cholecystectomy. Similar numbers to those laparoscopic procedures that became open operations were open procedures from the outset. From 2008–2012, 70% of laparoscopic cholecystectomies were performed electively or from the waiting list, while 29% were for those admitted acutely. For open cholecystectomies during the same period, 53% were elective/waiting list patients, while 42% were admitted acutely. All acute and publicly arranged (semi-acute) procedures, and most elective/waiting list procedures (64%), were performed in public hospitals. The total number of admissions for any cholecystectomy was higher in the 2008–2012 period compared with 2006–2010 and 2007–2011. The number of open cholecystectomy procedures has decreased compared with 2006–2010.

Table 13: Hospital Admissions for Cholecystectomy by Admission Type and Procedure Type, New Zealand 2008–2012

PROCEDURE TYPE	Acute	Arranged in Public	Elective/Waiting List	Total
<b>Number of Admissions: Total 2008–2012</b>				
Laparoscopic Cholecystectomy	8,058	251	19,491	27,800
Laparoscopic Proceeding to Open	688	20	672	1,450
Open Cholecystectomy	758	79	961	1,798
Any Cholecystectomy	9,455	348	21,097	30,900
<b>Number of Admissions: Annual Average</b>				
Laparoscopic Cholecystectomy	1,611.6	50.2	3,898.2	5,560.0
Laparoscopic Proceeding to Open	137.6	4.0	134.4	290.0
Open Cholecystectomy	151.6	15.8	192.2	359.6
Any Cholecystectomy	1,891.0	69.6	4,219.4	6,180.0
<b>Admissions (%)</b>				
Laparoscopic Cholecystectomy	29.0	0.9	70.1	100.0
Laparoscopic Proceeding to Open	47.4	1.4	46.3	100.0
Open Cholecystectomy	42.2	4.4	53.4	100.0
Any Cholecystectomy	30.6	1.1	68.3	100.0

**Data source:** NMDS: Hospital admissions with a new cholecystectomy procedure listed in any of the first 90 procedures.

Note: Procedure type numbers do not sum to 'Any Cholecystectomy' total as in a small number of cases more than one procedure type was listed.

### Admissions by primary diagnosis

In New Zealand during 2008–2012, a gallbladder calculus with acute cholecystitis was the most common primary diagnosis for those admitted acutely for cholecystectomy, followed by gallbladder calculi with other cholecystitis (Table 14). For elective/waiting list admissions, gallbladder calculi with other cholecystitis was the most frequent primary diagnosis, while unspecified diseases of the gallbladder were the second most common. Compared with 2006–2010, the most frequent primary diagnoses have not changed for acute and elective/waiting list cholecystectomy admissions. The total number of acute admissions for cholecystectomy has increased during the 2007–2011 period, while the number of elective/waiting list admissions has remained similar.



Table 14: Hospital Admissions for Cholecystectomy by Primary Diagnosis and Admission Type, New Zealand 2008–2012

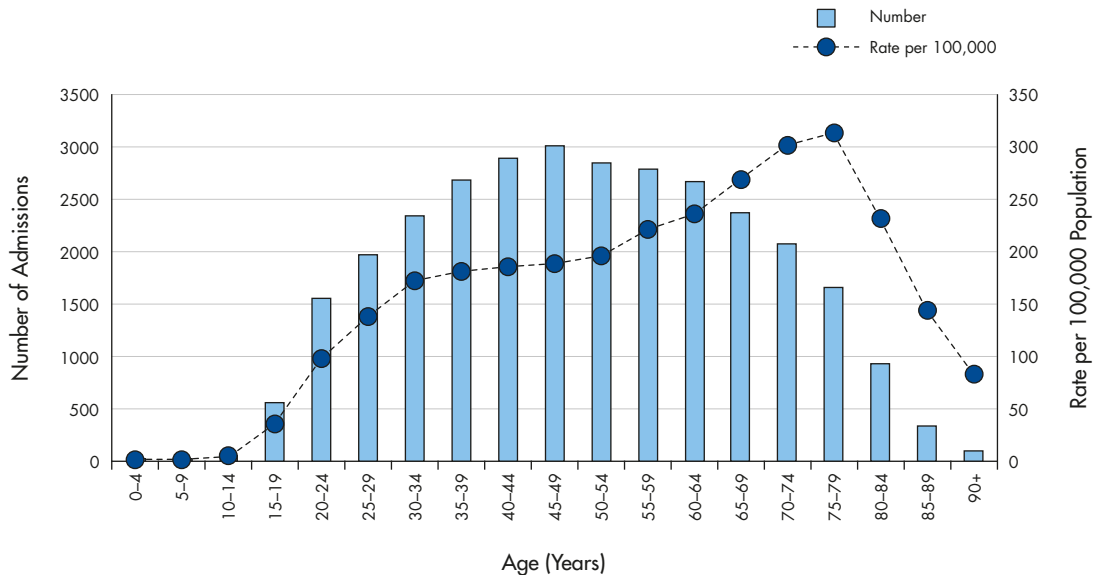
PRIMARY DIAGNOSIS	Number: Total 2008–2012	Number: Annual Average	Admissions (%)
<b>Cholecystectomy Admissions</b>			
<b>Acute</b>			
Gallbladder Calculi: With Acute Cholecystitis	3,621	724.2	38.3
Gallbladder Calculi: With Other Cholecystitis	2,672	534.4	28.3
Gallbladder Calculi: Without Cholecystitis	196	39.2	2.1
Gallbladder Calculi: Other	604	120.8	6.4
Acute Pancreatitis	895	179.0	9.5
Cholecystitis: Chronic	339	67.8	3.6
Cholecystitis: Other/Unspecified	656	131.2	6.9
Diseases of Gallbladder: Other Specified	77	15.4	0.8
Other Diseases of Biliary Tract	28	5.6	0.3
Malignant Neoplasms of Digestive Organs	81	16.2	0.9
Other Diagnoses	286	57.2	3.0
<b>Total Acute</b>	<b>9,455</b>	<b>1,891.0</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Gallbladder Calculi: With Acute Cholecystitis	44	8.8	12.6
Gallbladder Calculi: With Other Cholecystitis	142	28.4	40.8
Gallbladder Calculi: Without Cholecystitis	12	2.4	3.4
Gallbladder Calculi: Other	32	6.6	9.5
Malignant Neoplasms of Digestive Organs	25	5.0	7.2
Acute Pancreatitis	30	6.0	8.6
Cholecystitis: Chronic	22	4.4	6.3
Cholecystitis: Other/Unspecified	10	2.0	2.9
Other Diagnoses	31	6.2	8.9
<b>Total Arranged in Public</b>	<b>348</b>	<b>69.6</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Gallbladder Calculi: With Acute Cholecystitis	752	150.4	3.6
Gallbladder Calculi: With Other Cholecystitis	10,063	2,012.6	47.7
Gallbladder Calculi: Without Cholecystitis	1,353	270.6	6.4
Gallbladder Calculi: Other	578	115.6	2.7
Diseases of Gallbladder: Other Specified	224	44.8	1.1
Diseases of Gallbladder: Unspecified	5,127	1,025.4	24.3
Cholecystitis: Chronic	1,645	329.0	7.8
Cholecystitis: Other/Unspecified	280	56.0	1.3
Other Diseases of Biliary Tract	21	4.2	0.1
Malignant Neoplasms of Digestive Organs	283	56.6	1.3
Acute Pancreatitis	217	43.4	1.0
Other Diagnoses	554	110.8	2.6
<b>Total Elective/Waiting List</b>	<b>21,097</b>	<b>4,219.4</b>	<b>100.0</b>

Data source: NMDS: Hospital admissions with a cholecystectomy listed in any of the first 90 procedures.

### Admissions by age

While the number of cholecystectomy admissions during 2008–2012 peaked in those aged 45–49 years, the underlying age structure of the New Zealand population meant that the highest proportion of admissions were seen in those aged 75–79 years (Figure 24). This has not changed since the last reports for 2006–2010 and 2007–2011.

Figure 24: Hospital Admissions for Cholecystectomy by Age, New Zealand 2008–2012



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

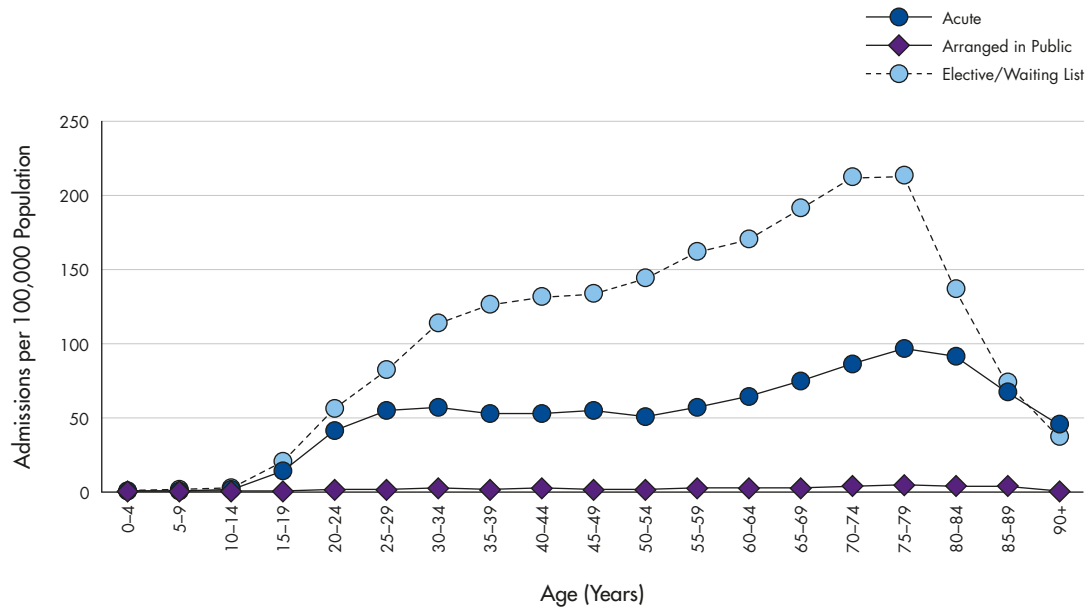
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age and admission type

During 2008–2012, elective/waiting list admissions were infrequent in children younger than 14 years, but increased thereafter, peaking in those aged 70–79 years (Figure 25). Admission rates then declined rapidly for those aged in their 80s and 90s. Acute admissions were also infrequent in those aged under 14 years, but increased for those in their late teens and 20s. Rates then remained relatively static until 50 years of age, after which they increased to reach a peak at ages 75–79 years, before declining. Acute admission rates were lower than elective/waiting list rates for all age groups except for those aged 90+ years. These trends were largely similar to the 2006–2010 and 2007–2011 findings.



Figure 25: Hospital Admissions for Cholecystectomy by Age and Admission Type, New Zealand 2008–2012



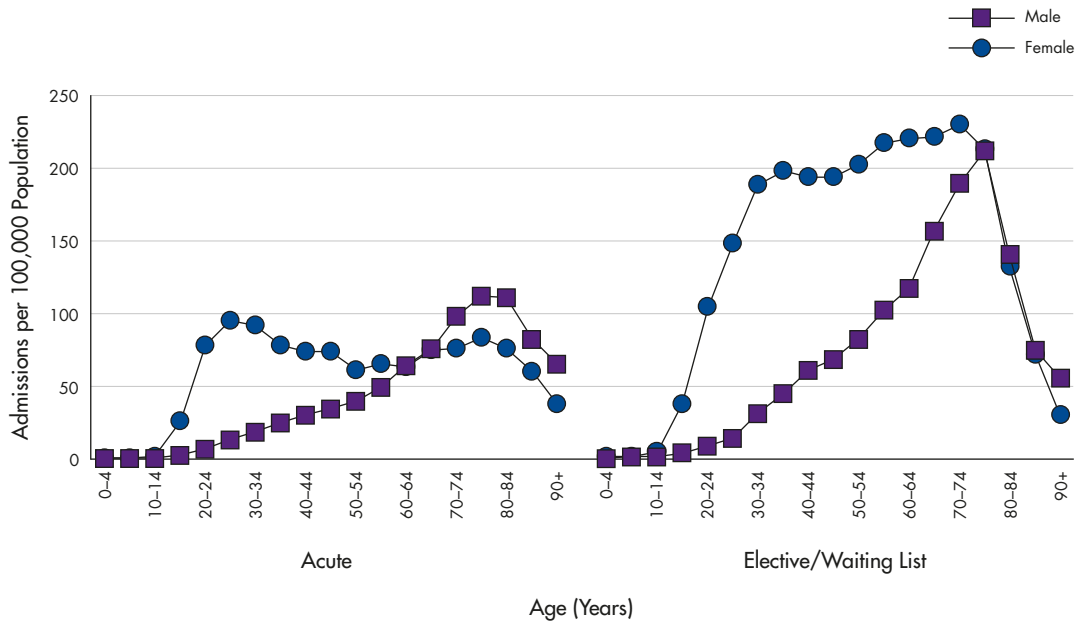
**Numerator:** NMDS: Hospital admissions with a cholecystectomy listed in any of the first 90 procedures.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age, admission type and gender

When broken down by gender, admission rates for cholecystectomy were higher for females than males from the ages of 15–59 years for acute admissions, and 10–79 years for elective/waiting list admissions (Figure 26). Admission rates for males clearly peaked at 80–84 years for acute admissions and 75–79 years for elective/waiting list admissions, while female rates peaked at 25–29 years and again at 75–79 years for acute admissions, and 70–74 years for elective/waiting list admissions. Compared with 2006–2010 and 2007–2011, admission rates remain generally similar. The peak in elective/waiting list admissions for females in 2007–2011 and 2008–2012 shows a small shift to the right compared to the 2006–2010 period, where the highest female admission rates were for those aged 60–64 years compared to 70–74 years in the later periods.

Figure 26: Hospital Admissions for Cholecystectomy by Age, Admission Type and Gender, New Zealand 2008–2012



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

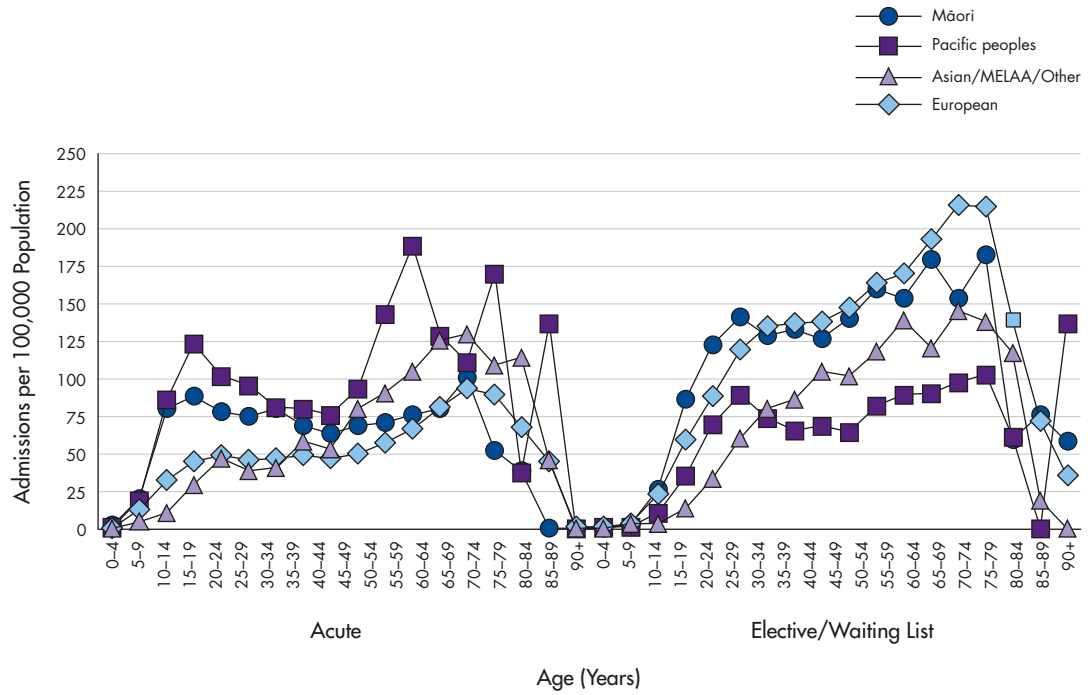
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age, admission type and ethnicity

From 2008–2012, acute admission rates for cholecystectomy were higher for Māori and Pacific peoples than for those of European ethnicity aged from 10 years up to 54 years (Figure 27). Pacific peoples also had high acute admission rates in some of the older age groups. By contrast, elective/waiting list admission rates were higher for people of European ethnicity than for other ethnic groups from the age of 35 years to 84 years. Pacific peoples also had lower rates of elective/waiting list admissions than Māori from the ages of 14–79 years.



Figure 27: Hospital Admissions for Cholecystectomy by Age, Admission Type and Ethnicity, New Zealand 2008–2012



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

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

Ethnicity is Level 1 prioritised.

MELAA: Middle Eastern/Latin American/African.



# Background Information on Mortality and Hospital Admissions following General Anaesthesia

Information from the NMDS and the NMC was used to review same and next day mortality following a general anaesthetic, as well as hospital admissions where one or more general anaesthetics were performed.

## Background: Mortality following General Anaesthesia

### Mortality by admission type and hospital type

In New Zealand during 2008–2012, there were 1436 deaths on the same or next day following a general anaesthetic (0.12% of admissions). Most of these deaths occurred during an acute admission (1041 (72%)) and at a public hospital (99%). All of the six deaths at private hospitals occurred among elective/waiting list admissions. The same/next day mortality rate following an anaesthetic 2007–2011 was 0.13% of admissions.

### Mortality by admission type and cause of death

In New Zealand during 2008–2012, for all admission types, cardiovascular causes were the most commonly listed underlying reason for mortality within the first day of receiving a general anaesthetic (Table 15). Cancers and gastrointestinal conditions also featured prominently. Compared with 2007–2011, total mortality following a general anaesthetic has slightly decreased for acute and elective/waiting list admission types.



Table 15: Same or Next Day Mortality following Hospital Admissions with One or More General Anaesthetics by Admission Type and Main Underlying Cause of Death, New Zealand 2008–2012

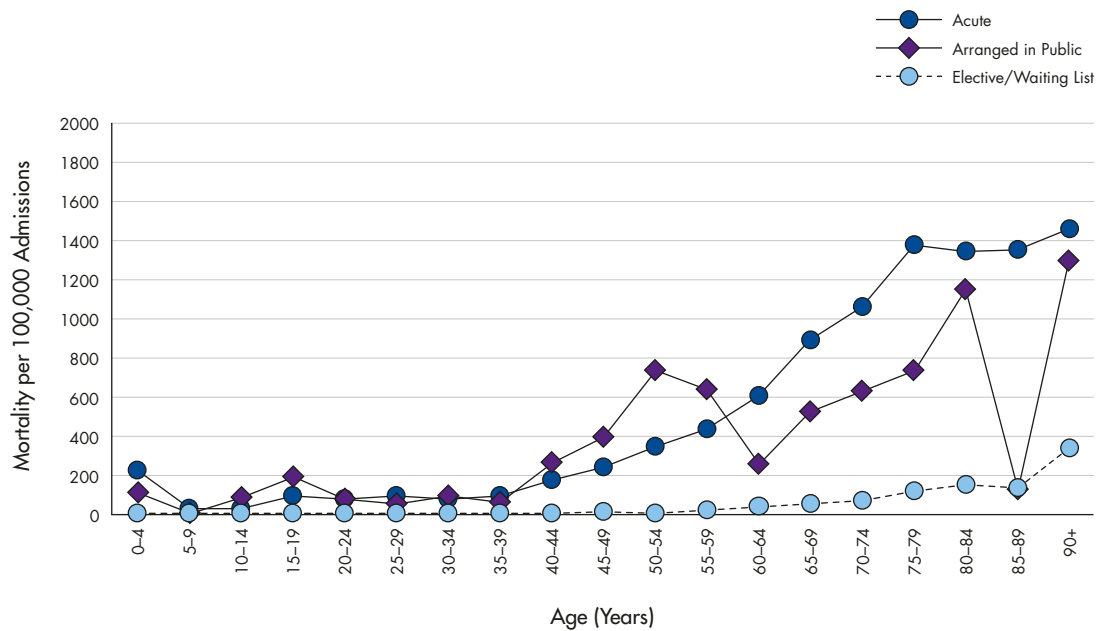
MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>General Anaesthetic</b>			
<b>Acute</b>			
Myocardial Infarction	97	19.4	9.32
Other Ischaemic Heart Disease	68	13.6	6.53
Other Cardiovascular Causes	267	53.4	25.65
Non-Insulin Dependent Diabetes	19	3.8	1.83
Cancers	103	20.6	9.89
Emphysema and COPD	6	1.2	0.58
Other Respiratory Diseases	11	2.2	1.06
Gastrointestinal Conditions	165	33.0	15.85
Falls	67	13.4	6.44
Other Injuries/External Causes	105	21.0	10.09
Other Causes	133	26.6	12.78
<b>Total Acute</b>	<b>1,041</b>	<b>208.2</b>	<b>100.00</b>
<b>Arranged in Public</b>			
Myocardial Infarction	10	2.0	4.7
Other Ischaemic Heart Disease	17	3.4	8.0
Other Cardiovascular Causes	85	17.0	40.1
Cancers	16	3.2	7.5
Respiratory Diseases	<3	s	s
Gastrointestinal Conditions	11	2.2	5.2
Falls	9	1.8	4.2
Other Injuries/External Causes	27	5.4	12.7
Other Causes	35	7.0	16.5
<b>Total Arranged in Public</b>	<b>212</b>	<b>42.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Myocardial Infarction	9	1.8	4.9
Other Ischaemic Heart Disease	22	4.4	12.0
Other Cardiovascular Causes	62	12.4	33.9
Cancers	57	11.4	31.1
Gastrointestinal Conditions	13	2.6	7.1
Other Causes	20	4.0	10.9
<b>Total Elective/Waiting List</b>	<b>183</b>	<b>36.6</b>	<b>100.0</b>
<b>Grand Total</b>	<b>1,436</b>	<b>287.2</b>	<b>100.0</b>

**Data source:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic (as recorded in the NMDS).  
 COPD: chronic obstructive pulmonary disease.  
 s: Rates suppressed due to small numbers.

### Mortality by age and admission type

In New Zealand during 2008–2012, mortality following general anaesthesia on the same or next day increased with increasing age for all admission types, although a small peak in mortality is evident for those aged 0–4 years in the acute category (Figure 28). Acute admissions had higher mortality rates in every age group compared with those admitted electively or from the waiting list. However mortality rates for people aged between 40–59 years were higher among arranged public hospital (semi-acute) admissions in comparison with acute admissions. These observations are consistent with mortality rates in 2007–2011.

Figure 28: Same or Next Day Mortality following Hospital Admissions with One or More General Anaesthetics by Age and Admission Type, New Zealand 2008–2012



**Numerator:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.

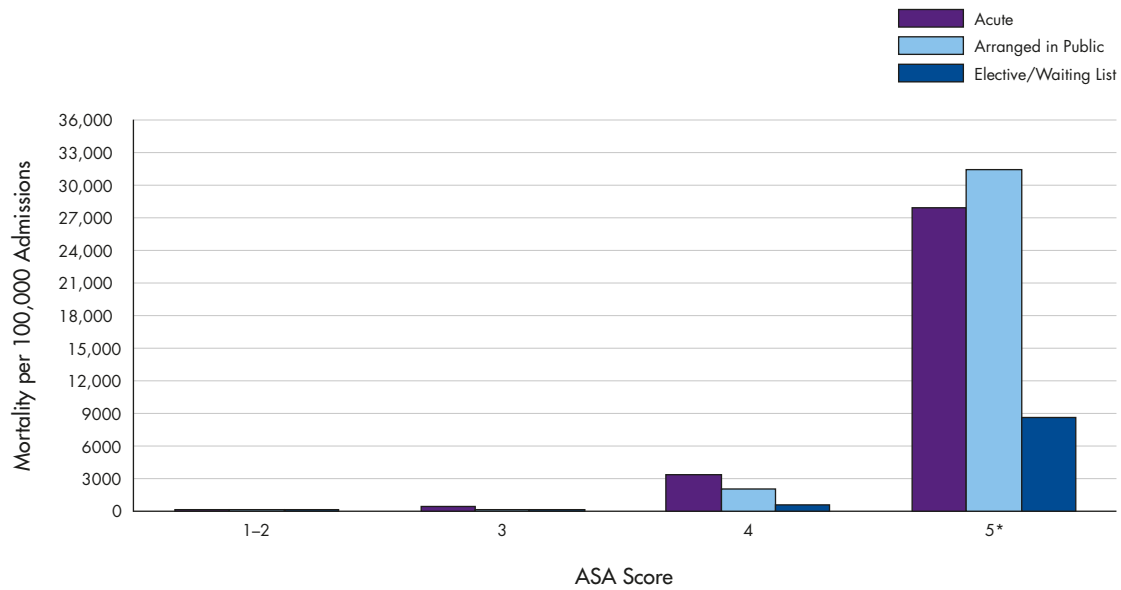
**Denominator:** NMDS: Hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures.

