Health NZ

New Zealand Cardiac Surgery National Report

2017

Preface

New Zealand Cardiac Surgical Annual Report 2017

Patients undergoing cardiothoracic surgery are some of the most ill patients that our health system cares for. Suffering conditions such as heart valve disease and blocked coronary arteries. All cardiothoracic surgeons have professional responsibilities towards patients, the public, their colleagues and employers, and the wider surgical profession, and to that end Cardiothoracic surgeons have championed the collection and publication of clinical outcomes data and since monitoring and publishing survival rates for adult cardiac surgery in New Zealand in the past 3 years; cardiothoracic units can now benchmark performance against the national average, a powerful tool for continued improvements in services to patients.

This report has been prepared by Dendrite Clinical Systems in conjunction with the National Cardiothoracic Surgery Clinical Network (NCSCN). It is based on information collected between 1 January 2017 and 31 December 2017, and presents performance and outcomes data on the most common, publicly-funded cardiac surgery procedures; mainly isolated coronary artery bypass grafting (CABG) and isolated aortic valve replacements (AVR).

The outcome of a cardiac surgical procedure is an example of teamwork. There are many factors such as the patient's general condition; the other medical staff (cardiologists, anaesthetists, intensivists and junior medical staff); the post-operative care (provided by nurses, physiotherapists, pharmacists *etc.*); and the hospital facilities (which impact infection rates, physical plant) that can have a bearing on the surgical outcome. Many of these factors are simply outside the day-to-day control of the Consultant Surgeon.

The sporting cliché *There is no 'I' in team* should be borne in mind when discussing hospital-specific data. We have used crude mortality, unadjusted for case mix, because our dataset is not yet big enough to apply case mix adjustment to every hospital practice.

Our patients should be reassured by the information presented within this report. Our national results compare very favourably with international standards and continue to improve.

The last 12 months has seen further progress towards improving cardiac services in New Zealand. There has been major investment nationally to improve the clinical settings in which our patients are treated, and cardiac surgery waiting times have continued to improve. Relatively fewer patients wait more than 12 weeks now for open heart surgery. Another point that is important to highlight is the extremely high standard of care that is being offered in this country. Despite ever-increasing complexity of case mix, the mortality rates here compare favourably with those elsewhere in the world. This is a tribute to the high standards of training being made available in New Zealand and to the commitment to quality that Cardiothoracic Surgeons promulgate.

Mr Adam El Gamel

Chair, National Cardiothoracic Surgery Clinical Network

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NCSCN members who contributed to this report:

- P Davis
- S Galvin
- A El Gamel
- D Haydock
- K Murray
- H Singh

Other contributors:

- C Allin
- R Kinsman
- A McGeorge
- P Walton

Introduction

The New Zealand National Cardiac Surgery Registry (NZCSR) has been established by the New Zealand cardiac surgical community as a quality assurance tool that will enable us to audit our practice, review surgical outcomes and to compare these between units in New Zealand and also to benchmark against internationally reported standards. This report is the analysis of the year 2017 of patient enrolment in all 5 cardiac surgical units in New Zealand (Auckland, Waikato, Capital and Coast, Canterbury, Southern).

At an individual Surgeon and unit level NZCSR facilitates analysis of work patterns and ensures that key performance Indicators are met. It is used for regular multi-disciplinary discussion of individual patient morbidity and mortality as part of already well established peer review and audit processes. On a national level NZCSR facilitates comparison of regional variation in surgical work load, patient characteristics, risk profiles, comparison of outcomes and will better inform national planning for current and future population and individual patient needs. With time the database will mature to become an important resource for ongoing improvement of patient care and also to facilitate the implementation of quality improvement projects. It will help us plan for national variations in healthcare needs of our population and to ensure equitable access to surgical treatment across the regions. The database is a tool for surgeons, cardiac surgical units and the New Zealand community to assess surgical intervention and outcomes across the country and to ensure the highest standard of care to our patients.