### Mortality by ASA score

Same or next day mortality following general anaesthesia increased with ASA score for each admission type during 2008–2012 (Figure 29). Within ASA categories 1–4, and most evident for those admissions with an ASA score of 3 or 4, there was a higher rate of mortality for those admitted acutely than for those admitted electively or from the waiting list, or those admitted semi-acutely (arranged in public). Among those patients admitted with an ASA score of 5 there were high mortality rates, especially for publicly arranged semi-acute admissions. Note that the sample sizes were small for elective/waiting list admissions with ASA scores of 5 (<3 deaths). These results are similar to those from 2005–2009 and 2007–2011.



Figure 29: Same or Next Day Mortality following Hospital Admissions with One or More General Anaesthetics by Admission Type and ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.  
**Denominator:** NMDS: Hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures.  
ASA score is first listed ASA score per admission.  
\*Care should be taken when interpreting ASA 5 scores for elective/waiting list and semi-acute admissions, as each are based on <3 deaths.

### Mortality by socio-demographic factors, number of anaesthetics and ASA score

#### Acute admissions

During 2008–2012, same or next day mortality following an acute hospital admission with one or more general anaesthetics was significantly higher for those age groups over 65 years (vs. 45–64 years), those who received more than one anaesthetic during their admission, and those with a first ASA score of 3 or more (Table 16). The risk of mortality was significantly lower for those groups aged under 45 years (vs. 45–64 years). The differences for each of these variables was statistically significant after the other socio-demographic and clinical factors in the multivariate model (age, gender, ethnicity, NZDep decile and ASA score) were adjusted for.

Compared with 2005–2009, the multivariate regression suggests that there is no longer a significantly higher risk of mortality for those of Māori or Asian/MELAA/Other ethnicity (vs. European ethnicity) (POMRC 2012)). Similarly, the statistical difference in mortality shown for those living in more deprived (deciles 9–10 compared with deciles 1–2) areas in 2005–2009 was not significant during 2007–2011 or 2008–2012.

#### Elective/Waiting list admissions

Same or next day mortality after an elective/waiting list hospital admission with a general anaesthetic during 2008–2012 was significantly higher for those groups aged over 65 years (vs. 45–64 years), those who received more than one anaesthetic during their admission, Māori (vs. European), those in NZDep deciles 7 and 8 (vs. 1 and 2), and those with a first ASA score of 3 or 4 (vs. ASA score 1 or 2) (Table 17). The risk of mortality was significantly lower for those aged 25–44 years (vs. 45–64 years). These differences were evident after socio-demographic and clinical factors (age, gender, ethnicity, NZDep decile and ASA score) were adjusted for in the multivariate model.

The results from the multivariate analyses were consistent between the 2005–2009, 2007–2011 and 2008–2012 periods. Compared with 2005–2009, there was no significant difference in NZDep deciles 9 and 10 at the multivariate level in 2007–2011 and 2008–2012. A notable difference between 2007–2011 and 2008–2012 was the significant increase in mortality for Māori evident in 2008–2012.

*Last ASA score and emergency status for all admissions combined*

During 2008–2012, when the emergency status and ASA score of the last listed general anaesthetic was considered, same or next day mortality following any admission type with one or more general anaesthetics was significantly higher for those age groups over 65 years (vs. 45–64 years), those with an ASA score of 3, 4, 5 or not stated (vs. ASA score 1 or 2), those with more than one anaesthetic during their admission, and those procedures that were given an emergency status (Table 18). Age groups less than 45 years of age were associated with a reduction in the mortality odds ratio. These trends have not markedly changed when compared with the previous 2005–2009 and 2007–2011 periods.



Table 16: Same Day or Next Day Mortality following Acute Admissions with One or More General Anaesthetics by Age, Gender, Number of Anaesthetics, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>General Anaesthetic</b>									
Age Group	0–24 Years	93	103,260	90.1	0.09	0.23*	0.18–0.29	0.41*	0.31–0.53
	25–44 Years	83	76,517	108.5	0.11	0.27*	0.21–0.35	0.49*	0.37–0.64
	45–64 Years	230	57,984	396.7	0.40	1.00		1.00	
	65–79 Years	360	32,947	1,092.7	1.09	2.77*	2.35–3.28	1.73*	1.44–2.07
	80+ Years	275	20,101	1,368.1	1.37	3.48*	2.92–4.15	1.97*	1.62–2.41
Gender	Male	590	154,521	381.8	0.38	1.00		1.00	
	Female	451	136,288	330.9	0.33	0.87*	0.77–0.98	0.90	0.79–1.03
Number of Anaesthetics	1	819	269,560	303.8	0.30	1.00		1.00	
	2+	222	21,249	1,044.8	1.04	3.47*	2.99–4.02	1.89*	1.60–2.22
	1–2	51	190,143	26.8	0.03	1.00		1.00	
	3	172	37,488	458.8	0.46	17.17*	12.56–23.47	8.30*	5.96–11.55
	4	384	10,997	3,491.9	3.49	134.79*	100.59–180.62	58.42*	42.68–79.97
First ASA Score	5	178	637	27,943.5	27.94	H*	H	H*	H
	Not Stated	12	16	75,000.0	75.00	H*	H	H*	H
	European	745	187,284	397.8	0.40	1.00		1.00	
	Māori	152	53,018	286.7	0.29	0.72*	0.61–0.86	1.18	0.97–1.44
	Pacific	71	26,567	267.2	0.27	0.67*	0.53–0.86	1.11	0.84–1.47
Ethnicity	Asian/MELAA/Other	49	19,925	245.9	0.25	0.62*	0.46–0.82	0.97	0.71–1.33
	Decile 1–2	130	43,373	299.7	0.30	1.00		1.00	
	Decile 3–4	122	44,404	274.8	0.27	0.92	0.72–1.17	0.80	0.62–1.04
	Decile 5–6	199	54,725	363.6	0.36	1.21	0.97–1.52	1.09	0.86–1.37
	Decile 7–8	279	66,077	422.2	0.42	1.41*	1.15–1.74	1.18	0.95–1.47
NZDep Decile	Decile 9–10	292	79,149	368.9	0.37	1.23*	1.00–1.52	1.19	0.95–1.48

**Numerator:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.

**Denominator:** NMBDS: Acute hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures. ASA score is first listed ASA score per admission.

\*: Significantly different from reference category. CI: Confidence interval. H: Odds ratios suppressed due to high mortality rates, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio. Caution should be used in interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).

Table 17: Same Day or Next Day Mortality following Elective/Waiting List Admissions with One or More General Anaesthetics by Age, Gender, Number of Anaesthetics, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>General Anaesthetic</b>									
Age Group	0–24 Years	<3	227,978	0.4	0.000	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>
	25–44 Years	6	172,343	3.5	0.002	0.23*	0.10–0.55	0.24*	0.09–0.62
	45–64 Years	37	245,472	15.1	0.01	1.00		1.00	
	65–79 Years	93	126,806	73.3	0.08	4.87*	3.33–7.13	3.15*	2.11–4.70
	80+ Years	46	29,783	154.5	0.17	10.26*	6.66–15.82	5.60*	3.50–8.98
Gender	Male	104	374,563	27.8	0.03	1.00		1.00	
	Female	79	427,817	18.5	0.02	0.67*	0.50–0.89	0.89	0.66–1.20
Number of Anaesthetics	1	88	796,335	11.1	0.01	1.00		1.00	
	2+	95	6,047	1,571.0	1.44	144.42*	107.94–193.22	61.29*	44.42–84.58
First ASA Score	1–2	29	389,960	7.4	0.01	1.00		1.00	
	3	64	68,961	92.8	0.11	12.49*	8.05–19.37	3.17*	2.01–4.99
	4	35	5,577	627.6	0.67	84.92*	51.87–139.10	11.09*	6.54–18.81
	5	<3	23	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>
	Not Stated	53	337,855	15.7	0.01	2.11*	1.34–3.32	2.52*	1.59–3.99
Ethnicity	European	139	590,798	23.5	0.02	1.00		1.00	
	Māori	26	98,169	26.5	0.03	1.13	0.74–1.71	2.13*	1.34–3.38
	Pacific	7	36,711	19.1	0.02	0.81	0.38–1.73	1.28	0.54–3.04
	Asian/MELAA/Other	9	49,094	18.3	0.02	0.78	0.40–1.53	1.80	0.90–3.59
NZDep Decile	Decile 1–2	19	148,828	12.8	0.01	1.00		1.00	
	Decile 3–4	28	146,258	19.1	0.02	1.50	0.84–2.69	1.28	0.71–2.31
	Decile 5–6	34	163,474	20.8	0.02	1.63	0.93–2.86	1.27	0.72–2.24
	Decile 7–8	59	181,864	32.4	0.03	2.54*	1.52–4.26	1.76*	1.04–3.00
	Decile 9–10	42	160,296	26.2	0.03	2.05*	1.19–3.53	1.40	0.79–2.47

**Numerator:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.

**Denominator:** NMDS: Elective/Waiting list hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures. ASA score is first listed ASA score per admission.

\*: Significantly different from reference category. CI: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, <sup>s</sup>: Suppressed due to small numbers.



Table 18: Same Day or Next Day Mortality following All Hospital Admissions with One or More General Anaesthetics by Age, Gender, Number of Anaesthetics, Last Documented ASA Score and Emergency Status, New Zealand 2008–2012

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
<b>General Anaesthetic</b>									
<b>Acute, Arranged in Public and Elective/Waiting List Combined</b>									
Age Group	0–24 Years	129	368,022	35.1	0.04	0.33*	0.27–0.40	0.54*	0.43–0.67
	25–44 Years	116	274,701	42.2	0.04	0.40*	0.32–0.49	0.58*	0.46–0.73
	45–64 Years	338	317,576	106.4	0.11	1.00		1.00	
	65–79 Years	508	168,696	301.1	0.30	2.84*	2.47–3.25	1.81*	1.56–2.11
	80+ Years	345	52,675	655.0	0.65	6.19*	5.33–7.19	2.49*	2.10–2.95
Gender	Male	789	564,581	139.7	0.14	1.00		1.00	
	Female	647	617,087	104.8	0.10	0.75*	0.68–0.83	0.89	0.79–1.00
Number of Anaesthetics	1	1,066	1,151,474	92.6	0.09	1.00		1.00	
	2+	370	30,196	1,225.3	1.23	13.39*	11.89–15.08	3.39*	2.94–3.91
Last Documented ASA Score	1–2	55	628,452	8.8	0.01	1.00		1.00	
	3	196	117,782	166.4	0.17	1.01*	1.01–1.02	9.36*	6.88–12.74
	4	487	19,071	2,553.6	2.55	2.09*	2.07–2.10	86.76*	64.61–116.49
	5	261	761	34,297.0	34.30	H*	H	H*	H
	Not Stated	362	415,517	87.1	0.09	0.99*	0.98–0.99	12.66*	9.47–16.93
Emergency Status	Non-Emergency/Not Stated	695	1,032,798	67.3	0.50	1.00		1.00	
	Emergency Procedure	741	148,872	497.7	0.07	7.43*	6.70–8.24	3.64*	3.13–4.22

**Numerator:** NMC: Same day (day 0) or next day (day 1) deaths following a general anaesthetic.

**Denominator:** NMDS: Hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures. ASA score is last listed ASA score per admission.

\*: Significantly different from reference category, CI: Confidence interval, H: Odds ratios suppressed due to high mortality rates, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio. Caution should be used in interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).



## Background: Hospital Admissions with One or More General Anaesthetics

### Admissions with one more general anaesthetics by by admission type and hospital type

In New Zealand during 2008–2012, the majority of admissions with one or more general anaesthetics were elective or drawn from the waiting list (67.9%), followed by acute admissions (24.6%). Publicly arranged or ‘semi-acute’ admissions (occurring within seven days of referral) were the least common admission type (7.5%) (Table 19). Admissions to private hospitals accounted for 37.9% of the elective/waiting list admissions. Acute admissions to private hospitals were rare. Compared with 2005–2009, this recent data shows an increase in the number of acute admissions while elective/waiting list admissions declined slightly.

Table 19: Hospital Admissions with One or More General Anaesthetics by Admission Type, New Zealand 2008–2012

ADMISSION TYPE	Total Admission Events 2008–2012	Annual Average	Admissions (%)
Acute	290,809	58,162	24.6
Arranged in Public	88,433	17,687	7.5
Elective/Waiting List	802,382	160,476	67.9
<b>Total Admissions</b>	<b>1,181,624</b>	<b>236,325</b>	<b>100.0</b>

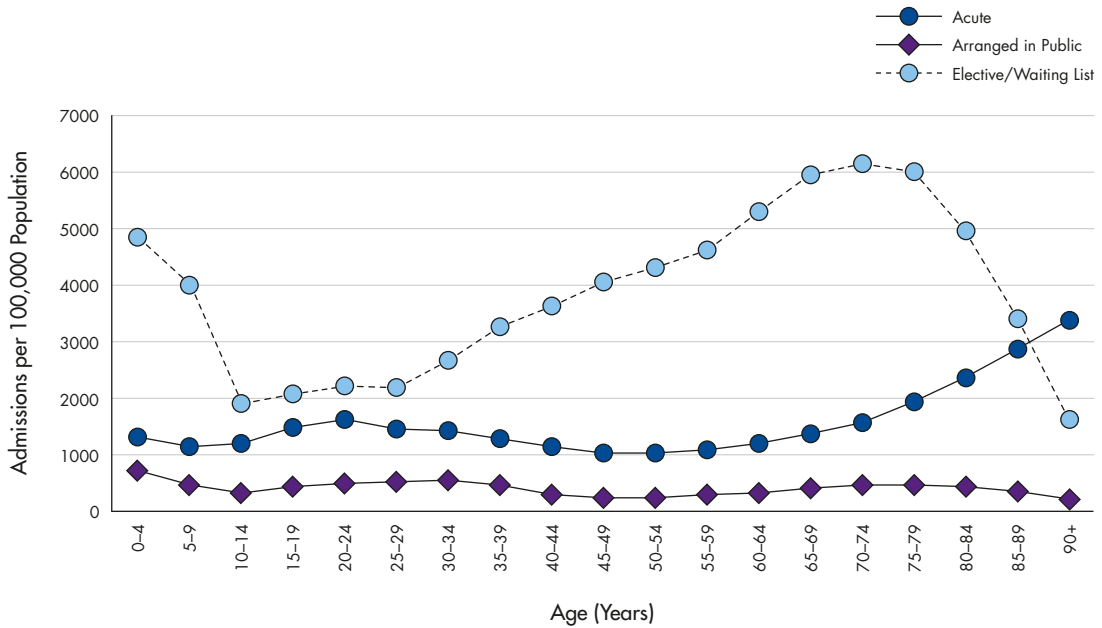
Data source: NMDS: Hospital admissions with one or more general anaesthetics.

### Admissions by admission type and age

From 2008–2012, elective/waiting list admissions with one or more general anaesthetics were highest in children aged 0–4 years, and declined rapidly until age 10–14 years (Figure 30). After this age, admission rates began to increase again, peaking overall at 70–74 years before declining in the older age groups. Acute admission rates increased slightly during the teenage years up to the 20–24 year age group, after which rates declined. After age 50–54, acute admissions increased again, reaching their highest level in those aged 90+ years. These trends are similar to previous findings for 2005–2009 and 2007–2011.



Figure 30: Hospital Admissions with One or More General Anaesthetics by Age and Admission Type, New Zealand 2008–2012



**Numerator:** NMDS: Hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

## Admissions by age, admission type and gender

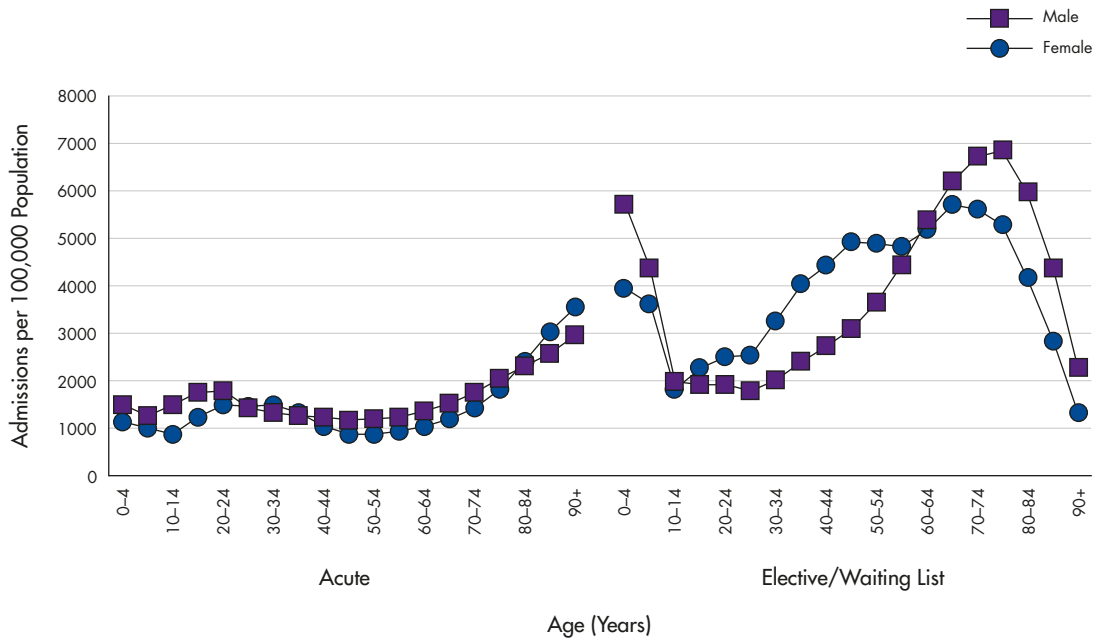
### Acute admissions

In New Zealand from 2008–2012, acute admission rates during 2008–2012 for males with one or more general anaesthetics decreased during childhood, with rates reaching their low point at 5–9 years, before increasing to a small peak in the late teens and early 20s (Figure 31). After this age, male acute admissions declined to another low point in the 40s and 50s, before increasing again with age up to 90+ years. For females, the trends were similar but with the initial low point shifted to the right, and then increasing to a small peak in their 20s and 30s. After the age of 50 years, female acute admission rates increased with age more quickly than for males. These trends are very similar to the acute admission results for 2005–2009 and 2007–2011.

### Elective/Waiting list admissions

Elective/Waiting list admissions in children and young people were highest in those aged 0–4 years, with rates then declining rapidly to a low point at 10–14 years (Figure 31). Rates then increased to a maximum at approximately 70 years, before declining once more. Admission rates were higher for males than females from age 0–14 years, and after 60 years of age. The 2008–2012 results are very similar to those observed in 2005–2009 and 2007–2011.

Figure 31: Hospital Admissions with One or More General Anaesthetics by Age, Admission Type and Gender, New Zealand 2008–2012



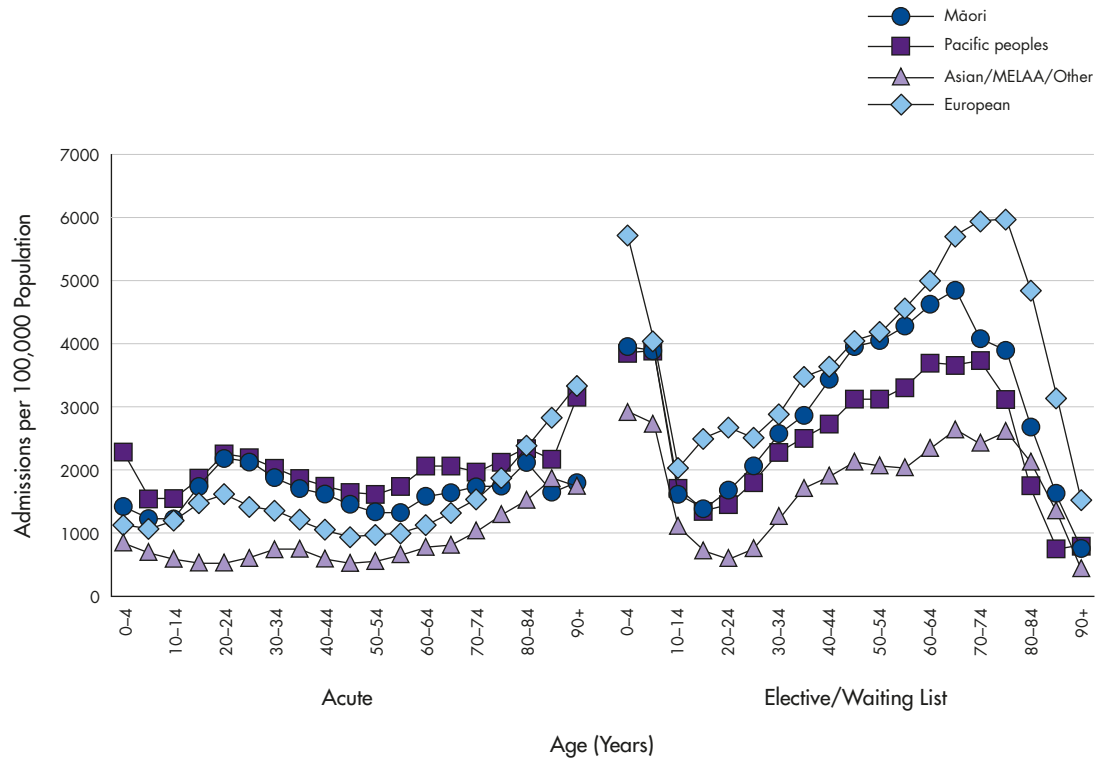
**Numerator:** NMDS: Hospital admissions with one or more general anaesthetics listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age, admission type and ethnicity

Acute admission rates during 2008–2012, where one or more general anaesthetics were administered, were higher for Māori and Pacific peoples than for people of European or Asian/MELAA/Other ethnicity up until 75 years of age (Figure 32). After this, ethnic differences were less consistent. Elective/Waiting list admission rates with general anaesthesia were higher for people of European ethnicity in every age group. Trends are generally consistent with the findings from 2005–2009 and 2007–2011.



Figure 32: Hospital Admissions with One or More General Anaesthetics by Age, Admission Type and Ethnicity, New Zealand 2008–2012



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

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

MELAA: Middle Eastern/Latin American/African.

# Background Information on Mortality and Hospital Admissions for Hip Arthroplasty

Information from the NMDS and the NMC was used to review mortality and hospital admissions in the first 30 days following hip arthroplasty.

## Background: Mortality following Hip Arthroplasty

### Mortality for hip arthroplasty by admission type and cause of death

In New Zealand during 2008–2012, injuries related to a fall were the most common underlying cause of death for acute and publicly arranged (semi-acute) admissions. Cardiovascular causes were also important. Among elective/waiting list admissions, cardiovascular causes were the predominant underlying cause of death (Table 20). These findings are consistent with 2005–2009.

Table 20: Mortality following Hip Arthroplasty by Admission Type and Main Underlying Cause of Death, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Hip Arthroplasty</b>			
<b>Acute</b>			
Fall	203	40.6	36.0
Other Injuries/External Causes	10	2.0	1.8
Cardiovascular	171	34.2	30.3
Neoplasm	59	11.8	10.5
Respiratory	38	7.6	6.7
Gastrointestinal	14	11.8	2.5
Dementia/Alzheimer's	21	7.6	3.7
Other	48	9.6	8.5
<b>Total Acute</b>	<b>564</b>	<b>11.8</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Fall	6	1.2	27.3
Cardiovascular	4	0.8	18.2
Respiratory	4	0.8	18.2
Neoplasm	3	0.6	13.6
Other	5	1.0	22.7
<b>Total Arranged in Public</b>	<b>22</b>	<b>4.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Falls and Other Injuries	4	0.8	7.3
Cardiovascular	26	5.2	47.3
Respiratory	5	1.0	9.1
Other	20	4.0	36.4
<b>Total Elective/Waiting List</b>	<b>55</b>	<b>11.0</b>	<b>100.0</b>

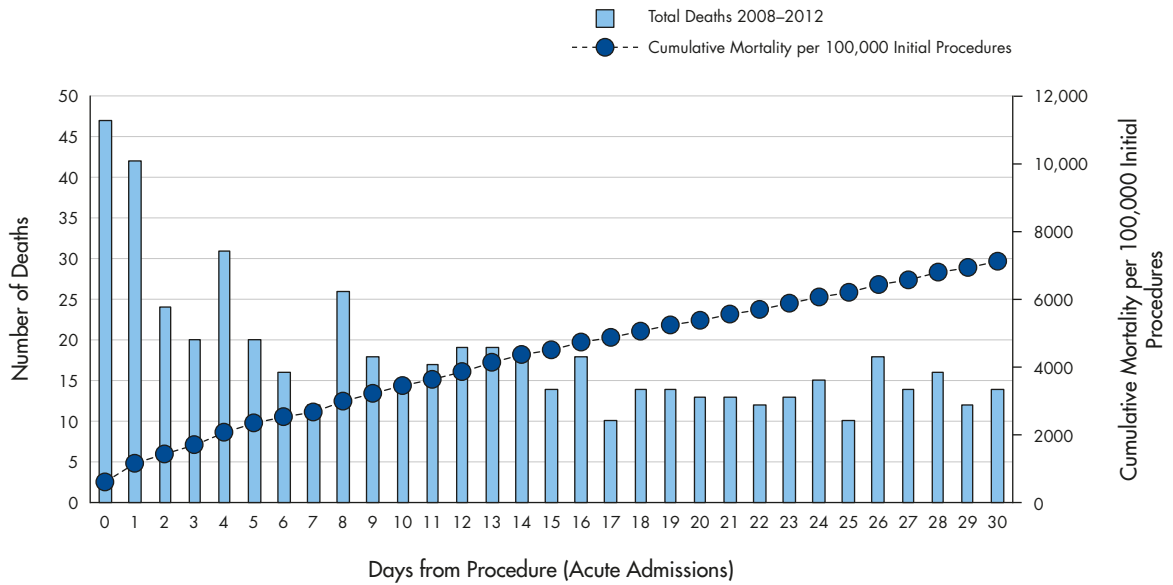
Data source: NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.



### Mortality by day from procedure

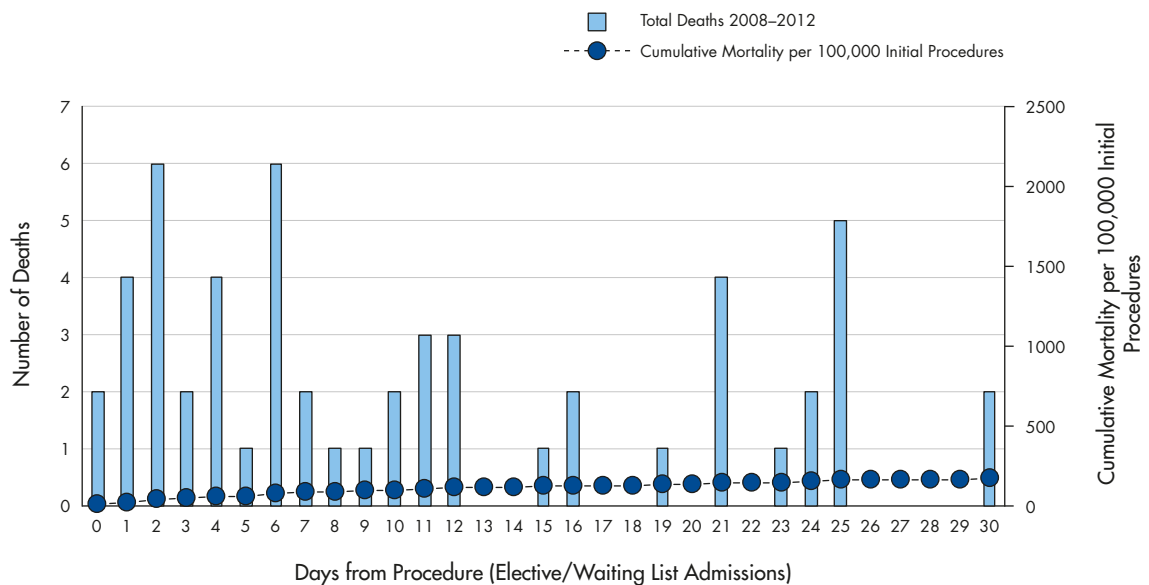
During 2008–2012, mortality following acute hip arthroplasty was highest on the same day as surgery (Figure 33), whilst for elective or waiting list admissions, the highest number of deaths occurred on days two and six after surgery (Figure 34). Cumulative 30-day mortality was higher for acute admissions (7.10% of initial procedures) than elective/waiting list admissions (0.17% of initial procedures). Compared with 2005–2009, cumulative mortality has decreased slightly for both admission types.

Figure 33: Mortality following Acute Admission for Hip Arthroplasty by Day from Procedure, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.  
**Denominator:** NMDS: Acute admissions with a hip arthroplasty listed in any of the first 90 procedures.

Figure 34: Mortality following Elective/Waiting List Admission for Hip Arthroplasty by Day from Procedure, New Zealand 2008–2012

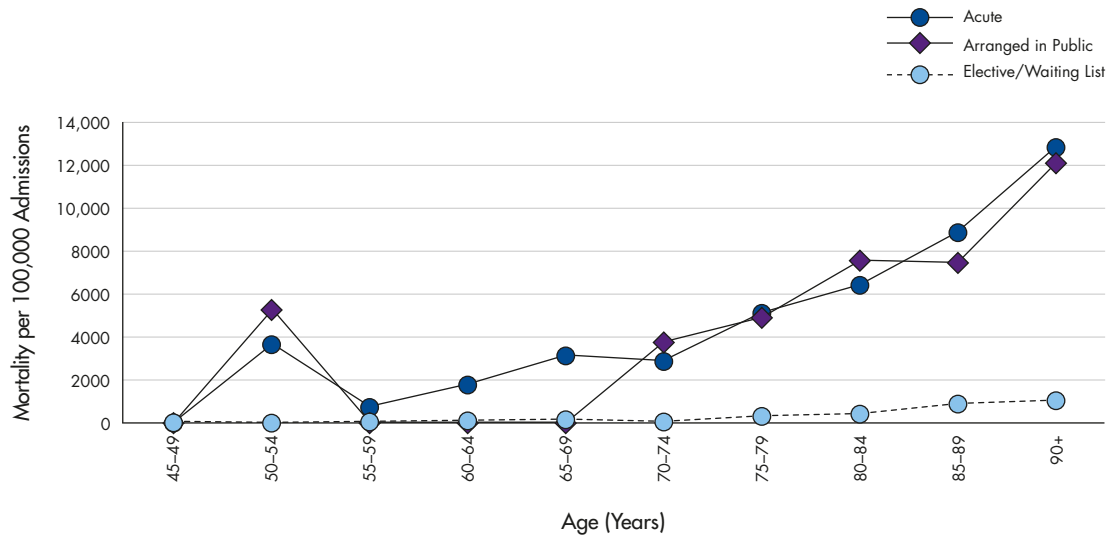


**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.  
**Denominator:** NMDS: Elective/Waiting list admissions with a hip arthroplasty listed in any of the first 90 procedures.

### Mortality by admission type and age

From 2008–2012, mortality following hip arthroplasty increased with increasing age for all admission types, with the highest rates being seen in those aged 90+ years (Figure 35). Within each age group, mortality rates for elective/waiting list admissions were generally low. These findings were similar in the previous report on deaths from 2005–2009.

Figure 35: Mortality following Hip Arthroplasty by Admission Type and Age, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.

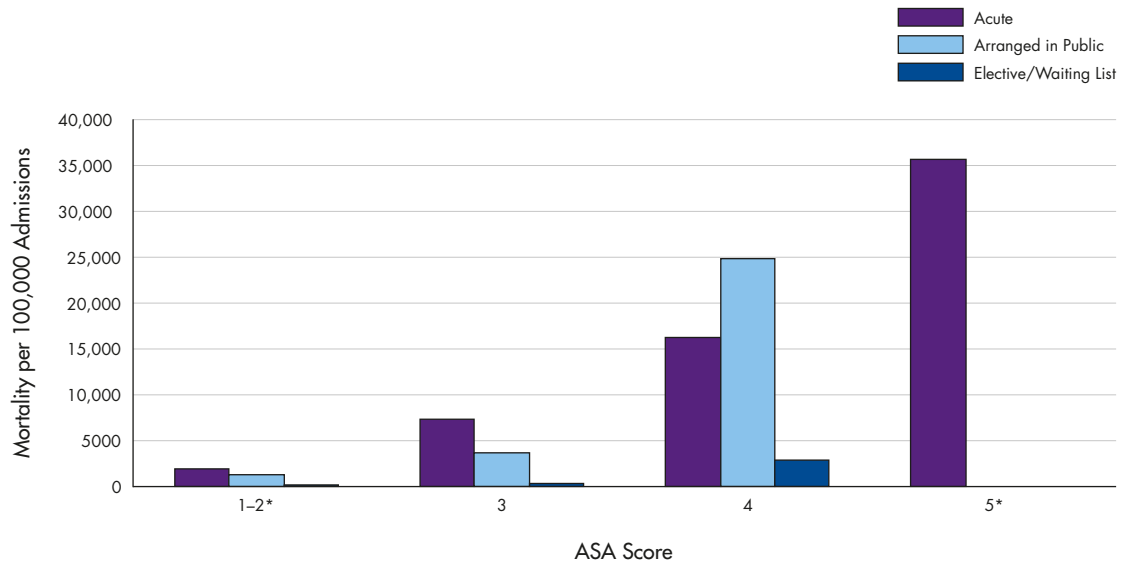
**Denominator:** NMDS: Admissions with a hip arthroplasty listed in any of the first 90 procedures.

### Mortality by ASA score

Mortality rates following a hip arthroplasty during 2008–2012 generally increased with increasing ASA score for all admission types (Figure 36). At each ASA category the mortality rate was higher for acute admissions compared with elective/waiting list admissions. The highest rate of mortality was observed for those admitted acutely with an ASA score of 5 (36% of admissions). These patterns are consistent with those previously observed in the earlier report with data from 2005–2009.



Figure 36: Mortality following Hip Arthroplasty by Admission Type and ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.  
**Denominator:** NMDS: Admissions with a hip arthroplasty listed in any of the first 90 procedures.

### Mortality by socio-demographic factors and ASA score

#### *Acute admissions*

Mortality rates following acute admissions for hip arthroplasty in New Zealand during 2008–2012 were significantly higher for those groups aged over 65 years (compared to 45–64 years), and for those with a first ASA score of 3 or 4 (compared with an ASA score of 1 or 2) (Table 21). Mortality was lower among females. These differences were evident when the model was adjusted for other socio-demographic risk factors (age, gender, ethnicity and NZDep decile) and ASA score. These trends were consistent with the findings from 2005–2009.

#### *Elective/Waiting list admissions*

From 2008–2012, mortality following elective/waiting list admissions for hip arthroplasty was significantly higher for those groups aged 65+ years (vs. 45–64 years) and those with an ASA score of 3 or 4 (vs. an ASA score of 1 or 2) (Table 22). These results were generally very similar when compared with those from 2005–2009.



Table 21: Mortality following Acute Admission for Hip Arthroplasty by Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>Hip Arthroplasty</b>									
<b>Acute</b>									
Age Group	45–64 Years	10	578	1,730.1	1.73	1.00		1.00	
	65–79 Years	91	2,331	3,903.9	3.90	2.48*	1.24–4.95	2.21*	1.10–4.44
	80+ Years	466	5,147	9,053.8	9.05	5.89*	3.03–11.46	4.65*	2.36–9.14
Gender	Male	224	2,518	8,895.9	8.90	1.00		1.00	
	Female	344	5,588	6,156.0	6.16	0.66*	0.56–0.79	0.65*	0.55–0.79
First ASA Score	1–2	35	1,806	1,938.0	1.94	1.00		1.00	
	3	282	3,812	7,397.7	7.40	4.00*	2.81–5.72	3.23*	2.25–4.62
	4	166	1,015	16,354.7	16.35	9.81*	6.75–14.25	7.35*	5.03–10.74
	5	4	11	36,363.6	36.36	H*	H	H*	H
	Not Stated	80	1,450	5,517.2	5.52	3.27*	2.18–4.89	2.63*	1.74–3.96
Ethnicity	European	526	7,401	7,107.1	7.11	1.00		1.00	
	Māori	14	260	5,384.6	5.38	0.77	0.48–1.33	1.08	0.61–1.90
	Pacific	4	91	4,395.6	4.40	0.61	0.22–1.66	0.64	0.20–2.06
	Asian/MELAA/Other	16	208	7,692.3	7.69	1.09	0.65–1.82	1.43	0.84–2.44
NZDep Decile	Decile 1–2	89	1,318	6,752.7	6.75	1.00		1.00	
	Decile 3–4	98	1,427	6,867.6	6.87	1.03	0.76–1.38	0.99	0.73–1.35
	Decile 5–6	119	1,784	6,670.4	6.67	1.00	0.75–1.33	1.01	0.75–1.36
	Decile 7–8	165	2,067	7,982.6	7.98	1.20	0.92–1.57	1.18	0.89–1.55
	Decile 9–10	95	1,458	6,515.8	6.52	0.97	0.72–1.32	0.98	0.72–1.36

**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMDS.

**Denominator:** NMDS: Acute admissions with a hip arthroplasty listed in any of the first 90 procedures.

\*: Significantly different to reference category, CI: Confidence interval, H: Odds ratios suppressed due to high mortality rates, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio.

Caution should be used in interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).



Table 22: Mortality following Elective/Waiting List Admissions for Hip Arthroplasty by Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

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
<b>Hip Arthroplasty</b>									
<b>Elective/Waiting List</b>									
Age Group	45–64 Years	7	11,706	59.8	0.06	1.00		1.00	
	65–79 Years	24	15,122	158.7	0.16	2.53*	1.18–5.74	2.25*	1.02–4.96
Gender	80+ Years	24	4,190	572.8	0.57	9.17*	4.04–20.79	6.45*	2.80–14.86
	Male	21	15,554	135.0	0.14	1.00		1.00	
First ASA Score	Female	34	16,654	204.2	0.20	1.51	0.88–2.61	1.29	0.77–2.17
	1–2	14	14,212	98.5	0.10	1.00		1.00	
Ethnicity	3	22	5,841	376.6	0.38	3.83*	1.96–7.49	2.60*	1.37–4.95
	4	7	240	2,916.7	2.92	30.37*	12.15–75.93	16.66*	6.84–40.61
NZDep Decile	Not Stated	12	11,914	100.7	0.10	1.02	0.47–2.21	1.16	0.56–2.40
	European	48	27,151	176.8	0.18	1.00		1.00	
Ethnicity	Māori	6	2,805	213.9	0.21	1.21	0.52–2.84	1.66	0.72–3.85
	Pacific	<3	314	\$	\$	\$	\$	\$	\$
Ethnicity	Asian/MELAA/Other	<3	467	\$	\$	\$	\$	\$	\$
	Decile 1–2	8	5,490	145.7	0.15	1.00		1.00	
Ethnicity	Decile 3–4	10	6,079	164.5	0.16	1.13	0.45–2.86	1.12	0.46–2.69
	Decile 5–6	6	6,950	86.3	0.09	0.59	0.21–1.71	0.55	0.20–1.47
Ethnicity	Decile 7–8	16	7,847	203.9	0.20	1.40	0.60–3.27	1.16	0.52–2.60
	Decile 9–10	15	5,801	258.6	0.26	1.78	0.75–4.20	1.45	0.63–3.32

**Numerator:** NMC: Deaths occurring within 30 days of a hip arthroplasty, as recorded in the NMCDS.

**Denominator:** NMCDS: Elective/Waiting list admissions with a hip arthroplasty listed in any of the first 90 procedures.

\*: Significantly different to reference category, CI: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, \$: Rates suppressed due to small numbers.

## Background: Hospital Admissions for Hip Arthroplasty

### Hip arthroplasty hospital admissions by admission type and hospital type

In New Zealand during 2008–2012, nearly 20 percent of hip arthroplasty admissions were acute admission events, almost 30 percent were elective/waiting list events at private hospitals, and just under half were elective/waiting list events at public hospitals (Table 23). This pattern is similar to hip arthroplasty admissions during 2005–2009.

Table 23: Hospital Admissions for Hip Arthroplasty by Admission Type and Hospital Type, New Zealand 2008–2012

ADMISSION TYPE	Total Admission Events 2008–2012	Annual Average	Admissions (%)
<b>Hip Arthroplasty</b>			
Acute	7,944	1,588.8	19.6
Arranged in Public	417	83.4	1.0
Public Hospital Elective/ Waiting List	20,154	4,030.8	49.7
Private Hospital Elective/ Waiting List	12,007	2,401.4	29.6
<b>Total Admissions</b>	<b>40,522</b>	<b>8,104.4</b>	<b>100.0</b>

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

### Hip arthroplasty admissions by primary diagnosis

In New Zealand during 2008–2012, fractures of the neck of femur were the leading reason for an acute admission for hip arthroplasty. Arthritis of the hip was the most common reason for an elective/waiting list admission (Table 24). These findings are the same as those reported for the 2005–2009 period.



Table 24: Hospital Admissions for Hip Arthroplasty by Primary Diagnosis and Admission Type, New Zealand 2008–2012

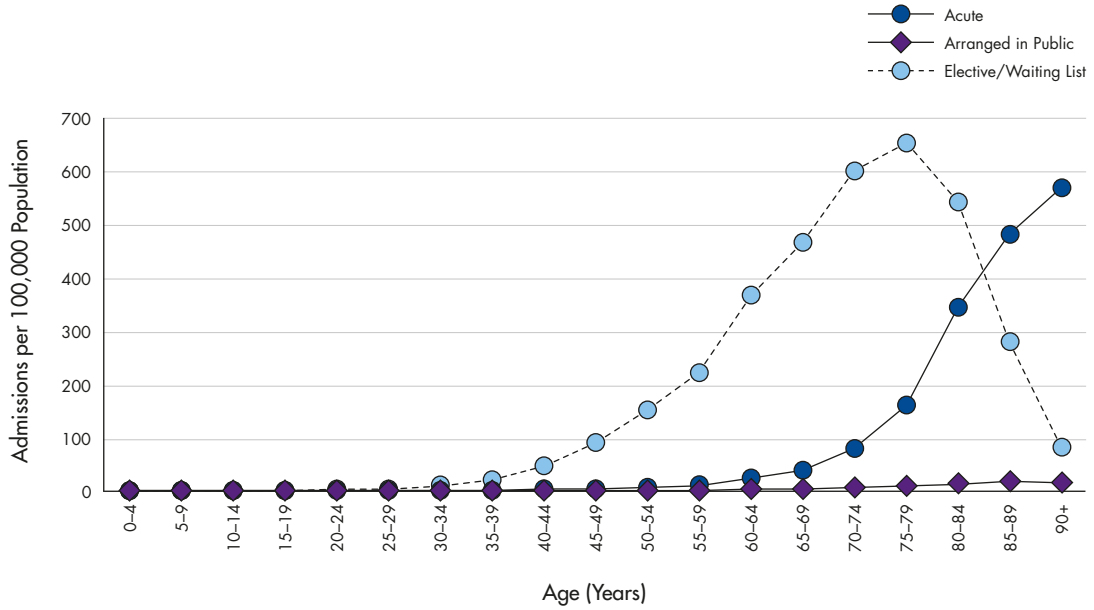
PRIMARY DIAGNOSIS	Total Admission Events 2008–2012	Annual Average	Admissions (%)
<b>Hip Arthroplasty</b>			
<b>Acute</b>			
Arthrosis of Hip	97	19.4	1.2
Fracture of Neck of Femur	6,095	1,219.0	76.7
Infection/Inflammation Internal Joint Prosthesis	204	40.8	2.6
Mechanical Complication Internal Joint Prosthesis	237	47.4	3.0
Other Complications Internal Orthopaedic Prosthesis	130	26.0	1.6
Other Diagnoses	750	150.0	9.4
Other Fracture of Femur	432	86.4	5.4
<b>Total Acute</b>	<b>7,945</b>	<b>1,589.0</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Arthrosis of Hip	64	12.8	15.3
Fracture of Neck of Femur	97	19.4	23.3
Infection/Inflammation Internal Joint Prosthesis	56	11.2	13.4
Mechanical Complication Internal Joint Prosthesis	58	11.6	13.9
Other Complications Internal Orthopaedic Prosthesis	44	8.8	10.6
Other Diagnoses	83	16.6	19.9
Other Fracture of Femur	15	3.0	3.6
<b>Total Arranged in Public</b>	<b>417</b>	<b>83.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Arthrosis of Hip	27,796	5,559.2	86.4
Fracture of Neck of Femur	15	3.0	0.0
Infection/Inflammation Internal Joint Prosthesis	338	67.6	1.1
Mechanical Complication Internal Joint Prosthesis	1,971	394.2	6.1
Other Complications Internal Orthopaedic Prosthesis	701	140.2	2.2
Other Diagnoses	1,329	265.8	4.1
Other Fracture of Femur	11	2.2	0.0
<b>Total Elective/Waiting List</b>	<b>32,161</b>	<b>6,432.2</b>	<b>100.0</b>

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

### Hip arthroplasty admissions by admission type and age

In New Zealand during 2008–2012, acute admission rates for hip arthroplasty rose with increasing age, with the highest rates being seen in those 90+ years of age. In contrast, elective/waiting list admission rates increased up to ages 75–79 years and then decreased (Figure 37). This pattern is the same as that noted for 2005–2009 data.

Figure 37: Hospital Admissions for Hip Arthroplasty by Age and Admission Type, New Zealand 2008–2012

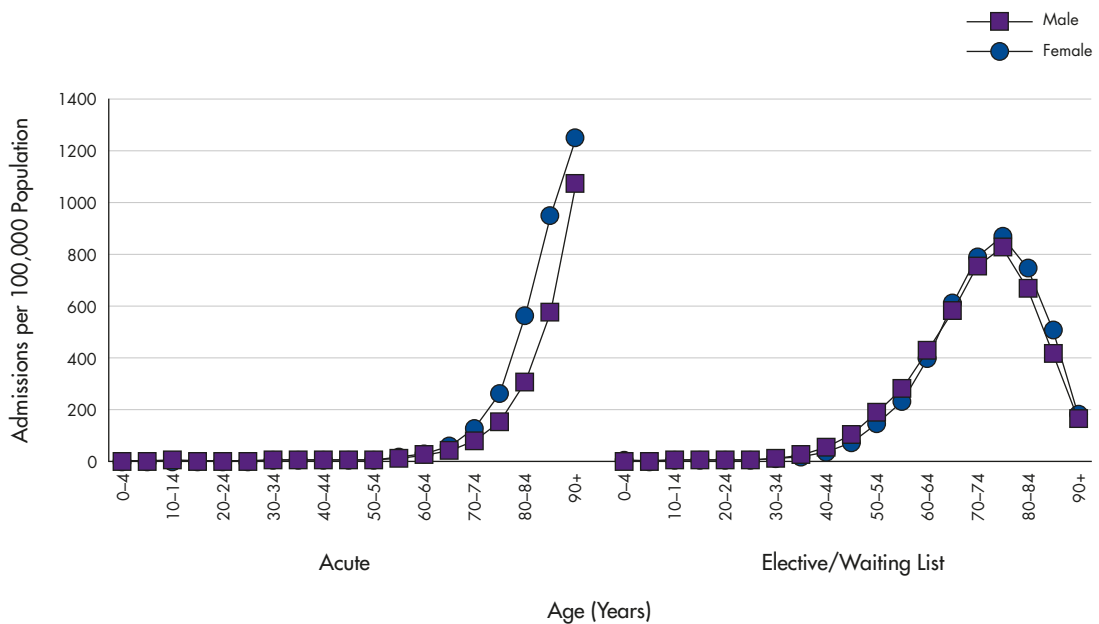


**Numerator:** NMDS: Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Hip arthroplasty admissions by admission type and gender

During 2008–2012, acute admission rates for hip arthroplasty increased with increasing age for both males and females, although from age 65–69 years 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 males and females after 75–79 years of age (Figure 38). These results are consistent with the findings from 2005–2009.