All data is collated and analysed independently by Dendrite Clinical Systems, an internationally respected specialist supplier of clinical database and analysis software. The project is overseen by the National Cardiac Surgery Clinical Network which comprises members from each of the 5 public cardiac surgical units in New Zealand along with members from the Ministry of Health, the National Cardiac Network and community representatives. We aim to provide a patient focused, accurate and transparent report of outcomes for cardiac surgery in New Zealand. The 2 most common category of operation performed in New Zealand are reported: Isolated Coronary Artery Bypass Grafting (CABG) and Isolated Aortic Valve replacement (AVR). Volume of procedure, patient characteristics, morbidity and mortality indicators of resource utilisation are presented. These 2 groups combined make up approximately 65% of all cardiac surgery performed in New Zealand and are reflective of national surgical practice and results. Outcomes for individual patients are heavily influenced by factors such as overall health, age, co-existing medical conditions, acuity and magnitude of surgery. Therefore, major outcomes such as mortality will be risk adjusted using internationally validated and accepted risk scoring tools. Also we will compare outcomes in New Zealand by benchmarking against other internationally reported cardiac surgical registries. In comparison to these other registries New Zealand is a small surgical community, to ensure that reporting of outcomes does not reflect statistically insignificant variation we aim to produce a National yearly report. Ultimately our goal is to provide the highest standard of medical and surgical care to the population of New Zealand and to continue to reflect on and to improve our practice for the good of our patients.

Over the coming years as the registry grows we expect it will form the framework for development and ongoing reporting of a number of quality improvement programmes.

Finally, it is important to stress that a cardiac surgical team is an extensive one and numerous medical professionals' support and provide care to each individual patient through their journey. Whilst the operation is ultimately the largest intervention undertaken it is important to stress that each of the medical professions involved (cardiologist, surgeon, perfusionist, intensive care specialist, anaesthetist, junior doctor, nurse, social worker, physiotherapist, pharmacist and occupational therapist) play an important role in the care provided to, and the outcomes for each individual patient. When we report outcomes these are collectively shared by all members of the team. The development of a robust and accurate database allows us to identify where the team is doing well but also where there is room for the team to improve. The national database is supported by a rigorous governance structure, each individual surgeon maintains professional development and practice audit in keeping with standards set by the New Zealand Medical Council (NZMC), The Australasian Society of Cardiac and Thoracic Surgeons (ANZCTS) and The Royal Australasian College of Surgeons (RACS). Whilst the database and our regulatory bodies (NZMC, RACS) have processes in place to identify and further assess underperforming individuals an important aspect of a national report is that it remains confidential at an individual surgeon and patient level. In reporting unit results we are acknowledging that the outcomes presented are not just attributable to individuals but are a product of the collaboration between and the contributions made by all members of the cardio surgical team.

Mr Sean Galvin

on behalf of the National Cardiothoracic Surgery Clinical Network (NCSCN)

Data presentation

- The data presented within this report is for the period 1 January 2017 to 31 December 2017.
- It includes all public funded cardiac surgical procedures performed nationally.
- In this report we have analysed the risk factors and their impact on outcomes.
- The two standardised operations included are coronary artery bypass grafting (CABG) and aortic valve replacement (AVR) these account for over 65% of the workload of all cardiac surgical units.
- The data has been collected using Dendrite Clinical Systems clinical database.
- The definitions used in this database have been aimed to be identical with international definitions so a realistic comparison can be made with other international standards.

Overview of people who had cardiac surgery

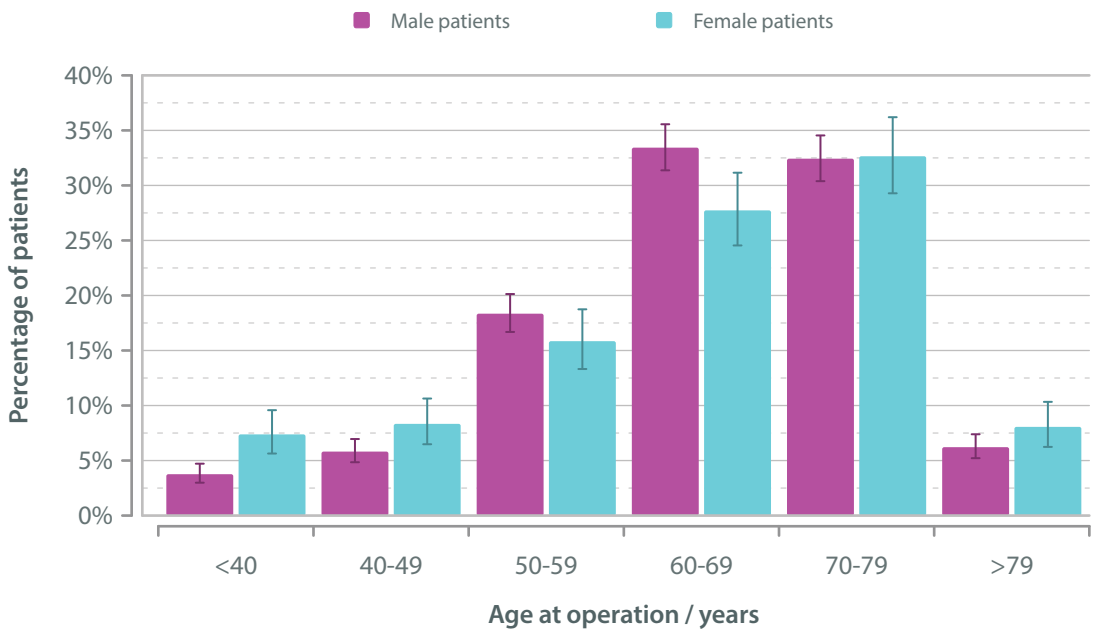
In the 12-month period (2017) a total of 2,727 cardiac surgical procedures were performed across the five publicly-funded cardiac surgery centres [1] (Table 1).