Figure 38: Hospital Admissions for Hip Arthroplasty by Age, Admission Type and Gender, New Zealand 2008–2012



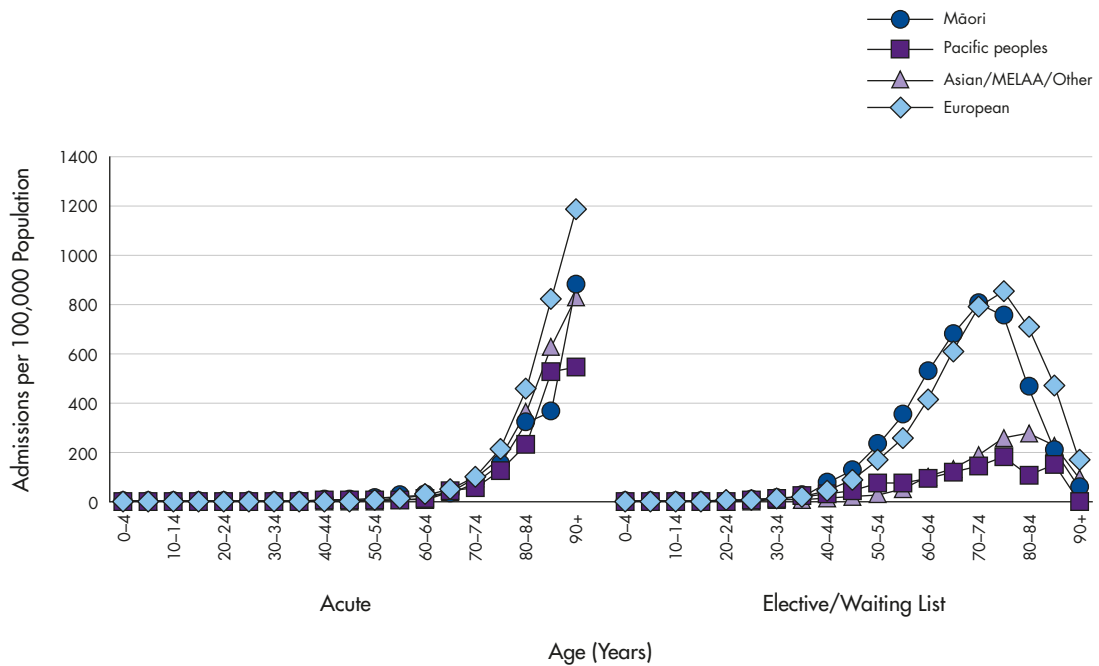
**Numerator:** NMDS: Hospital admissions with a hip arthroplasty listed in any of the first 90 procedures.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).



### Admissions by age, admission type and ethnicity

In New Zealand during 2008–2012, acute admission rates for hip arthroplasty increased with increasing age for all ethnic groups, with the highest rates being seen in those aged 90+ years (Figure 39). Care should be taken when interpreting admission rates for Māori, Pacific and Asian/MELAA/Other peoples aged 90+ years, however, due to the small number of cases involved (less than 20). In contrast, elective/waiting list admission rates for Māori, European and Pacific peoples were highest for those in their 70s, and for Asian/MELAA/Other peoples rates were highest in their 80s.

Figure 39: Hospital Admissions for Hip Arthroplasty by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDs: Admissions with a hip arthroplasty listed in any of the first 90 procedures.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

Ethnicity is Level 1 prioritised.

MELAA: Middle Eastern/Latin American/African.

# Background Information on Mortality and Hospital Admissions for Knee Arthroplasty

Information from the NMDS and the NMC was used to review mortality and hospital admissions in the first 30 days following knee arthroplasty.

## Background: Mortality following Knee Arthroplasty

### Mortality by cause of death

In New Zealand during 2008–2012, cardiovascular causes were the most frequently listed main underlying cause of death for those dying within 30 days of an admission for knee arthroplasty (Table 25). Respiratory and gastrointestinal causes also featured prominently. These trends are consistent with the findings for 2005–2009 except that neoplasms were not a main underlying cause during 2008–2012.

Table 25: Mortality following Knee Arthroplasty by Main Underlying Cause of Death, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Knee Arthroplasty</b>			
Cardiovascular	23	4.6	50
Respiratory	4	0.8	9
Gastrointestinal	4	0.8	9
Other	15	3.0	32
<b>Total</b>	<b>46</b>	<b>9.2</b>	<b>100</b>

Data source: NMDS: Deaths occurring within 30 days of a knee arthroplasty, as recorded in the NMDS.

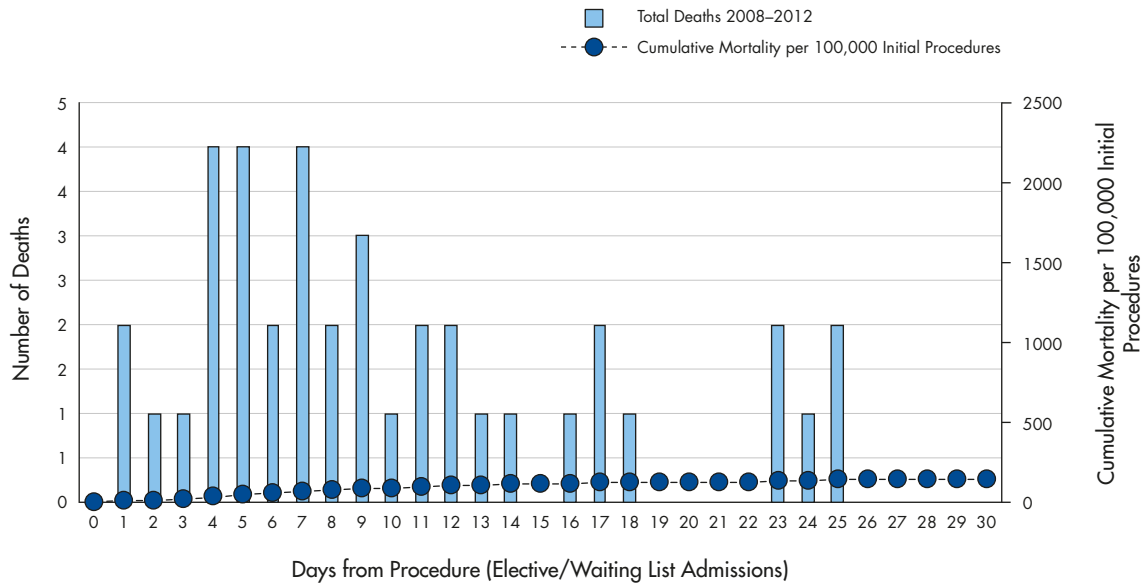
Because of the small number of knee arthroplasties undertaken among acute and publicly arranged (semi-acute) admissions, the following analysis is restricted to a review of 30-day mortality following elective/ waiting list procedures.

### Mortality by day from procedure

Mortality following elective or waiting list knee arthroplasty during 2008–2012 was highest on days four, five and seven after surgery (Figure 40). Cumulative 30-day mortality was 0.14% of initial procedures. Compared with 2005–2009, cumulative mortality has decreased slightly.



Figure 40: Mortality following Elective/Waiting List Admission for Knee Arthroplasty by Day from Procedure, New Zealand 2008–2012

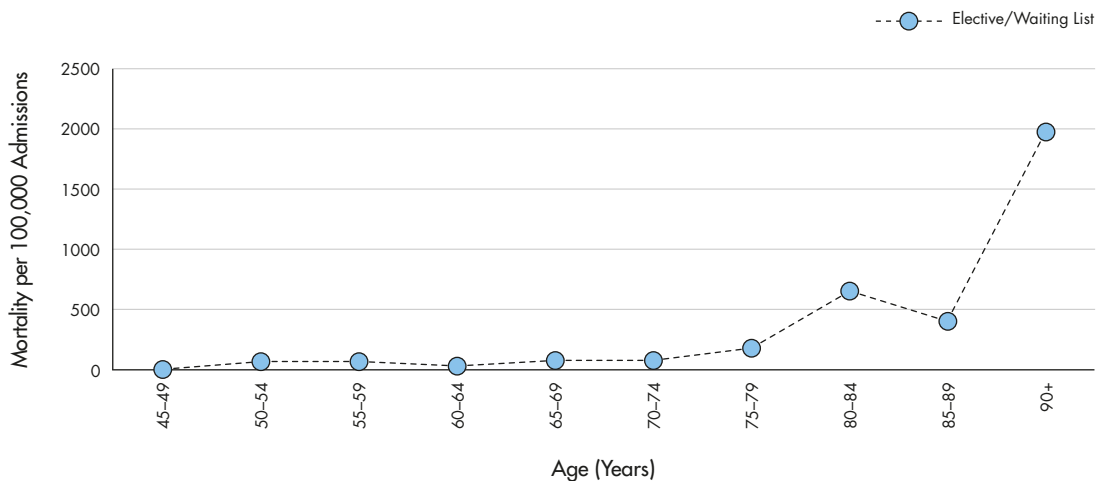


**Numerator:** NMC: Deaths occurring within 30 days of a knee arthroplasty, as recorded in the NMDS.  
**Denominator:** NMDS: Elective/Waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.

### Mortality following elective/waiting list knee arthroplasty by age

During 2008–2012, mortality following knee arthroplasty increased with increasing age for elective/waiting list admissions, with the highest rates being seen in those aged 90+ years (Figure 41). These findings were similar to the 2005–2009 findings presented in a previous report.

Figure 41: Mortality following Elective/Waiting List Admission for Knee Arthroplasty by Age, New Zealand 2008–2012



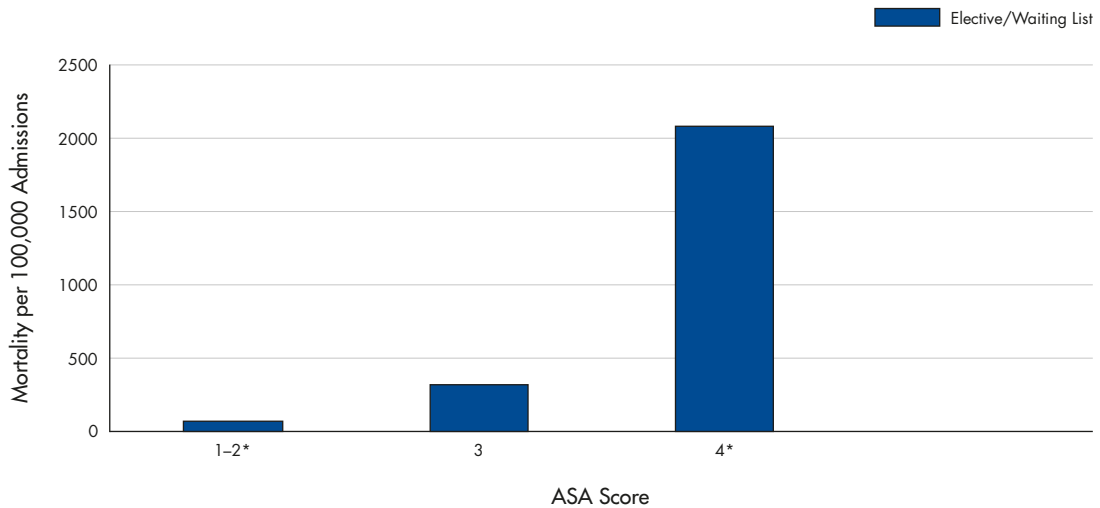
**Numerator:** NMC: Deaths occurring within 30 days of a knee arthroplasty, as recorded in the NMDS.  
**Denominator:** NMDS: Elective/Waiting list admissions with a knee arthroplasty listed in any of the first 90 procedures.



### Mortality by ASA score

Mortality rates following an elective/waiting list knee arthroplasty during 2008–2012 increased with increasing ASA score (Figure 42). The highest rate of mortality was observed for those admitted with an ASA score of 4, although it should be noted that this rate was based on three or fewer deaths and may be unreliable. These patterns are consistent with those previously observed in the earlier report on data from 2005–2009.

Figure 42: Mortality following Elective/Waiting List Admission for Knee Arthroplasty by ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a 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: ASA 4 based on small number of deaths.

### Mortality by socio-demographic factors and ASA score

#### *Elective/Waiting list admissions*

From 2008–2012, mortality following elective/waiting list admissions for knee arthroplasty was significantly higher for those groups aged 80+ years (vs. 45–64 years) and those with an ASA score of 3 or 4 (vs. an ASA score of 1 or 2) (Table 26). These results were generally very similar when compared with those from 2005–2009, although gender was no longer statistically significant in the recent analysis.



Table 26: Mortality following Elective/Waiting List Admissions for Knee Arthroplasty by Age, Gender, First ASA Score, Ethnicity and NZ Dep Decile, New Zealand 2008–2012

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
<b>Knee Arthroplasty</b>									
<b>Elective/Waiting List</b>									
Age Group	45–64 Years	4	9,473	42.2	0.04	1.00		1.00	
	65–79 Years	15	14,411	104.1	0.10	2.47	0.82–7.43	3.08	0.87–10.59
	80+ Years	20	3,158	633.3	0.63	15.09*	5.15–44.18	16.20*	4.58–57.25
	Male	24	12,925	185.7	0.19	1.00		1.00	
	Female	15	14,378	104.3	0.10	0.56	0.29–10.7	0.59	0.30–1.14
First ASA Score	1–2	9	12,620	71.3	0.07	1.00		1.00	
	3	18	5,514	326.4	0.33	4.59*	2.06–10.22	3.15*	1.38–7.14
	4	3	144	2,083.3	2.08	29.81*	7.99–111.29	17.15*	4.49–65.98
	Not Stated	9	9,025	99.7	0.10	1.40	0.56–3.53	1.34	0.52–3.49
Ethnicity	European	32	22,477	142.4	0.14	1.00		1.00	
	Māori	3	1,682	178.4	0.18	1.25	0.38–4.10	1.99	0.56–7.08
	Pacific	<3	1,034	\$	\$	\$	\$	\$	\$
	Asian/MELAA/Other	<3	1,049	\$	\$	\$	\$	\$	\$
	NZDep Decile	Decile 1–2	8	4,571	175.0	0.18	1.00		1.00
	Decile 3–4	8	4,865	164.4	0.16	0.94	0.35–2.51	0.86	0.32–2.31
	Decile 5–6	7	5,975	117.2	0.12	0.67	0.24–1.85	0.41	0.13–1.25
	Decile 7–8	8	6,593	121.3	0.12	0.69	0.26–1.85	0.58	0.22–1.56
	Decile 9–10	8	5,264	152.0	0.15	0.87	0.33–2.31	0.71	0.25–1.98

**Numerator:** NMC: Deaths occurring within 30 days of a knee arthroplasty, as recorded in the NMDS.

**Denominator:** NMDS: Elective/Waiting list hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.

\*: Significantly different from reference category, CI: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, \$: Suppressed due to small numbers.

## Background: Hospital Admissions for Knee Arthroplasty

### Knee arthroplasty admissions by admission type and hospital type

In New Zealand during 2008–2012, most admissions were elective/waiting list events at either private hospitals (35%) or public hospitals (64%) (Table 27). Only 1.5% of admissions were not elective/waiting list admissions and as a consequence the analyses that follow consider knee arthroplasties as a group without breakdown by admission type. The overall number of admissions has increased slightly since 2005–2009.

Table 27: Hospital Admissions for Knee Arthroplasty by Admission Type and Hospital Type, New Zealand 2008–2012

ADMISSION TYPE	Total Admission Events 2008–2012	Annual Average	Admissions (%)
<b>Knee Arthroplasty</b>			
Acute	323	64.6	1.2
Arranged in Public	87	17.4	0.3
Public Hospital Elective/Waiting List	17,662	3,532.4	63.7
Private Hospital Elective/Waiting List	9,641	1,928.2	34.8
<b>Total Admissions</b>	<b>27,713</b>	<b>5,542.6</b>	<b>100.0</b>

Data source: 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 2008–2012, arthrosis of the knee was the leading reason for an admission for knee arthroplasty (Table 28). This finding is the same as that reported for the 2005–2009 period.

Table 28: Hospital Admissions for Knee Arthroplasty by Primary Diagnosis, New Zealand 2008–2012

PRIMARY DIAGNOSIS	Total Admission Events 2008–2012	Annual Average	Admissions (%)
<b>Knee Arthroplasty</b>			
Arthrosis of Knee	25,015	5,003.0	90.3
Infection/Inflammation Internal Joint Prosthesis	400	80.0	1.4
Mechanical Complication Internal Joint Prosthesis	730	146.0	2.6
Other Complications Internal Orthopaedic Prosthesis	424	84.8	1.5
Other Diagnoses	901	180.2	3.3
Rheumatoid Arthritis	244	48.8	0.9
<b>Total</b>	<b>27,714</b>	<b>5,542.8</b>	<b>100.0</b>

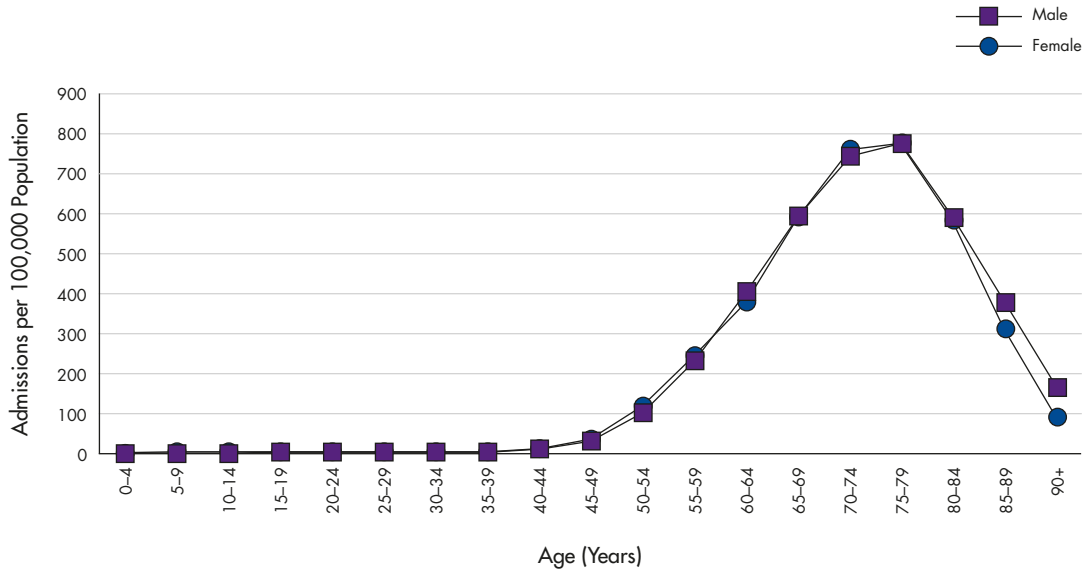
Data source: NMDS: Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.



### Knee arthroplasty admissions by age and gender

In New Zealand during 2008–2012, hospital admission rates for knee arthroplasty rose 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 43). This pattern is the same as that noted for 2005–2009 data.

Figure 43: Hospital Admissions for Knee Arthroplasty by Age and Gender, New Zealand 2008–2012



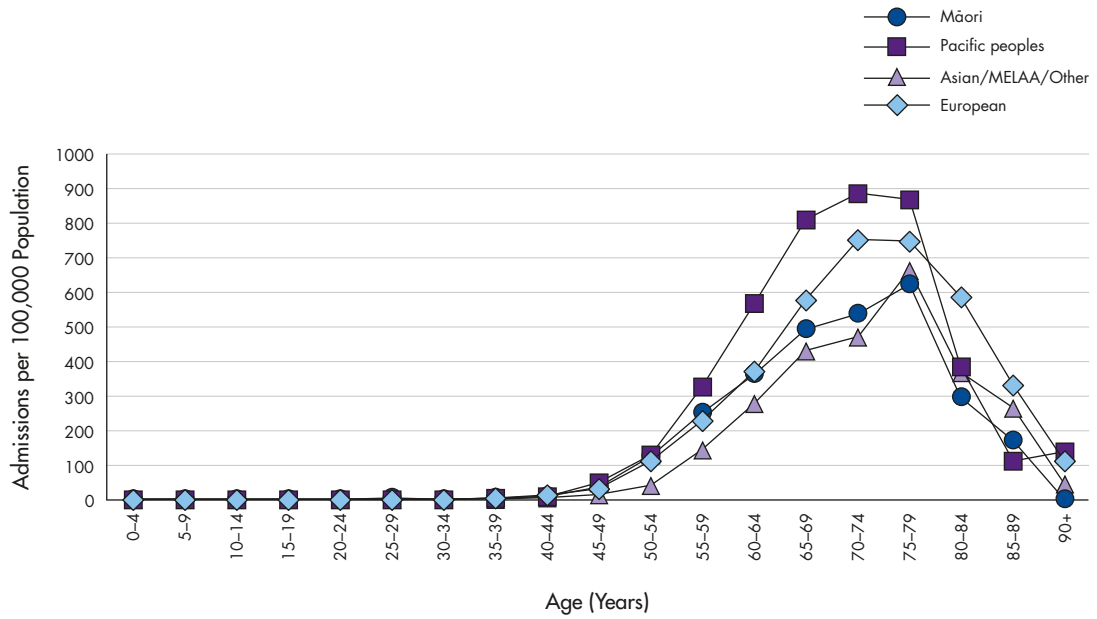
**Numerator:** NMDS: Hospital admissions with a knee arthroplasty listed in any of the first 90 procedures.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age and ethnicity

In New Zealand during 2008–2012, admission rates for knee arthroplasty increased with increasing age for all ethnic groups, with rates reaching a peak amongst those in their 70s, before declining again (Figure 44). Admission rates were higher for Pacific peoples until 80–84 years of age. In a previous report the 2005–2009 admission rates for Europeans were higher than those for other ethnic groups among all age groups older than 65 years.

Figure 44: Hospital Admissions for Knee Arthroplasty by Age and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: Admissions with a knee arthroplasty listed in any of the first 90 procedures.

**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

Ethnicity is Level 1 prioritised.

MELAA: Middle Eastern/Latin American/African.



## Background Information on Mortality and Hospital Admissions with an ASA Score of 1 or 2

Information from the NMDS and the NMC was used to review mortality and hospital admissions in the first 30 days following a general anaesthetic or a neuraxial block in those admitted electively or from the waiting list with a first ASA score of 1 or 2.

### Background: Mortality in Elective Admissions with an ASA Score of 1 or 2

#### Mortality by hospital type, cause of death and age

In New Zealand during 2008–2012, among people given an initial ASA score of 1 or 2 who were admitted electively or from the waiting list, and who received a general anaesthetic or neuraxial block during their admission, there was a total of 225 deaths within 30 days. The majority of these (211 deaths) occurred following a procedure at a public hospital. The cumulative five-year mortality rate at public hospitals was 0.06% of admissions, which was higher than the corresponding rate at private hospitals (0.02%).

In New Zealand during 2008–2012, malignant/other neoplasms were the most frequently listed cause of death for those over 45 years of age who were given an initial ASA score of 1 or 2, were admitted electively or from the waiting list, and who received a general anaesthetic or neuraxial block during their admission (Table 29). Myocardial infarctions/other ischaemic heart disease and other cardiovascular causes were also leading causes of mortality in those aged over 45 years. Compared with 2006–2010 and 2007–2011 findings, mortality counts were lower in the older age groups aged over 65 years. The common causes of mortality were largely the same as in the previous reports.

Table 29: Thirty-Day Mortality following Elective/Waiting List Admissions with a First ASA Score of 1 or 2 by Age and Main Underlying Cause of Death, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH	Number: Total 2008–2012	Number: Annual Average	% of Deaths in Age Group
<b>0–24 Years</b>			
Injuries/External Causes	<3	s	s
Malignant/Other Neoplasms	<3	s	s
Other Causes	6	1.2	60.0
<b>Total 0–24 Years</b>	<b>10</b>	<b>2.0</b>	<b>100.0</b>
<b>25–44 Years</b>			
Malignant/Other Neoplasms	7	1.4	53.3
Other Causes	8	1.6	46.7
<b>Total 25–44 Years</b>	<b>15</b>	<b>3.0</b>	<b>100.0</b>
<b>45–64 Years</b>			
Malignant/Other Neoplasms	27	6.2	53.4
Myocardial Infarction/Other Ischaemic Heart Disease	7	1.6	13.8
Other Cardiovascular Causes	4	0.8	6.9
Respiratory Diseases	<3	s	s
Other Causes	18	2.4	20.7
<b>Total 45–64 Years</b>	<b>57</b>	<b>11.6</b>	<b>100.0</b>
<b>65–79 Years</b>			
Malignant/Other Neoplasms	36	7.2	48.0
Myocardial Infarction/Other Ischaemic Heart Disease	26	5.2	34.7
Other Cardiovascular Causes	4	0.8	5.3
Injuries/External Causes	3	0.6	4.0
Gastrointestinal Diseases	<3	s	s
Other Causes	4	0.8	5.3
<b>Total 65–79 Years</b>	<b>75</b>	<b>15.0</b>	<b>100.0</b>
<b>80+ Years</b>			
Malignant/Other Neoplasms	33	6.6	48.5
Myocardial Infarction/Other Ischaemic Heart Disease	11	2.2	16.2
Gastrointestinal Diseases	8	1.6	11.8
Respiratory Diseases	6	1.2	8.8
Other Causes	10	2.0	14.7
<b>Total 80+ Years</b>	<b>68</b>	<b>13.6</b>	<b>100.0</b>

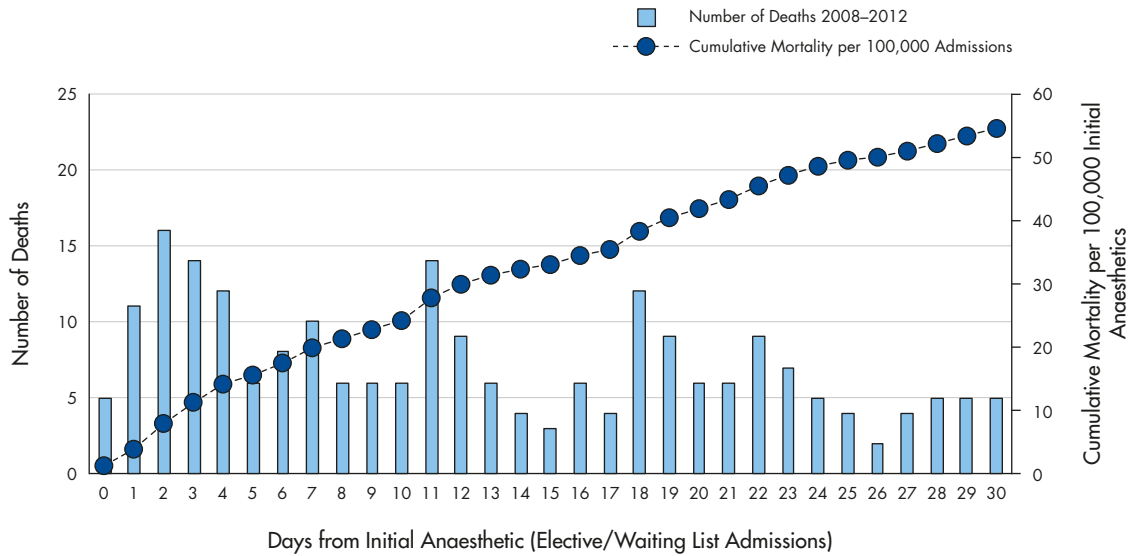
**Data source:** NMC:Deaths occurring within 30 days of a general anaesthetic or neuraxial block in those admitted electively or from the waiting list with an initial ASA score of 1 or 2.  
s: Rates suppressed due to small numbers.

### Mortality by day from first anaesthetic

From 2008 to 2012, during the first 30 days following an initial general anaesthetic or neuraxial block in those admitted electively with an ASA score of 1 or 2, mortality was highest on the second day after surgery, although deaths occurred with varying numbers right up until day 30 following the initial anaesthetic (Figure 45). Cumulative mortality at day 30 reached 0.05% of initial anaesthetics. This rate is lower compared to 2006–2010 and 2007–2011, where cumulative mortality was 0.07% and 0.06% of initial anaesthetics respectively.



Figure 45: Thirty-Day Mortality following Elective/Waiting List Admission with a First ASA Score of 1 or 2 by Day from Initial Anaesthetic, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a general anaesthetic or neuraxial block in those admitted electively or from the waiting list with a first ASA score of 1 or 2.

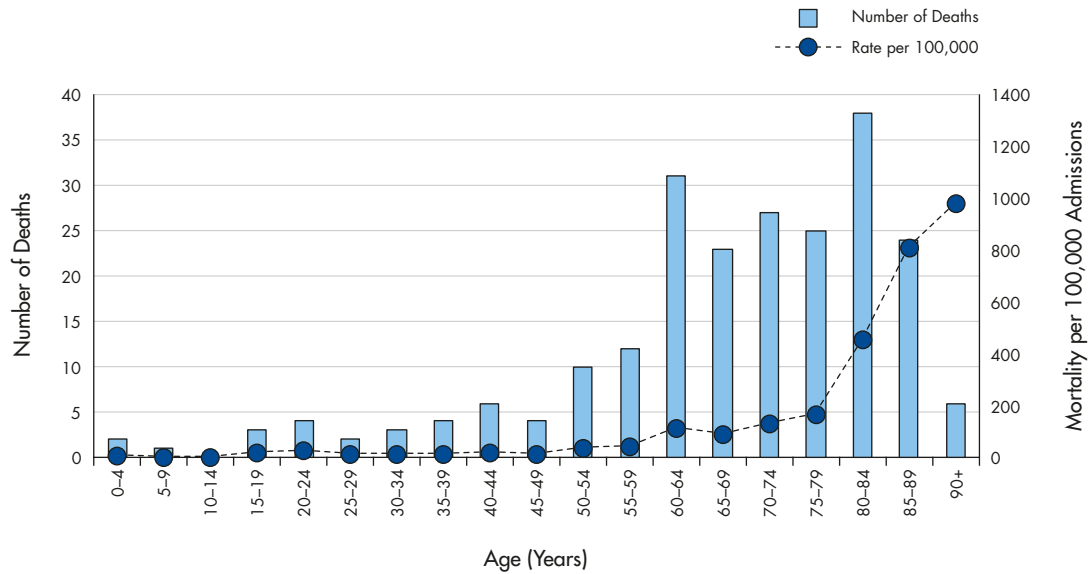
**Denominator:** NMDS: Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

### Mortality by age

Mortality in the first 30 days following an initial general anaesthetic or neuraxial block on those with an ASA score of 1 or 2 during 2008–2012 was relatively infrequent under the age of 50 years (Figure 46). Mortality rates increased progressively after 50 years, reaching the highest rate at 90+ years. The number of deaths in each age group also generally increased after the age of 50 years; however, mortality counts were highest at ages 80–84 years. These trends are similar to the 2006–2010 and 2007–2011 reporting time periods. Compared with the preceding period, mortality among those aged 90+ has decreased in 2008–2012.



Figure 46: Thirty-Day Mortality following Elective/Waiting List Admission with a First ASA Score of 1 or 2 by Age, New Zealand 2008–2012



**Numerator:** NMC: Deaths occurring within 30 days of a general anaesthetic or neuraxial block in those admitted electively or from the waiting list with a first ASA score of 1 or 2.

**Denominator:** NMDS: Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

### Mortality by socio-demographic and clinical factors

During 2008–2012, mortality in the first 30 days following an initial general anaesthetic or neuraxial block in those with a first ASA score of 1 or 2 was significantly higher for females than males, every age group over 25 years of age (compared to 0–24 years), those with a last ASA score of 3 or 4 (vs. ASA score 1 or 2), those undergoing emergency procedures and those receiving two or more anaesthetics during their admission. These differences occurred when the risk was adjusted for other socio-demographic factors and clinical factors (Table 30). These results are consistent with the findings from 2006–2010 and 2007–2011.

Table 30: Thirty-Day Mortality of Elective/Waiting List Admissions with a First ASA Score of 1 or 2 by Age, Gender, Ethnicity, NZDep Decile, ASA Score of Last Anaesthetic, Emergency Status of Last Anaesthetic and Number of Anaesthetics, New Zealand 2008–2012

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
<b>ASA 1 or 2 and a General Anaesthetic or Neuraxial Block</b>									
<b>Elective/Waiting List</b>									
Age Group	0–24	10	131,538	7.6	0.01	1.00		1.00	
	25–44	15	93,093	16.1	0.02	2.12	0.95–4.72	2.40*	1.07–5.36
	45–64	57	115,810	49.2	0.05	6.48*	3.31–12.68	6.34*	3.21–12.52
	65–79	75	60,660	123.6	0.12	16.28*	8.42–31.50	12.98*	6.54–25.76
	80+	68	11,965	568.3	0.57	75.18*	38.70–146.05	54.40*	26.98–109.67
Gender	Male	99	232,403	42.6	0.04	1.00		1.00	
	Female	126	180,662	69.7	0.07	1.64*	1.26–2.13	1.52*	1.16–1.99
Ethnicity	European	188	292,949	64.2	0.06	1.00		1.00	
	Māori	23	61,294	37.5	0.04	0.59*	0.38–0.90	1.38	0.86–2.20
	Pacific	7	23,204	30.2	0.03	0.47	0.22–1.00	1.04	0.47–2.28
	Asian/MELAA/Other	5	29,581	16.9	0.02	0.26*	0.11–0.64	0.52	0.21–1.28
NZDep Decile	Decile 1–2	30	66,161	45.3	0.05	1.00		1.00	
	Decile 3–4	37	69,924	52.9	0.05	1.17	0.72–1.89	1.00	0.61–1.65
	Decile 5–6	49	82,073	59.7	0.06	1.32	0.84–2.07	1.19	0.75–1.88
	Decile 7–8	62	98,454	63.0	0.06	1.39	0.90–2.15	1.32	0.85–2.06
	Decile 9–10	47	96,015	49.0	0.05	1.08	0.68–1.71	1.23	0.77–1.98
ASA Score of Last Anaesthetic	1–2	184	411,853	44.7	0.04	1.00		1.00	
	3	12	532	2,255.6	2.26	51.669*	28.64–93.22	3.90*	1.77–8.61
	4	18	142	12,676.1	12.68	324.804*	194.06–543.63	15.73*	7.30–33.90
	5	<3	6	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>
	Not Stated	9	533	1,688.6	1.69	38.46*	19.60–75.49	5.84*	2.52–13.51
Emergency Status of Last Anaesthetic	Non-Emergency/Not Stated	191	408,224	46.8	0.05	1.00		1.00	
	Emergency	34	4,842	702.2	0.70	15.11*	10.48–21.79	2.60*	1.46–4.62
Number of Anaesthetics	One	143	393,935	36.3	0.04	1.00		1.00	
	Two Plus	82	19,131	428.6	0.43	11.85*	9.03–15.56	4.42*	2.31–8.44

Numerator: NMC; Deaths occurring within 30 days of a general anaesthetic or neuraxial block in those admitted electively or from the waiting list with a first ASA score of 1 or 2.

Denominator: NMDs; Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

\*: Significantly different from reference category, CI: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, <sup>s</sup>: Suppressed due to small numbers.

Caution should be used in interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).

## Background: Elective/Waiting List Admissions with an ASA Score of 1 or 2

### Admissions by age and hospital type

In New Zealand during 2008–2012, the largest number of elective/waiting list admissions occurred among people with a first ASA score of 1 or 2 who were aged less than 25 years (Table 31). Overall, 14% of these admissions occurred at private hospitals. People aged 45–64 had the highest percentage of admissions to private facilities (16%) and those aged over 80 years the lowest (8%).

Table 31: Elective/Waiting List Admissions in Those with a First ASA Score of 1 or 2 by Hospital Type and Age Group, New Zealand 2008–2012

AGE GROUP	Number of Admissions 2008–2012 Public Hospitals	Number of Admissions 2008–2012 Private Hospitals	Total Admissions 2008–2012
0–24	113,464	18,074	131,538
25–44	79,659	13,434	93,093
45–64	97,490	18,320	115,810
65–79	53,087	7,573	60,660
80+	10,993	972	11,965
Total	354,693	58,373	413,066

Data source: NMDS: Elective/Waiting list admissions in those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

### Admissions by age and primary procedure

In New Zealand during 2008–2012, dental procedures, grommets and tonsillectomy +/- adenoidectomy were the leading reasons for elective admissions in people aged less than 25 years with a first ASA score of 1 or 2, while hysterectomy, laparoscopic sterilisation, and dilation and curettage of the uterus were the leading reasons for those people aged 25–44 years (Table 32). When compared with 2006–2010 and 2007–2011, the total number of procedures has increased in all age groups. The three most common procedures were the same for the youngest age group. Among those people aged 25–44 years, laparoscopic sterilisation and hysterectomy procedures remain frequent.

Hip and knee arthroplasty procedures were common procedure for all three age groups aged over 44 years (Table 33). This was similar to 2006–2010 and 2007–2011.



Table 32: Elective/Waiting List Admissions in Those Aged 0–44 Years with a First ASA Score of 1 or 2 by Primary Procedure and Age, New Zealand 2008–2012

PRIMARY PROCEDURE	Number: Total 2008–2012	Number: Annual Average	% of Admissions in Age Group
<b>0–24 Years</b>			
Dental Procedures	28,160	5,632	21.41
Grommets	18,412	3,682	14.00
Tonsillectomy +/- Adenoidectomy	14,799	2,960	11.25
Inguinal Hernia Repair	2,945	589	2.24
Removal of Screw, Pin, Wire, Plate, Rod or Nail	2,731	546	2.08
Adenoidectomy without Tonsillectomy	2,330	466	1.77
Other Procedures	62,161	12,432	47.26
<b>Total 0–24 Years</b>	<b>131,538</b>	<b>26,308</b>	<b>100.00</b>
<b>25–44 Years</b>			
Hysterectomy: Abdominal and Vaginal	4,282	856	4.60
Dilation and Curettage of Uterus	4,149	830	4.46
Laparoscopic Sterilisation	3,881	776	4.17
Cholecystectomy: Laparoscopic and Open	3,845	769	4.13
Elective Lower Segment Caesarean Section	3,236	647	3.48
Dental Procedures	3,408	682	3.66
Diagnostic Hysteroscopy	2,618	524	2.81
Procedures on the Cervix	2,706	541	2.91
Other Procedures	64,968	12,994	69.79
<b>Total 25–44 Years</b>	<b>93,093</b>	<b>18,619</b>	<b>100.00</b>

Data source: NMDS: Elective/Waiting list admissions in those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

Table 33: Elective/Waiting List Admissions in Those Aged 45+ Years with a First ASA Score of 1 or 2 by Primary Procedure and Age, New Zealand 2008–2012

PRIMARY PROCEDURE	Number: Total 2008–2012	Number: Annual Average	% of Admissions in Age Group
<b>45–64 Years</b>			
Hysterectomy: Abdominal and Vaginal	5,921	1,184	5.11
Hip Arthroplasty Including Revisions	5,470	1,094	4.72
Dilation and Curettage of Uterus	4,719	944	4.07
Knee Arthroplasty Including Revisions	4,430	886	3.83
Cholecystectomy: Laparoscopic and Open	3,958	792	3.42
Inguinal Hernia Repair	3,977	795	3.43
Excision of Lesion of Breast Including Re-Excisions	3,329	666	2.87
Other Procedures	84,006	16,801	72.54
<b>Total 45–64 Years</b>	<b>115,810</b>	<b>23,162</b>	<b>100.00</b>
<b>65–79 Years</b>			
Knee Arthroplasty Including Revisions	6,667	1,333	10.99
Hip Arthroplasty Including Revisions	6,578	1,316	10.84
Inguinal Hernia Repair	2,653	531	4.37
Colorectal Resection	2,191	438	3.61
Transurethral Resection of Prostate	2,130	426	3.51
Cholecystectomy: Laparoscopic and Open	1,902	380	3.14
Other Procedures	38,539	7,708	63.53
<b>Total 65–79 Years</b>	<b>60,660</b>	<b>12,132</b>	<b>100.00</b>
<b>80+ Years</b>			
Hip Arthroplasty Including Revisions	1,409	282	11.78
Knee Arthroplasty Including Revisions	1,221	244	10.20
Colorectal Resection	646	129	5.40
Transurethral Resection of Prostate	620	124	5.18
Other Procedures	8,069	1,614	67.44
<b>Total 80+ Years</b>	<b>11,965</b>	<b>2,393</b>	<b>100.00</b>

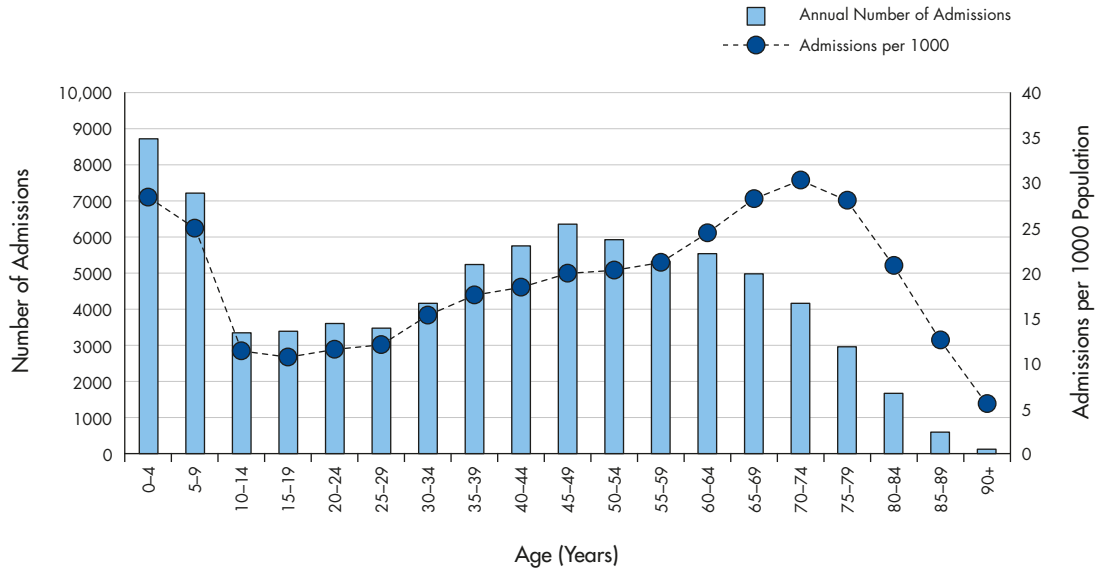
Data source: NMDS: Elective/Waiting list admissions in those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.

### Admissions by age

During 2008–2012, the highest annual numbers of admissions in those with an ASA score of 1 or 2 were for those aged 0–4 years, followed by those in the 5–9 year age group (Figure 47). Admission counts then decreased and remained low between 10–29 years, before increasing again to reach a peak at 45–49 years. After 50 years, admission numbers decreased with age. Because of the underlying age structure of the New Zealand population, admission rates per 100,000 people in each age group reached a maximum at 70–74 years. These trends have not changed since the 2006–2010 findings from a previous report.



Figure 47: Elective/Waiting List Admissions in Those with a First ASA Score of 1 or 2 by Age, New Zealand 2008–2012

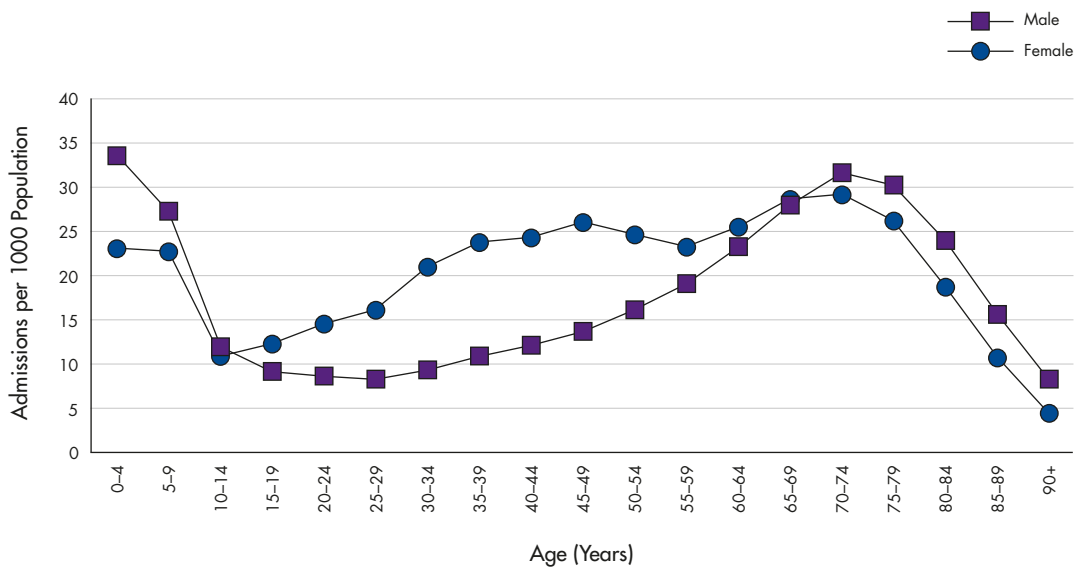


**Numerator:** NMC: Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or neuraxial block.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age and gender

Elective/Waiting list admissions during 2008–2012 for those with a first ASA score of 1 or 2 were higher for males than females under the age of 10 years (Figure 48). After this age, rates then increased at a faster rate for females, resulting in a higher proportion of female admissions for those aged 15–69 years. From the age of 70 years onwards, males again showed higher rates of admissions than females. Both genders showed an initial peak in admissions at ages 0–4 years, with a secondary peak occurring later on in the 70–74 year age group. These results are very similar to those for the 2006–2010 period.

Figure 48: Elective/Waiting List Admissions in Those with a First ASA Score of 1 or 2 by Age and Gender, New Zealand 2008–2012

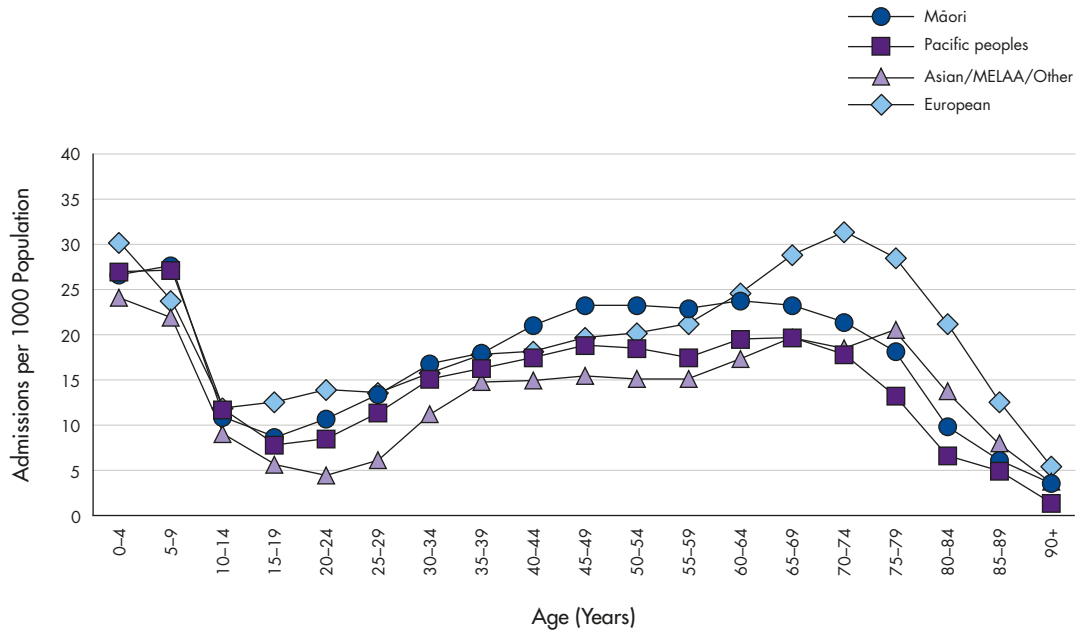


**Numerator:** NMC: Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).

### Admissions by age and ethnicity

During 2008–2012, between the ages of 0–14 years, there were no consistent differences in elective/ waiting list admission rates for those of different ethnic groups with a first ASA score of 1 or 2 (Figure 49). European peoples had higher admission rates than other ethnic groups from the age of 60 years onwards, peaking at 70–74 years. Admission rates for Māori and Pacific ethnic groups reached their highest point at ages 5–9 years.

Figure 49: Elective/Waiting List Admissions in Those with a First ASA Score of 1 or 2 by Age and Ethnicity, New Zealand 2008–2012



**Numerator:** NMC: Elective/Waiting list admissions of those with a first ASA score of 1 or 2 and either a general anaesthetic or a neuraxial block.  
**Denominator:** Statistics New Zealand: Estimated Resident Population (projected from 2008).  
 Ethnicity is Level 1 prioritised.  
 MELAA: Middle Eastern/Latin American/African



## Background Information on Mortality and Hospital Admissions for Pulmonary Embolus-Associated and Attributed Mortality

Information from the NMDS and the NMC was used to review mortality and hospital admissions in the first 30 days following general anaesthesia associated with, or attributed to, pulmonary embolus.

### Background: Mortality for Pulmonary Embolus-Associated and Attributed Mortality

#### Pulmonary embolus-associated mortality by admission type and cause of death

In New Zealand during 2008–2012, malignant/other neoplasms and falls were the most frequently listed main underlying causes of death in those meeting the criteria for a pulmonary embolus-associated death<sup>1</sup> who were admitted acutely (Table 34). Similarly, malignant/other neoplasms was the most common main underlying cause of death for elective/waiting list admissions that met the criteria above. These causes were the same as the findings for the 2006–2010 and 2007–2011 periods; however, the total number of deaths in each admission type has increased.

<sup>1</sup> A pulmonary embolus-associated death is defined as one that occurred within 30 days of first anaesthetic for a pulmonary embolus-associated admission. For further details refer to Appendix 2.



Table 34: Pulmonary Embolus-Associated Mortality by Main Underlying Cause of Death and Admission Type, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH AND ADMISSION TYPE	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Pulmonary Embolus-Associated Mortality</b>			
<b>Acute</b>			
Falls	44	8.8	21.1
Other Injuries/External Causes	10	2.0	4.8
Malignant/Other Neoplasms	57	11.4	27.3
Myocardial Infarction/Other Ischaemic Heart Disease	22	4.4	10.5
Pulmonary Embolus	9	1.8	4.3
Other Cardiovascular Causes	20	4.0	9.6
Gastrointestinal Diseases	22	4.4	10.5
Respiratory Diseases	11	2.2	5.3
Other Causes	14	2.8	6.7
<b>Total Acute</b>	<b>209</b>	<b>41.8</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Malignant/Other Neoplasms	11	2.2	50.0
Pulmonary Embolus	<3	s	s
Other Causes	10	2.0	45.5
<b>Total Arranged in Public</b>	<b>22</b>	<b>4.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Malignant/Other Neoplasms	35	7.0	46.1
Pulmonary Embolus	<3	s	s
Myocardial Infarction/Other Ischaemic Heart Disease	6	1.2	7.9
Other Cardiovascular Causes	7	1.4	9.2
Other Causes	26	5.2	34.2
<b>Total Elective/Waiting List</b>	<b>76</b>	<b>15.2</b>	<b>100.0</b>

**Data source:** NMC: Pulmonary embolus-associated deaths within 30 days of first anaesthetic of index admission.  
s: Rates suppressed due to small numbers.

### Pulmonary embolus-attributed mortality by admission type and cause of death

For deaths attributed to a pulmonary embolus during 2008–2012, falls, malignant/other neoplasms and other causes were the most common main underlying causes of death for those admitted acutely who met the criteria for a pulmonary embolus-attributed death<sup>2</sup> (Table 35). Compared to 2006–2010 and 2007–2011, the most common causes are similar; however, total deaths have increased for all admission types.

<sup>2</sup> A pulmonary embolus-attributed death is defined as a death that occurred within 30 days of a general anaesthetic or neuraxial block and where a pulmonary embolus was listed as the main or contributory cause of death in the NMC. For further details refer to Appendix 2.



Table 35: Pulmonary Embolus-Attributed Mortality by Main Underlying Cause of Death and Admission Type, New Zealand 2008–2012

MAIN UNDERLYING CAUSE OF DEATH AND ADMISSION TYPE	Total Deaths 2008–2012	Annual Average	Deaths in Category (%)
<b>Pulmonary Embolus-Attributed Mortality</b>			
<b>Acute</b>			
Falls	34	6.8	25.2
Malignant/Other Neoplasms	32	6.4	23.7
Pulmonary Embolus	11	2.2	8.1
Other Causes	58	11.6	43.0
<b>Total Acute</b>	<b>135</b>	<b>27.0</b>	<b>100.0</b>
<b>Arranged in Public</b>			
All Causes	9	0.4	100.0
<b>Total Arranged in Public</b>	<b>9</b>	<b>0.4</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Malignant/Other Neoplasms	22	4.4	40.0
Cardiovascular Causes	10	2.0	18.2
Other Causes	23	4.6	41.8
<b>Total Elective/Waiting List</b>	<b>55</b>	<b>11.0</b>	<b>100.0</b>

Data source: NMC: Pulmonary embolus-attributed deaths within 30 days of first anaesthetic of index admission.

## Mortality by day from first anaesthetic

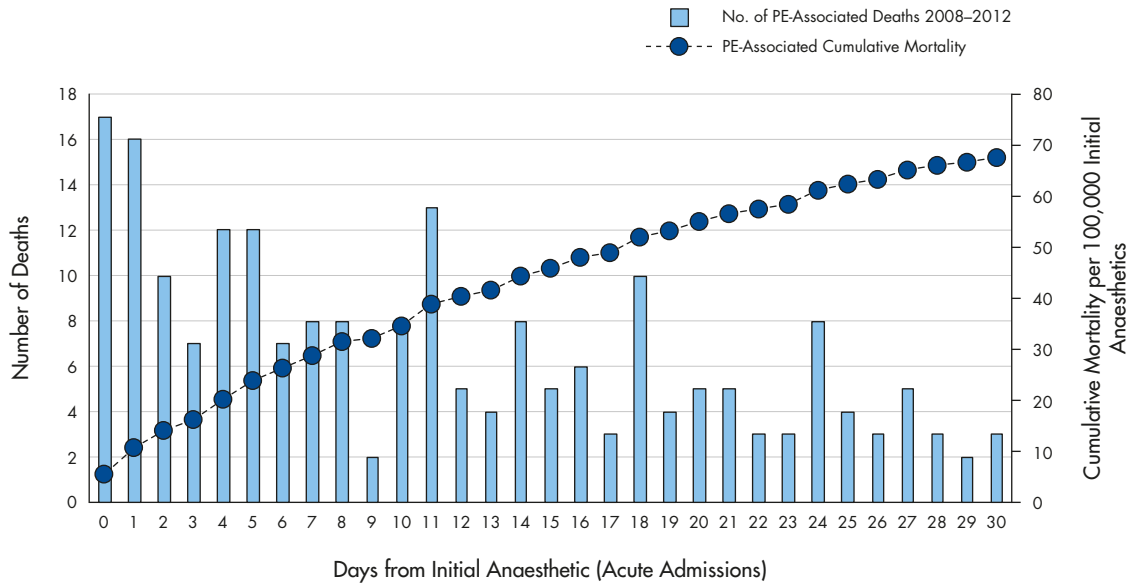
### *Acute admissions*

Pulmonary embolus-associated mortality in those admitted acutely during 2008–2012 was highest on both the day a general anaesthetic or neuraxial block was administered (day 0) and day 1 after the anaesthetic (Figure 50). Subsequent smaller spikes in mortality occurred on days 4, 5, 11 and 18; however, deaths continued to occur right up until day 30. Cumulative mortality over the 30-day period reached 0.068% of initial anaesthetics during 2008–2012 – an increase compared to the 2007–2011 period where 30-day cumulative mortality was 0.062% of initial anaesthetics.

### *Elective/Waiting list admissions*

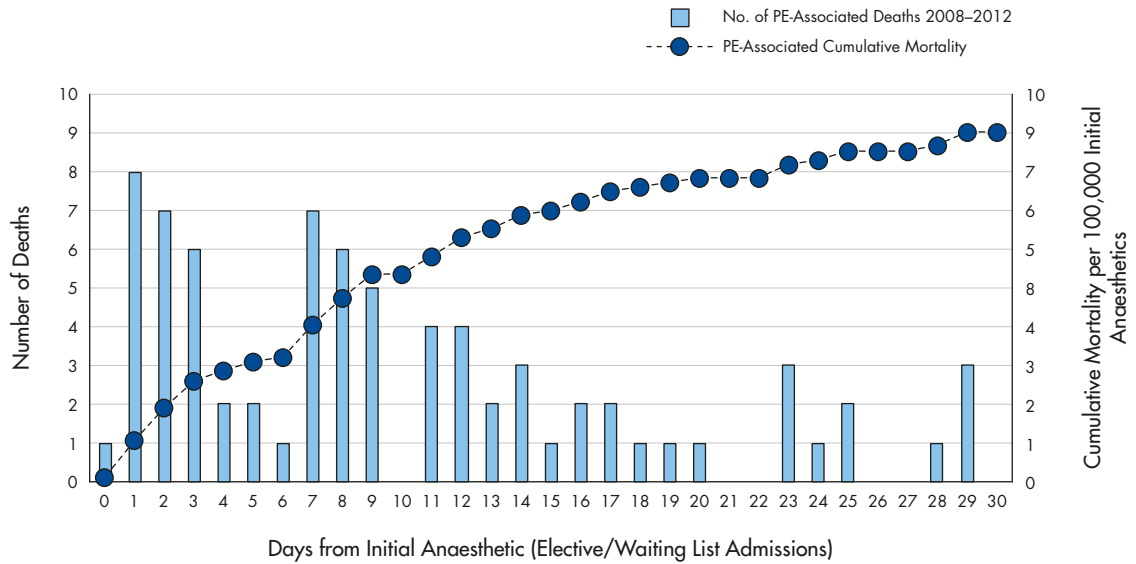
Mortality following elective/waiting list admissions associated with a pulmonary embolus, was highest on the first, second and seventh days following a general anaesthetic or neuraxial block during 2008–2012 (Figure 51). Cumulative mortality reached 0.009% of initial anaesthetics, which was similar to 2007–2011. Compared with 2007–2011, the pattern of deaths associated with a pulmonary embolus over the 30 days following general anaesthetic/neuraxial block was generally very similar.

Figure 50: Pulmonary Embolus-Associated Mortality in Acute Admissions by Day from Initial Anaesthetic, New Zealand 2008–2012



**Numerator:** NMC: Pulmonary embolus-associated deaths within 30 days of initial anaesthetic of an acute index admission.  
**Denominator:** NMDS: All acute admissions with a general anaesthetic or neuraxial block.  
 PE: pulmonary embolus.

Figure 51: Pulmonary Embolus-Associated Mortality in Elective/Waiting List Admissions by Day from Initial Anaesthetic, New Zealand 2008–2012



**Numerator:** NMC: Pulmonary embolus-associated deaths within 30 days of first anaesthetic of an elective/waiting list index admission.  
**Denominator:** NMDS: All elective/waiting list admissions with a general anaesthetic or neuraxial block.  
 PE: pulmonary embolus.

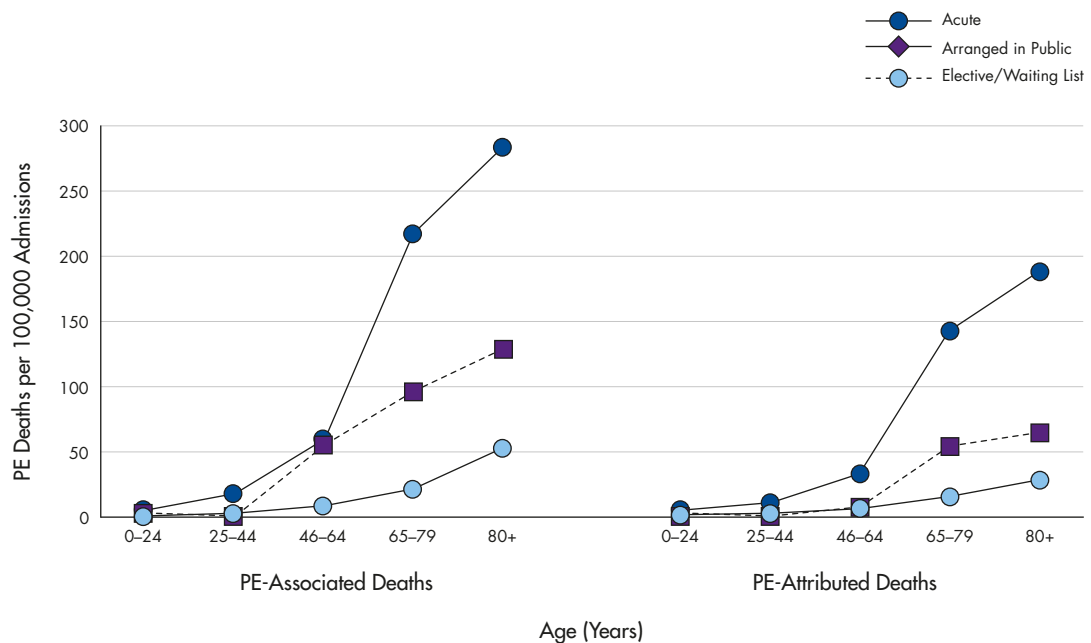


### Mortality by age

During 2008–2012, pulmonary embolus-associated mortality was relatively infrequent in those aged under 25 years, but rose rapidly thereafter, with the highest rates evident for those aged over 80 years (Figure 52). In most age groups, mortality was highest for acute admissions, followed by arranged in public (semi-acute) admissions and then elective/waiting list admissions. Likewise, pulmonary embolus-attributed mortality increased with increasing age for all admission types. When compared with 2007–2011 data, overall patterns for the 2008–2012 data were very similar; however, mortality rates were higher with the later data, particularly among people aged over 44 years. Pulmonary embolus-attributed death rates for people aged over 64 years have increased among acute admissions.

When the analysis was confined only to those with a pulmonary embolus-associated admission, 30-day mortality rates were much higher than when all admissions with a general anaesthetic or neuraxial block were included in the denominator (Figure 53). This was similar to the data from 2007–2011, where the mortality rate among those aged 80+ years who were admitted acutely and who experienced a pulmonary embolus was again approximately 24%. However, the recent data also indicates that mortality among young people (aged 0–24 years) admitted electively or from the waiting list, and who experienced a pulmonary embolus, was also relatively high (18%). These results, at least in part, reflect the effect of small numbers for both the numerator and denominator.

Figure 52: Pulmonary Embolus-Associated and Attributed Mortality by Age and Admission Type, New Zealand 2008–2012

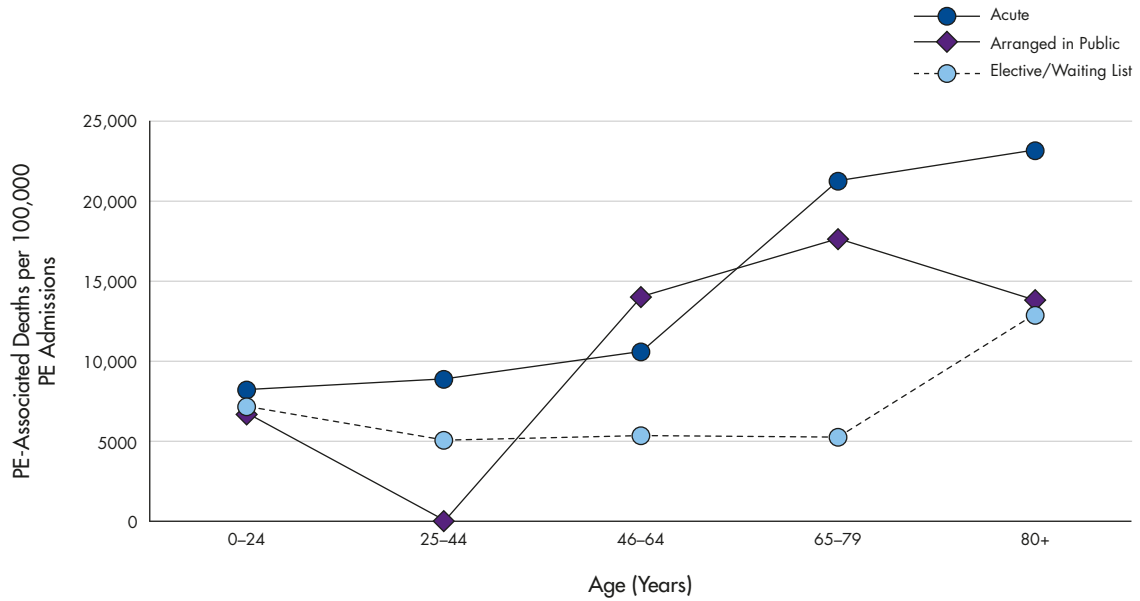


**Numerator:** NMC: Pulmonary embolus-associated and attributed deaths within 30 days of first anaesthetic of an index admission.

**Denominator:** NMDS: All admissions with a general anaesthetic or neuraxial block.

PE: pulmonary embolus.

Figure 53: Thirty-Day Mortality in Pulmonary Embolus-Associated Admissions by Age and Admission Type, New Zealand 2008–2012



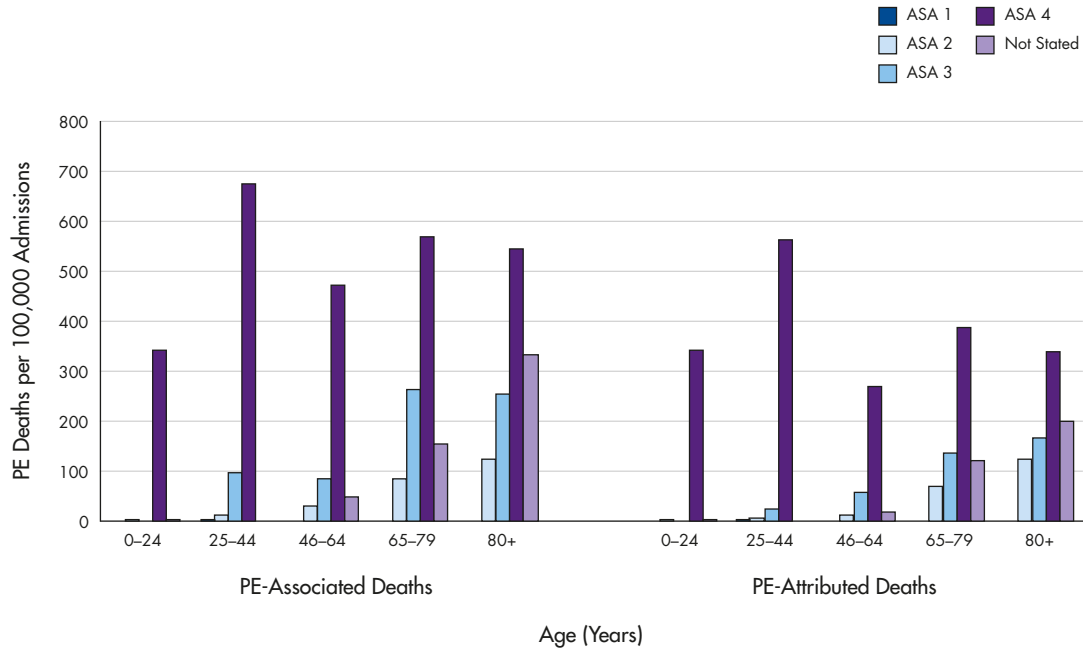
**Numerator:** NMC: Pulmonary embolus-associated deaths within 30 days of first anaesthetic of index admission.  
**Denominator:** NMDS: All pulmonary embolus-associated hospital admissions.  
 PE: pulmonary embolus.

### Mortality by age, admission type and ASA score

Pulmonary embolus-associated and attributed mortality during 2008–2012 were more common in those admissions that were either acute or had an ASA score of 4 (Figures 54 and 55). In general, there was a stepwise increase in mortality with rising ASA score; however, there were exceptions to this pattern, some of which may be due to small numbers. For acute admissions, pulmonary embolus-associated and attributed deaths among people aged 25–44 years with an ASA score of 4 has increased in 2008–2012 compared with 2007–2011. These results, at least in part, reflect the effect of small numbers for both the numerator and denominator. Pulmonary embolus-associated and attributed mortality below 45 years of age were uncommon among elective admissions.

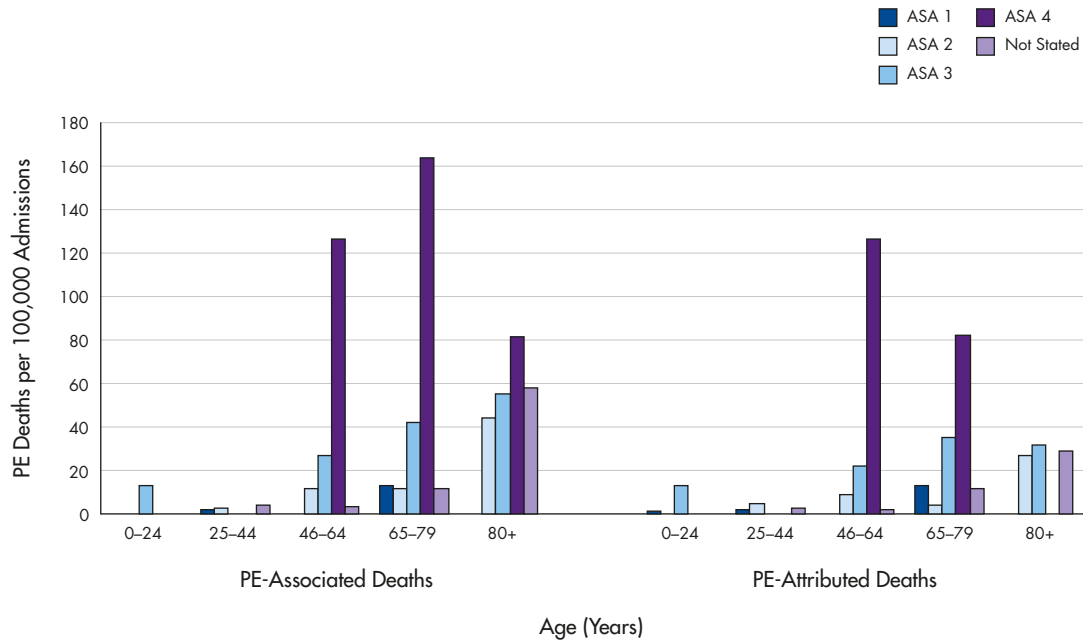


Figure 54: Pulmonary Embolus-Associated and Attributed Mortality in Acute Admissions by Age and ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Pulmonary embolus-associated and attributed deaths within 30 days of first anaesthetic of acute index admissions.  
**Denominator:** NMDS: All acute admissions with a general anaesthetic or neuraxial block.  
 PE: pulmonary embolus.

Figure 55: Pulmonary Embolus-Associated and Attributed Mortality in Elective/Waiting List Admissions by Age and ASA Score, New Zealand 2008–2012



**Numerator:** NMC: Pulmonary embolus-associated and attributed deaths within 30 days of first anaesthetic of elective/waiting list index admissions.  
**Denominator:** NMDS: All elective/waiting list admissions with a general anaesthetic or neuraxial block.  
 PE: pulmonary embolus.

## Mortality by socio-demographic and clinical factors

### *Pulmonary embolus-associated mortality*

In New Zealand during 2008–2012, pulmonary embolus-associated mortality rates were significantly higher for acute and arranged in public (semi-acute) admissions (vs. elective/waiting list admissions), those aged 25 years and older (vs 0–24 years) and those with an ASA score of 3, 4 or 5 (vs. ASA score 1 or 2) (Table 36). These results are generally consistent with 2007–2011 and 2006–2010.

When the analysis was confined to only those with a pulmonary embolus-associated admission, mortality was significantly higher for those admitted acutely or semi-acutely (vs. elective/waiting list admissions), those aged 80 years and older (vs 0–24 years) and those with an ASA score of 3, 4 or 5 (vs. ASA score 1 or 2) (Table 37). These results are generally consistent with 2007–2011 and 2006–2010 except semi-acute hospital admissions were not significant in the previous reports.

### *Pulmonary embolus-attributed mortality*

During 2008–2012, pulmonary embolus-attributed mortality rates were significantly higher for those admitted acutely (vs. elective/waiting list admissions), those aged 45 years and older (vs. 0–24 years), those with an ASA score of 3, 4 or 5 (vs. ASA score 1 or 2) and those in NZDep deciles 3–4 (vs. deciles 1–2) (Table 38). These results are generally consistent with 2007–2011 and 2006–2010, with the exception of NZDep deciles 3–4.

Table 36: Pulmonary Embolus-Associated Mortality by Admission Type, Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

VARIABLE	CATEGORY	No. PE-Associated Deaths	No. Admissions with GA or Neuraxial Block	Rate per 100,000 Admissions	Rate per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
<b>Pulmonary Embolus-Associated Mortality</b>									
Admission Type	Elective/ Waiting List	76	843,189	9.0	0.01	1.00		1.00	
	Arranged in Public	22	131,427	16.7	0.02	1.86*	1.16–2.99	2.70*	1.66–4.39
	Acute	209	309,423	67.5	0.07	7.50*	5.77–9.75	5.77*	4.33–7.70
Age Group	0–24 Years	7	376,721	1.9	0.00	1.00		1.00	
	25–44 Years	20	320,812	6.2	0.01	3.35*	1.42–7.93	3.27*	1.38–7.76
	45–64 Years	65	330,383	19.7	0.02	10.59*	4.86–23.08	9.06*	4.11–19.97
	65–79 Years	118	190,840	61.8	0.06	33.28*	15.53–71.34	19.82*	9.04–43.46
	80+ Years	97	65,330	148.5	0.15	79.99*	37.15–172.24	23.15*	10.36–51.71
Gender	Male	156	693,594	22.5	0.02	1.00		1.00	
	Female	151	590,490	25.6	0.03	1.14	0.91–1.42	1.01	0.80–1.27
First ASA Score	1–2	58	694,346	8.4	0.01	1.00		1.00	
	3	112	136,136	82.3	0.08	9.86*	7.28–14.19	3.39*	2.39–4.79
	4	76	21,377	355.5	0.36	42.71*	28.33–58.64	9.06*	6.19–13.26
	5	5	743	672.9	0.67	81.10*	16.13–166.07	11.86*	4.23–33.25
	Not Stated	56	431,397	13.0	0.01	1.55*	1.05–2.67	1.63*	1.11–2.39
Ethnicity	European	263	908,142	29.0	0.03	1.00		1.00	
	Māori	19	180,234	10.5	0.01	0.36*	0.23–0.58	0.63	0.39–1.02
	Pacific	11	76,986	14.3	0.01	0.49*	0.27–0.90	0.78	0.42–1.46
	Asian/MELAA/ Other	7	84,527	8.3	0.01	0.29*	0.14–0.61	0.52	0.24–1.11
NZDep Decile	Decile 1–2	40	220,915	18.1	0.02	1.00		1.00	
	Decile 3–4	56	221,339	25.3	0.03	1.40	0.93–2.10	1.30	0.86–1.96
	Decile 5–6	58	255,606	22.7	0.02	1.25	0.84–1.87	1.08	0.72–1.63
	Decile 7–8	84	294,077	28.6	0.03	1.58*	1.08–2.30	1.35	0.92–1.97
	Decile 9–10	67	286,694	23.4	0.02	1.29	0.87–1.91	1.29	0.86–1.94

**Numerator:** NMC: Pulmonary embolus-associated deaths within 30 days of first anaesthetic of index admissions.

**Denominator:** NMDS: All pulmonary embolus-associated admissions.

\*: Significantly different from reference category, CI: Confidence interval, GA: General anaesthetic, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, PE: Pulmonary embolus.



Table 37: Pulmonary Embolus-Associated Mortality among Pulmonary Embolus-Associated Admissions by Admission Type, Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

VARIABLE	CATEGORY	No. PE-Associated Deaths	No. Admissions with GA or Neuraxial Block	Rate per 100,000 Admissions	Rate per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
<b>Pulmonary Embolus-Associated Mortality in Pulmonary Embolus-Associated Admissions</b>									
Admission Type	Elective/ Waiting List	76	1,225	6,204.1	6.20	1.00		1.00	
	Arranged in Public	22	181	12,154.7	12.15	2.09*	1.27–3.46	1.86*	1.10–3.14
	Acute	209	1,262	16,561.0	16.56	3.00*	2.28–3.95	2.41*	1.78–3.25
Age Group	0–24 Years	7	90	7,777.8	7.78	1.00		1.00	
	25–44 Years	20	297	6,734.0	6.73	0.86	0.35–2.10	1.03	0.41–2.57
	45–64 Years	65	789	8,238.3	8.24	1.07	0.47–2.40	1.35	0.58–3.13
	65–79 Years	118	996	11,847.4	11.85	1.59	0.72–3.53	2.15	0.93–4.97
	80+ Years	97	496	19,556.5	19.56	2.88*	1.29–6.43	2.96*	1.27–6.93
Gender	Male	156	1,375	11,345.5	11.35	1.00		1.00	
	Female	151	1,293	11,678.3	11.68	1.03	0.82–1.31	1.03	0.80–1.32
First ASA Score	1–2	58	950	6,105.3	6.11	1.00		1.00	
	3	112	800	14,000.0	14.00	2.50*	1.80–3.49	1.78*	1.26–2.53
	4	76	303	25,082.5	25.08	H*	H	H*	H
	5	5	10	50,000.0	50.00	H*	H	H*	H
	Not Stated	56	605	9,256.2	9.26	1.57*	1.07–2.30	1.36	0.91–2.03
Ethnicity	European	263	2,251	11,683.7	11.68	1.00		1.00	
	Māori	19	222	8,558.6	8.56	0.71	0.44–1.15	0.87	0.51–1.48
	Pacific	11	76	14,473.7	14.47	1.28	0.67–2.46	1.52	0.76–3.04
	Asian/MELAA/ Other	7	56	12,500.0	12.50	1.08	0.48–2.41	1.45	0.63–3.33
NZDep Decile	Decile 1–2	40	445	8,988.8	8.99	1.00		1.00	
	Decile 3–4	56	455	12,307.7	12.31	1.42	0.93–2.18	1.33	0.85–2.09
	Decile 5–6	58	555	10,450.5	10.45	1.18	0.77–1.80	1.07	0.69–1.67
	Decile 7–8	84	677	12,407.7	12.41	1.43	0.96–2.13	1.26	0.83–1.91
	Decile 9–10	67	519	12,909.4	12.91	1.50	0.99–2.27	1.44	0.92–2.25

**Numerator:** NMC: Pulmonary embolus-associated deaths within 30 days of first anaesthetic of index admissions.

**Denominator:** NIMDS: All pulmonary embolus-associated admissions.

\*: Significantly different from reference category. CI: Confidence interval, GA: General anaesthetic, H: Odds ratios suppressed due to high mortality rates, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, PE: Pulmonary embolus. Caution should also be observed when interpreting ORs where mortality exceeds 10% (see Appendix 2 for details).



Table 38: Pulmonary Embolus-Attributed Mortality by Admission Type, Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

VARIABLE	CATEGORY	No. PE-Associated Deaths	No. Admissions with GA or Neuraxial Block	Rate per 100,000 Admissions	Rate per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
<b>Pulmonary Embolus-Attributed Mortality</b>									
Admission Type	Elective/Waiting List	55	843,189	6.5	0.01	1.00		1.00	
	Arranged in Public	9	131,427	6.8	0.01	1.05	0.52–2.12	1.44	0.70–2.95
	Acute	135	309,423	43.6	0.04	6.69*	4.89–9.16	5.01*	3.55–7.07
Age Group	0–24 Years	8	376,721	2.1	0.00	1.00		1.00	
	25–44 Years	14	320,812	4.4	0.00	2.06	0.86–4.90	2.03	0.85–4.84
	45–64 Years	37	330,383	11.2	0.01	5.27*	2.46–11.32	4.48*	2.06–9.75
	65–79 Years	79	190,840	41.4	0.04	19.50*	9.42–40.35	10.97*	5.12–23.51
	80+ Years	61	65,330	93.4	0.09	44.01*	21.06–91.97	12.16*	5.50–26.89
Gender	Male	104	693,594	15.0	0.02	1.00		1.00	
	Female	95	590,490	16.1	0.02	1.07	0.81–1.42	0.94	0.71–1.25
First ASA Score	1–2	42	694,346	6.0	0.01	1.00		1.00	
	3	52	136,136	38.2	0.04	8.26*	5.62–12.13	3.04*	1.99–4.64
	4	48	21,377	224.5	0.22	38.76*	25.71–58.43	9.23*	5.81–14.65
	5	12	743	1615.1	1.62	112.14*	44.27–284.08	18.04*	6.30–51.67
	Not Stated	43	431,397	10.0	0.01	1.30	0.83–2.05	1.44	0.90–2.29
Ethnicity	European	172	908,142	18.9	0.02	1.00		1.00	
	Māori	14	180,234	7.8	0.01	0.41*	0.24–0.71	0.68	0.38–1.21
	Pacific	5	76,986	6.5	0.01	0.34*	0.14–0.67	0.53	0.21–1.31
	Asian/MELAA/Other	4	84,527	4.7	0.00	0.25*	0.09–0.67	0.44	0.16–1.20
NZDep Decile	Decile 1–2	21	220,915	9.5	0.01	1.00		1.00	
	Decile 3–4	45	221,339	20.3	0.02	2.13*	1.27–3.59	1.92*	1.14–3.24
	Decile 5–6	41	255,606	16.0	0.02	1.69	0.99–2.86	1.40	0.82–2.39
	Decile 7–8	48	294,077	16.3	0.02	1.72*	1.03–2.87	1.45	0.87–2.43
	Decile 9–10	43	286,694	15.0	0.01	1.58	0.94–2.66	1.59	0.93–2.71

**Numerator:** NMC: Pulmonary embolus-attributed deaths within 30 days of first anaesthetic of index admissions.

**Denominator:** NMDS: All admissions with a general anaesthetic or neuraxial block.

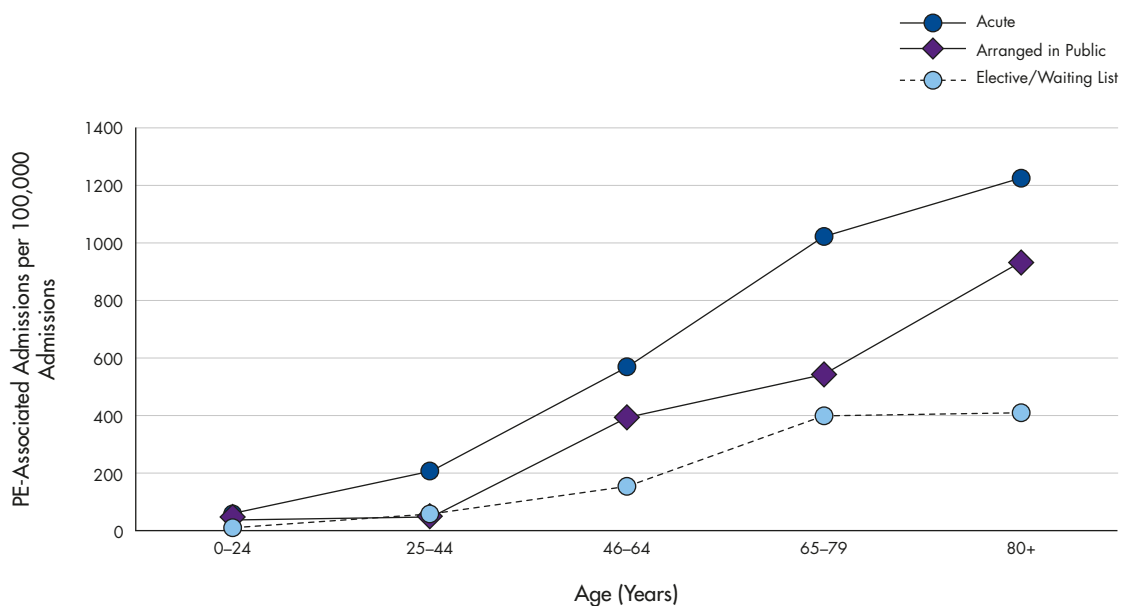
\*: Significantly different from reference category, CI: Confidence interval, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, PE: Pulmonary embolus.

## Background: Pulmonary Embolus-Associated Hospital Admissions

### Admissions by age and hospital type

In New Zealand during 2008–2012, pulmonary embolus-associated hospital admissions were infrequent in young people (aged less than 25 years), but increased thereafter for all types of admissions, particularly acute admissions (Figure 56). People aged over 80 years had the highest rates of pulmonary embolus-associated hospital admissions regardless of admission type. These findings are the same as those observed with the 2007–2011 data where, again, pulmonary embolus-associated hospital admissions were highest for acute hospital admissions and lowest for elective/waiting list admissions. The rate of pulmonary embolus-associated hospital admissions was similar in 2008–2012 compared with 2007–2011 for all admission types.

Figure 56: Pulmonary Embolus-Associated Hospital Admissions by Age and Admission Type, New Zealand 2008–2012



**Numerator:** NMDs: All admissions meeting the criteria for a pulmonary embolus-associated admission.

**Denominator:** NMDs: All admissions with a general anaesthetic or neuraxial block.

PE: pulmonary embolus.

### Admissions by primary procedure

During 2008–2012, repairs of fractures of the femur and pelvis were the most frequent procedures undertaken during acute admissions associated with pulmonary emboli, followed by arthroplasties of the hip (Table 39). Knee and hip arthroplasties were also the most common procedures undertaken during elective/waiting list admissions associated with pulmonary emboli. These findings were similar to those observed in 2007–2011, although it should be noted that procedures are reported by blocks in this report.



Table 39: Pulmonary Embolus-Associated Hospital Admissions by Admission Type and Primary Procedure, New Zealand 2008–2012

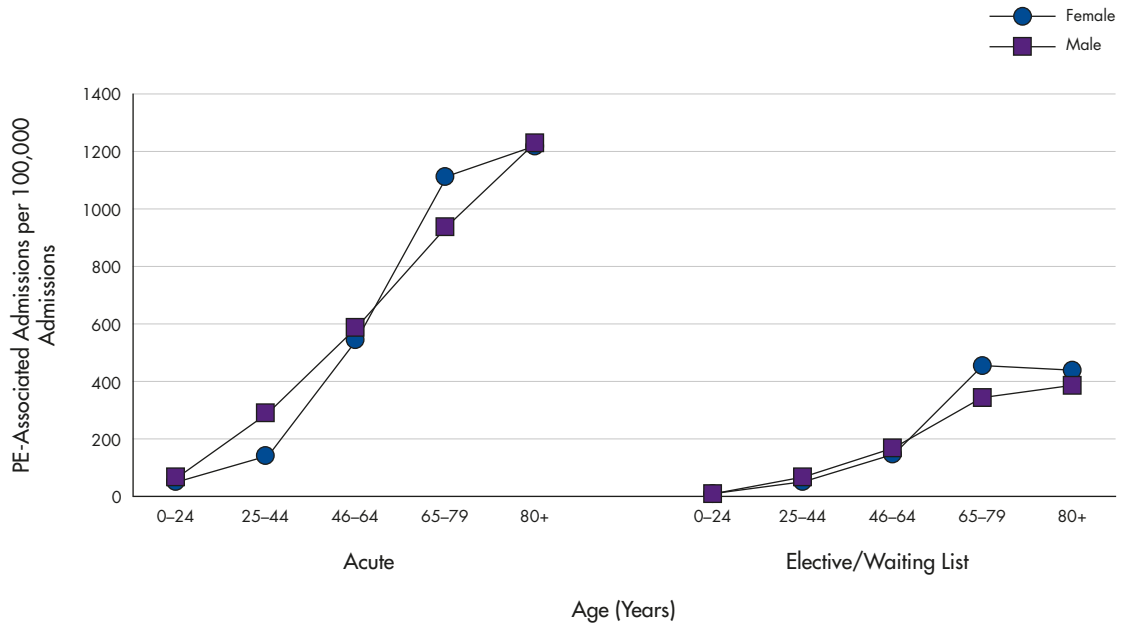
PRIMARY PROCEDURE BLOCK	Total Admission Events 2008–2012	Annual Average	Admissions (%)
<b>Pulmonary Embolus-Associated Admissions</b>			
<b>Acute</b>			
Procedures on Fracture of Femur or Pelvis	130	26.0	10.3
Hip Arthroplasty (Including Revisions)	126	25.2	10.0
Reduction of Fracture of Femur or Pelvis	55	11.0	4.4
Colectomy	45	9.0	3.6
Excision Procedures on Other Musculoskeletal Sites	35	7.0	2.8
Open Reduction of Fracture of Ankle or Toe	33	6.6	2.6
Resection of Small Intestine	29	5.8	2.3
Division of Abdominal Adhesions	28	5.6	2.2
Other Procedures	781	156.2	61.9
<b>Total Acute</b>	<b>1,262</b>	<b>252.4</b>	<b>100.0</b>
<b>Arranged in Public</b>			
Revision of Vascular Access Device	11	2.2	6.1
Coronary Artery Bypass	8	1.6	4.4
Hip Arthroplasty (Including Revisions)	6	1.2	3.3
Other Procedures	156	31.2	86.2
<b>Total Arranged in Public</b>	<b>181</b>	<b>36.2</b>	<b>100.0</b>
<b>Elective/Waiting List</b>			
Knee Arthroplasty (Including Revisions)	359	71.8	29.3
Hip Arthroplasty (Including Revisions)	144	28.8	11.8
Hysterectomy	37	7.4	3.0
Colectomy	30	6.0	2.4
Anterior Resection of Rectum	21	4.2	1.7
Other Procedures	634	126.8	51.8
<b>Total Elective/Waiting List</b>	<b>1,225</b>	<b>245.0</b>	<b>100.0</b>

Data source: NMDS: All admissions meeting the criteria for a pulmonary embolus-associated admission.

### Admissions by age, admission type and gender

There was no major difference between males and females in relation to acute and elective/waiting list admissions for pulmonary embolus-associated hospital admissions during 2008–2012 (Figure 57). The pattern and rate of pulmonary embolus-associated hospital admissions was generally similar to the 2007–2011 data.

Figure 57: Pulmonary Embolus-Associated Hospital Admissions Age, Admission Type and Gender, New Zealand 2008–2012



**Numerator:** NMDS: All admissions meeting the criteria for a pulmonary embolus-associated admission.

**Denominator:** NMDS: All admissions with a general anaesthetic or neuraxial block.

Note: Obstetric-related PE excluded.

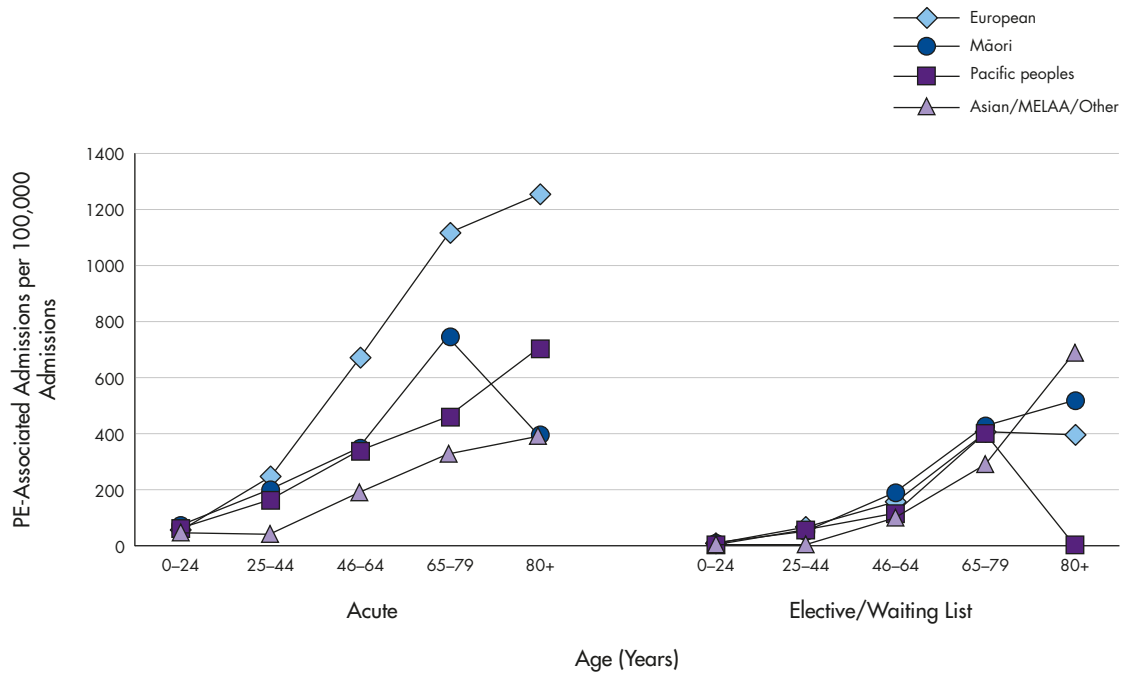
PE: pulmonary embolus.

### Admissions by age, admission type and ethnicity

Pulmonary embolus-associated admissions were infrequent among young people of all ethnic groups during 2008–2012 (Figure 58). Among European peoples, rates for acute admissions increased with increasing age, especially among those over 44 years of age. Compared with 2007–2011, the same pattern was evident. For elective/waiting list admissions, ethnic differences were less evident. Small numbers mean that caution is needed when interpreting rates for people aged over 80 years with Māori, Pacific or Asian/MELAA/Other ethnicity.



Figure 58: Pulmonary Embolus-Associated Hospital Admissions by Age, Admission Type and Ethnicity, New Zealand 2008–2012



**Numerator:** NMDS: All admissions meeting the criteria for a pulmonary embolus-associated admission.

**Denominator:** NMDS: All admissions with a general anaesthetic or neuraxial block.

Ethnicity is Level 1 Prioritised.

Care should be taken when interpreting rates for Māori, Pacific and Asian/MELAA/Other peoples aged 80+ years due to the small number of cases ( $n < 5$ ) in each category.

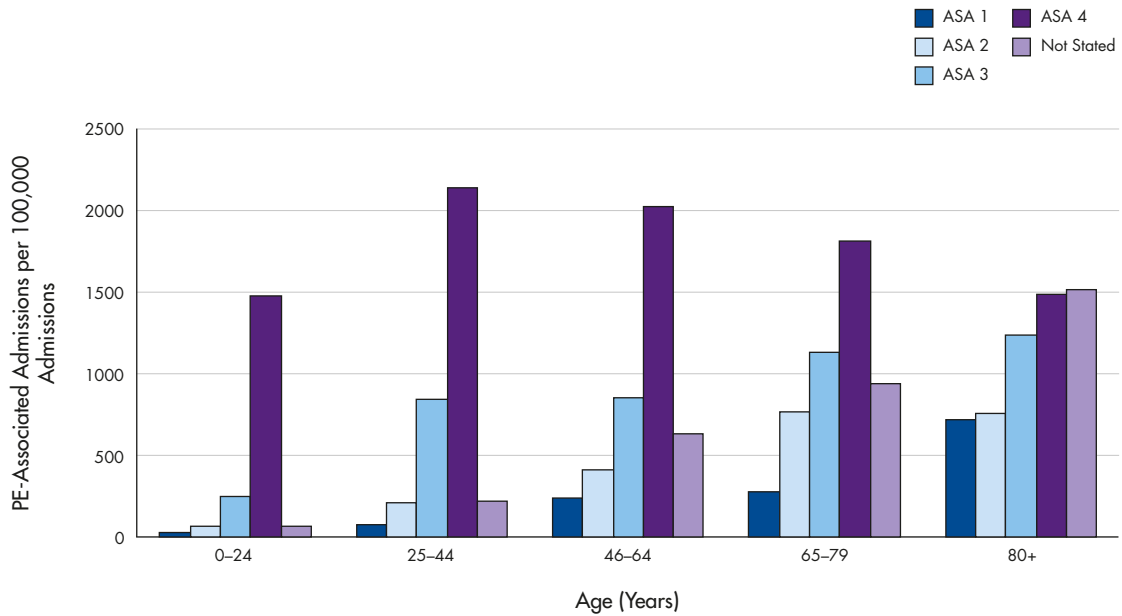
MELAA: Middle Eastern/Latin American/African.

PE: pulmonary embolus.

### Admissions by age, admission type and ASA score

During 2008–2012, acute pulmonary embolus-associated admissions increased with increasing ASA score in all age groups (Figure 59). With the exception of people aged 0–24 years, similar patterns were seen for elective/waiting list admissions, although in each ASA category, admission rates for elective/waiting list admissions were lower than for acute admissions (Figure 60). In all age groups and across admission types, rates were highest for ASA 4 (small numbers precluded a valid analysis of ASA 5). These patterns were similar to the 2007–2011 data.

Figure 59: Pulmonary Embolus-Associated Acute Admissions by Age and First ASA Score, New Zealand 2008–2012



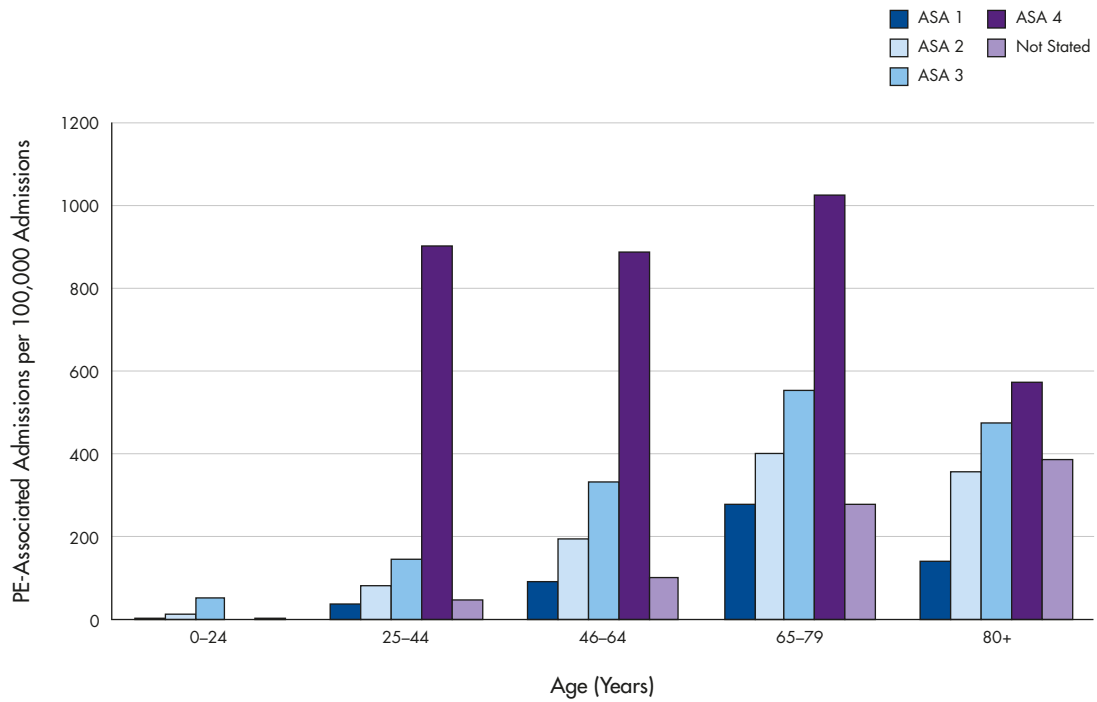
**Numerator:** NMDS: All acute admissions meeting the criteria for a pulmonary embolus-associated admission.

**Denominator:** NMDS: All acute admissions with a general anaesthetic or neuraxial block.

ASA 5 excluded due to small numbers.

PE: pulmonary embolus.

Figure 60: Pulmonary Embolus-Associated Elective/Waiting List Admissions by Age and First ASA Score, New Zealand 2008–2012



**Numerator:** NMDS: All elective/waiting list admissions meeting the criteria for a pulmonary embolus-associated admission.

**Denominator:** NMDS: All elective/waiting list admissions with a general anaesthetic or neuraxial block.

ASA 5 excluded due to small numbers.

PE: pulmonary embolus.



### Pulmonary embolus-associated admissions by socio-demographic and clinical factors

Pulmonary embolus-associated admissions during 2008–2012 were significantly higher for those admitted acutely or semi-acutely in a public hospital (vs. elective/waiting list admissions), those over the age of 25 years (vs. those aged 0–24 years), and those with an ASA score of 3 or more (compared to an ASA score of 1 or 2) (Table 40). In contrast, admission rates were significantly lower for Māori, Pacific and Asian/ MELAA/Other ethnicities (vs. European ethnicities). These differences were evident when the risk was adjusted for other socio-demographic (age, gender, ethnicity, NZDep decile) and clinical (ASA score, admission type) factors. These results are very similar when compared to 2007–2011 data.



Table 40: Pulmonary Embolus-Associated Hospital Admissions by Admission Type, Age, Gender, First ASA Score, Ethnicity and NZDep Decile, New Zealand 2008–2012

VARIABLE	CATEGORY	No. PE-Associated Admissions	No. Admissions with GA or Neuraxial Block	Rate per 100,000 Admissions	Rate per 100 Admissions (%)	Univariate OR	95% CI	Multivariate OR	95% CI
<b>Pulmonary Embolus-Associated Hospital Admissions</b>									
Admission Type	Elective/ Waiting List	1,225	843,189	145.3	0.15	1.00		1.00	
	Arranged in Public	181	131,427	137.7	0.14	0.95	0.81–1.11	1.44*	1.23–1.70
	Acute	1,262	309,423	407.9	0.41	2.82*	2.60–3.05	2.71*	2.49–2.96
Age Group	0–24 Years	90	376,721	23.9	0.02	1.00		1.00	
	25–44 Years	297	320,812	92.6	0.09	3.88*	3.06–4.91	3.84*	3.02–4.88
	45–64 Years	789	330,383	238.8	0.24	10.02*	8.05–12.46	9.85*	7.88–12.31
	65–79 Years	996	190,840	521.9	0.52	21.95*	17.69–27.24	17.55*	14.02–21.97
	80+ Years	496	65,330	759.2	0.76	32.02*	25.57–40.08	16.0*	12.60–20.32
Gender	Male	1,375	693,594	198.2	0.20	1.00		1.00	
	Female	1,293	589,197	219.5	0.22	1.11*	1.02–1.19	1.01	0.93–1.09
First ASA Score	1–2	950	694,346	136.8	0.14	1.00		1.00	
	3	800	136,136	587.6	0.59	4.32*	3.93–4.74	1.89*	1.70–2.10
	4	303	21,377	1,417.4	1.42	10.49*	9.21–11.95	3.37*	2.92–3.89
	5	10	743	1,345.9	1.35	9.96*	5.32–18.65	2.64*	1.36–5.12
	Not Stated	605	431,397	140.2	0.14	1.06	0.96–1.17	0.99	0.89–1.10
Ethnicity	European	2,251	908,142	247.9	0.25	1.00		1.00	
	Māori	222	180,234	123.2	0.12	0.50*	0.43–0.57	0.82*	0.70–0.94
	Pacific	76	76,986	98.7	0.10	0.40*	0.32–0.50	0.62*	0.49–0.79
	Asian/MELAA/ Other	56	84,527	66.3	0.07	0.27*	0.21–0.35	0.41*	0.31–0.54
NZDep Decile	Decile 1–2	445	220,915	201.4	0.20	1.00		1.00	
	Decile 3–4	455	221,339	205.6	0.21	1.02	0.90–1.16	0.98	0.86–1.20
	Decile 5–6	555	255,606	217.1	0.22	1.08	0.95–1.22	0.99	0.87–1.13
	Decile 7–8	677	294,077	230.2	0.23	1.14*	1.01–1.29	1.07	0.94–1.20
	Decile 9–10	519	286,694	181.0	0.18	0.90	0.79–1.02	0.96	0.84–1.10

**Numerator:** NMDS: All admissions meeting the criteria for a pulmonary embolus-associated admission as outlined above.

**Denominator:** NMDS: All admissions with a general anaesthetic or neuraxial block.

\*: Significantly different from reference category, CI: Confidence interval, GA: General anaesthetic, MELAA: Middle Eastern/Latin American/African, OR: Odds ratio, PE: Pulmonary embolus.



## Appendices

### Appendix 1: Thirty-day Mortality Rates in New Zealand Resident Population

Table 41: Thirty-Day Mortality Rates for New Zealand Resident Population

AGE GROUPS (FIVE-YEAR BLOCKS)*	Male 30-Day Mortality/100,000	Female 30-Day Mortality/100,000
0	44.88	36.00
1	2.38	1.89
5	0.58	0.66
10	1.40	1.15
15	6.25	2.71
20	7.40	3.04
25	6.00	3.53
30	8.14	4.27
35	9.53	5.92
40	13.81	9.29
45	19.48	13.97
50	29.75	21.04
55	46.60	30.16
60	70.60	49.07
65	117.29	81.12
70	191.34	129.04
75	332.14	215.10
80	581.51	415.73
85	1,011.37	801.21
90	1,841.84	1,722.66

\* The age interval relates to a five-year period except for age 0 (which relates to a one-year period), age one (which relates to a four-year period) and age 90 which relates to remaining life span.

Based on Statistics New Zealand Life Tables 2009–11.

## Appendix 2: Methods

The data sources and methods employed in this report for chapters that have been published before are consistent with those used for previous reports unless otherwise stated. Methods related to new chapters are outlined below.

### Data sources

Hospital admission data was obtained from the NMDS and compared with Estimated Resident Population counts from Statistics New Zealand (projected from 2008). Mortality rates were sourced from NMC data and compared to NMDS admissions counts.

In relation to specific chapters included in this report, the following data was obtained:

- **Cholecystectomy**

All hospital admissions were included with a cholecystectomy listed in the first 90 procedure codes (ICD-10-AM Australian Classification of Health Interventions (ACHI) Procedure Codes, Version 3: 3044300, 3044500, 3044600, 3044800, 3044900, 3045401, 3045500). In a small proportion of cases (n=420), other more complex procedures were undertaken at the same time as the cholecystectomy (eg, liver resections). In such cases where a cholecystectomy was performed as part of a more complex procedure, the risk of mortality is likely to have been significantly higher than if a cholecystectomy was either the main or the only procedure undertaken at the time of the operation. These admissions were not included in the analyses. Mortality rates of those who died following a cholecystectomy were sourced from NMC data (with cases being selected from the cohort of those undergoing cholecystectomy, as identified in the NMDS) and compared to NMDS admissions where a cholecystectomy was listed in any of the first 90 procedure codes.

- **General anaesthesia**

All hospital admissions were included with a general anaesthetic (ICD-10-AM ACHI Version 3: 92514XX) listed in the first 90 procedure codes were sourced from the NMDS. Mortality rates of those who died (on the same day or the day following a general anaesthetic) are sourced from NMC data and compared to NMDS admissions counts where a general anaesthetic was administered.

- **Hip arthroplasty**

All hospital admissions were included with a hip arthroplasty listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, Blocks: 1489 and 1492) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Knee arthroplasty**

All hospital admissions were included with a knee arthroplasty listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, Blocks: 1518, 1519, 1523 and 1524) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Mortality in elective admissions with an ASA score of 1 or 2**

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

- **Bariatric surgery**

Hospital admissions were initially reviewed if any bariatric procedure was listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, Blocks: 889, 875 and 1666) as listed in the NMDS. Admissions for the chapter were included only if a bariatric procedure for morbid obesity was listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, Block: 889) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.



- **ASA 4 and 5**

All hospital admissions were included in those with an ASA score of 4 or 5 that included a general anaesthetic (ICD-10-AM ACHI Procedure Code Version 3: Block 1910, 92514-XX) or neuraxial block (ICD-10-AM ACHI Procedure Code Version 3: Block 1909, 92508-XX). Deaths related to the admissions with an ASA score of 4 or 5 were included where mortality occurred within 30 days of the general anaesthetic or neuraxial block.

- **PTCA**

All hospital admissions were included with an angioplasty procedure listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, 3530400, 3530500, 3531000, 3531001, 3531002) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **CABG**

All hospital admissions were included with a CABG procedure listed in the first 90 procedure codes (ICD-10-AM ACHI Procedure Codes, Version 3, 3849700, 3849710, 3849720, 3849730, 3849740, 3849750, 3849760, 3849770, 3850000, 3850300, 3850001, 3850301, 3850002, 3850302, 3850003, 3850303, 3850004, 3850304, 9020100, 9020101, 9020102, 9020103, 3863700) as recorded in the NMDS. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Sepsis**

All hospital admissions were included with any secondary diagnosis of sepsis. The ICD-10-AM Edition 3 diagnosis codes used to define sepsis were: A400, A401, A402, A403, A408, A409, A410, A411, A412, A413, A414, A4150, A4151, A4152, A4158, A418, A419, R571, R578, R579, and T811. An admission was included if any of these codes were identified in the 2nd to 90th diagnostic fields. Mortality information was sourced from the NMC and as recorded in the NMDS.

- **Pulmonary embolus-associated and attributed mortality**

- *Pulmonary embolus admissions*

All hospital admissions were included where a general anaesthetic (ICD-10-AM ACHI Procedure Code 92514-XX) or neuraxial block (ICD-10-AM ACHI Procedure Code Version 3: 92508-XX) was administered, and where 1) a pulmonary embolus (ICD-10-AM Version 3: 126.0, 126.8, 126.9) was identified in any of the diagnostic codes associated with the admission or 2) the patient was readmitted within 30 days of the first anaesthetic date of the index admission with a pulmonary embolus identified in any of the diagnostic codes or 3) where the patient died within 30 days of the first anaesthetic date of the index admission and a pulmonary embolus was identified as the main underlying cause of death or as a contributory cause in the NMC. The denominator used the NMDS: All hospital admissions where the patient received a general anaesthetic or neuraxial block. Note: In ICD-10-AM, pulmonary emboli associated with pregnancy and childbirth are coded separately, and these obstetric-related pulmonary emboli have been excluded from this analysis.

- *Pulmonary embolus-associated mortality*

Numerator: NMDS and NMC: All deaths occurring within 30 days of the first anaesthetic date of the index admission where the hospital admission met the criteria for a pulmonary embolus-associated admission outlined above.

a) Denominator: NMDS: All hospital admissions where the patient received a general anaesthetic or neuraxial block.

b) Denominator: NMDS: All pulmonary embolus-associated hospital admissions in those receiving a general anaesthetic or neuraxial block.

- *Pulmonary embolus-attributed mortality*

Numerator: NMDS and NMC: All deaths occurring within 30 days of the first anaesthetic date of the index admission where a pulmonary embolus was listed as either the main underlying cause of death or as a contributory cause of death in the NMC.

Denominator: NMDS: All hospital admissions where the patient received a general anaesthetic or neuraxial block.

## Notes on interpretation

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

### 1) Hospital admission types and hospital readmissions

The following occurrences, unless otherwise stated, have been dealt with in the same way as in previous reports.

#### *Acute, arranged in public (semi-acute) and elective/waiting list admissions*

The analyses included in this report used the hospital admissions typology specified in the NMDS Data Dictionary (National Health Board 2014). An acute admission is defined as an unplanned admission occurring on the day of presentation, while an arranged in public (semi-acute) 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, elective/waiting list admissions arise when the planned admission date is seven or more days after the date the decision was made that admission was necessary.

These definitions, however, are inconsistently used by private hospitals uploading their data to the NMDS, with a significant proportion of private hospital admissions being coded as semi-acute when in reality they meet the criteria for an elective/ waiting list admission as outlined above. As a result, in the report all semi-acute private hospital cases have been included in the elective/waiting list category, while arranged admissions occurring in public hospitals have been included in the arranged in public (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 hospitals only.

#### *Private and public hospital admissions*

The NMDS contains near complete information on all publicly funded inpatient events occurring in public hospitals. In contrast, private hospital events include a mix of publicly funded and privately funded cases. DHB-funded events occurring in private hospitals are usually reported to the NMDS by the DHB contracting the treatment, and thus are mostly complete in the dataset. 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 of Health 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 Accident Compensation Corporation (ACC) funded events, or publicly funded long-stay geriatric cases. Thus, in this report it must be remembered that the data presented is likely to undercount some private hospital events, with the magnitude of this undercount being difficult to quantify (although it is assumed to be significant).

#### *Readmissions*

Both first-time procedures and revisions of previous procedures were included in the analyses, with a small number of individuals appearing more than once in the data. In such cases, if a second procedure occurred within 30 days of the initial procedure, it was considered to be a revision, arising as a complication of the first procedure, and, in such cases, the outcomes arising from the second procedure were attributed to the first. These readmissions were not included in the denominator used to calculate mortality rates by procedure. If a readmission occurred more than 30 days from the original procedure, however, this was considered to be a new procedure in the calculation of mortality rates.

### 2) Chapter-specific notes

The following information relates to chapters on clinical areas that have not been presented in previous reports.

#### *Mortality related to CABG, PTCA, sepsis, ASA 4 and 5, and bariatric surgery*

Consistent with other reports, mortality is presented as deaths occurring within 30 days of any procedure that meets the definition criteria for that chapter. In addition, for the new chapters presented in this report for the first time (CABG, PTCA, sepsis, ASA 4 and 5, and bariatric surgery) deaths as inpatients are also included where they have occurred after a relevant procedure but before discharge home or to a rehabilitation facility. The inclusion of deaths prior to discharge is consistent with the POMRC's terms of reference A2 (Deaths occurring after an operative procedure after 30 days but before discharge from hospital or to a rehabilitation facility).



#### *Multiple anaesthetics and readmissions for ASA 4 and 5*

Admissions were included if the ASA score of any anaesthetic (either a general anaesthetic or a neuraxial block) during that admission was either 4 or 5. Most admissions (91.5%) included only one anaesthetic with an ASA score of 4 or 5 as the first anaesthetic. In a number of admissions (1302) multiple anaesthetics were administered and the ASA score for one of these later anaesthetic events was 4 or 5. The anaesthetic with an ASA score of 4 or 5 was taken to be the index event for both the calculation of 30-day mortality and for assigning the ASA score.

In this analysis, all admissions with any anaesthetic procedure with an ASA or 4 or 5 have been included even if the ASA score of an earlier or later anaesthesia during that admission was not 4 or 5. Similarly only, deaths within 30 days of the index anaesthetic have been included, even if earlier or later anaesthesia occurred during the same admission (ie, 30-day mortality has been calculated with respect to the index rather than the first or last anaesthetic within an admission). In a small number of cases, two admissions occurred within 30 days of death. In such cases, the first elective/waiting list admission in the 30-day period has been taken to be the index event.

#### *Admissions and mortality related to sepsis*

An admission was included if any of the listed codes for sepsis were identified in the 2nd to 90th diagnostic fields. Admissions included any hospital event with a surgical diagnosis related group DRG that listed at least one operating room procedure. The list of operating room procedures and all other clinical codes were obtained by the Health Quality & Safety Commission and were based on the Victorian State Government document: *Patient Safety Translated Technical Specifications* ([http://www.health.vic.gov.au/\\_\\_data/assets/pdf\\_file/0009/270855/Translated-Technical-Specifications.pdf](http://www.health.vic.gov.au/__data/assets/pdf_file/0009/270855/Translated-Technical-Specifications.pdf)). Operating room procedures and diagnoses were translated into ICD-10-AM Edition 3 and DRG codes were translated into Edition 3 and Edition 6. As from 1 July 2011 NMDS data contains DRGs in ICD-10-AM Edition 6. The following exclusions were applied to the admissions:

- any admissions with a primary diagnosis of sepsis
- those with a primary diagnosis of infection
- those with any code for an immunocompromised state
- those with any code for cancer
- those with a major diagnostic category 14 (pregnancy, childbirth and puerperium)
- those with a length of stay of less than two days.

The first operation date was used as the index date for mortality.

The following occurrences, unless otherwise stated, have been dealt with in the same way as in previous reports.

#### *Multiple anaesthetics and readmissions for the 'Mortality following General Anaesthesia' chapter*

While in the majority of cases only one general anaesthetic was performed per hospital admission, in 2.5% of admissions, two or more general anaesthetics were performed, with the maximum number of general anaesthetics performed during any one admission being 75. 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 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.

*Multiple anaesthetics and readmissions for the 'Mortality in Elective Admissions with an ASA Score of 1 or 2' chapter*

Elective/Waiting list admissions were included if the ASA score of the first anaesthetic (either a general anaesthetic or a neuraxial block) during that admission was either 1 or 2. In a small number of admissions, multiple anaesthetics were administered, and in some cases the ASA score for these later anaesthetic events was 3 or more. Because the first anaesthetic was taken to be the index event for both the calculation of 30-day mortality and for assigning the ASA score, in this analysis all admissions have been included, even if the ASA score of later anaesthesia was 3 or more. Similarly, only deaths within 30 days of the index anaesthetic have been included, even if later anaesthesia occurred during the same admission (ie, 30-day mortality has been calculated with respect to the first rather than the last anaesthetic within an admission). In a small number of cases, two elective/waiting list admissions occurred within 30 days of death. In such cases, the first elective/waiting list admission in the 30-day period has been taken to be the index event.

*Multiple anaesthetics and readmissions for the 'Pulmonary Embolus-Associated and Attributed Mortality' chapter*

In a small number of cases, two or more hospital admissions occurred within 30 days of a pulmonary embolus-associated or attributed death, and in such cases, the first admission was considered to be the index admission, with the second admission being removed from both the numerator and denominator of the mortality rate calculations (although both admissions were included in the calculation of pulmonary embolus-associated admission rates). Similarly, only deaths occurring within 30 days of the first anaesthetic date of the index admission were included, even if later anaesthesia occurred during the same admission (ie, 30-day mortality was calculated with respect to the first rather than the last anaesthetic for each index admission).

### 3) Socio-demographic and clinical covariates

The following occurrences, unless otherwise stated, have been dealt with in the same way as in previous reports.

*NZDep decile*

Analysis of NZDep information is not separately included in this report as only 2006 NZDep data could be obtained. It is likely that the 2006 data would have limited relevance to the admissions and mortality information from the later years analysed in this report. Thus, separate analyses of data were not presented in relation to NZDep. However, this data was used in the logistic regression analyses in order to give some indication of the effect of deprivation on the results.

*ASA and emergency suffixes*

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

Table 42: Thirty-Day Mortality Rates for New Zealand Resident Population

ASA SCORE	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
<b>Emergency</b>	<b>Modifier Description</b>
0	Procedure being performed as an emergency
9	Non-emergency or not known



Unless otherwise specified, the ASA status referred to throughout this report is the ASA status derived from the first anaesthesia code for each admission event (with the order of procedure codes being determined by the diagnosis sequence variable within the NMDS). In the case of multiple anaesthetics, it is likely that this first ASA status reflects most closely the ASA status of the patient at the time of admission. However, in Table 18 of the companion background report ([www.hqsc.govt.nz/our-programmes/mrc/pomrc/publications-and-resources/publication/2151](http://www.hqsc.govt.nz/our-programmes/mrc/pomrc/publications-and-resources/publication/2151)) the ASA status 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).

#### **4) Interpreting multivariate analyses: odds ratios and rate ratios**

This report used logistic regression for multivariate analysis. A limitation of logistic regression is that the results generated are expressed as odds ratios (the odds of an event occurring in an exposed group versus the odds of it occurring in an unexposed group) as opposed to rate ratios such as relative risk (the risk of an event occurring in an exposed group relative to the risk of it occurring in the unexposed group).

Odds ratios provide a close estimate relative risk for rare outcomes. However, for non-rare outcomes, odds ratios become biased away from the null, resulting in a tendency to over-estimate the magnitude of any effect.

In this report, consistent with previous reports, all odds ratios derived from figures where the mortality rate exceeds 20% have been suppressed (as indicated by an H). Interpreting any odds ratios where the associated mortality is in the 10–19% range should also be interpreted with caution because of the tendency for odds ratios to slightly overestimate rate ratio (and the magnitude of effect).



## List of Abbreviations

<b>ACC</b>	Accident Compensation Corporation
<b>ACHI</b>	Australian Classification of Health Interventions
<b>ASA</b>	American Society of Anesthesiologists
<b>CABG</b>	Coronary artery bypass graft
<b>CI</b>	Confidence interval
<b>DHB</b>	District health board
<b>DRG</b>	Diagnosis related group
<b>LIMA</b>	Left internal mammary artery
<b>MELAA</b>	Middle Eastern/Latin American/African
<b>MOR</b>	Multivariate odds ratio
<b>NMC</b>	National Mortality Collection
<b>NMDS</b>	National Minimum Dataset
<b>NZDep</b>	New Zealand Deprivation Index
<b>OR</b>	Odds ratio
<b>PE</b>	Pulmonary embolus
<b>POMR</b>	Perioperative mortality rate
<b>POMRC</b>	Perioperative Mortality Review Committee
<b>PTCA</b>	Percutaneous Transluminal Coronary Angioplasty
<b>RIMA</b>	Right internal mammary artery
<b>UOR</b>	Univariate odds ratio
<b>VTE</b>	Venous thromboembolism
<b>WHO</b>	World Health Organization



## References

National Health Board. 2014. *National Minimum Dataset (Hospital Events) Data Dictionary*. Wellington: Ministry of Health.

URL: <http://www.health.govt.nz/publication/national-minimum-dataset-hospital-events-data-dictionary>

POMRC. 2015. *Perioperative Mortality in New Zealand: Fourth report of the Perioperative Mortality Review Committee*. Wellington: Health Quality & Safety Commission. URL: <http://www.hqsc.govt.nz/our-programmes/mrc/pomrc/publications-and-resources/publication/2151/>



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