70% of cardiac surgical procedures were for patients aged 60 years or over with 73% of the total number of patients male (Fig. 1).

Table 1. All cardiac surgery patients in 2017: age and gender

		Gender		
		Male	Female	All
Age at operation / years	<40	75	54	**129**
	40-49	116	61	**177**
	50-59	366	116	**482**
	60-69	667	203	**870**
	70-79	647	239	**886**
	>79	124	59	**183**
	Unspecified	0	0	**0**
	All	**1,995**	**732**	**2,727**

Fig. 1 **All cardiac surgery patients: Age & gender distributions; calendar year 2017 (n=2,727)**



1. The 5 District Health Boards (DHB) undertaking Cardiac surgery: Auckland DHB, Waikato DHB, Capital and Coast DHB, Canterbury DHB, Southern DHB.

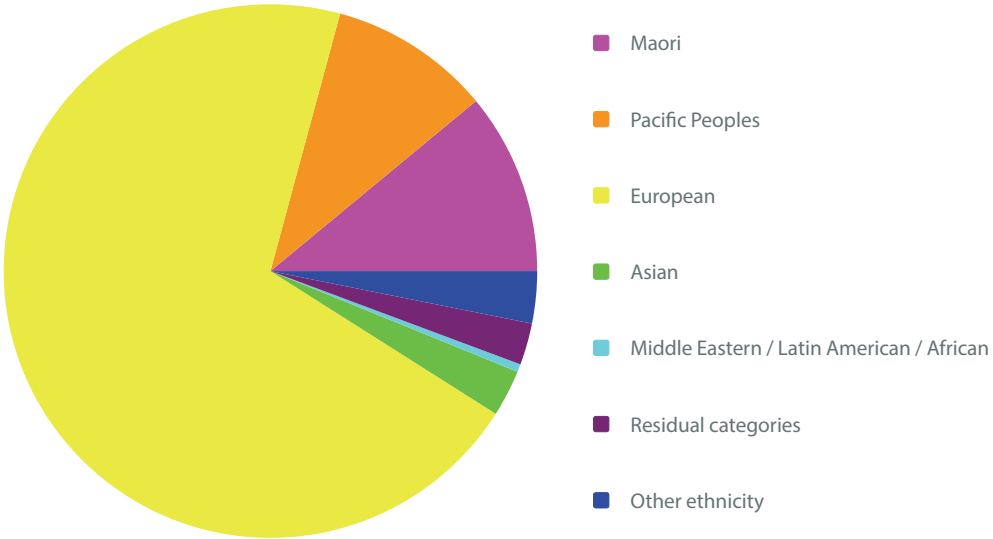
Ethnicity

70.2% of patients were of European ethnicity with Maori accounting for 11.0% and Pacific Peoples 9.8%; (Table 2)

Table 2. Ethnicity of patients undergoing cardiac surgery in 2017

		Count	Percentage
Ethnicity	Maori	300	11.0%
	Pacific Peoples	267	9.8%
	European	1,915	70.2%
	Asian	77	2.8%
	Middle Eastern / Latin American / African	13	0.5%
	Residual categories	69	2.5%
	Other ethnicity	86	3.2%
	Unspecified	0	
	All	**2,727**	

Fig. 2 **All cardiac surgery patients: Ethnicity; calendar year 2017 (n=2,727)**



Risk factors

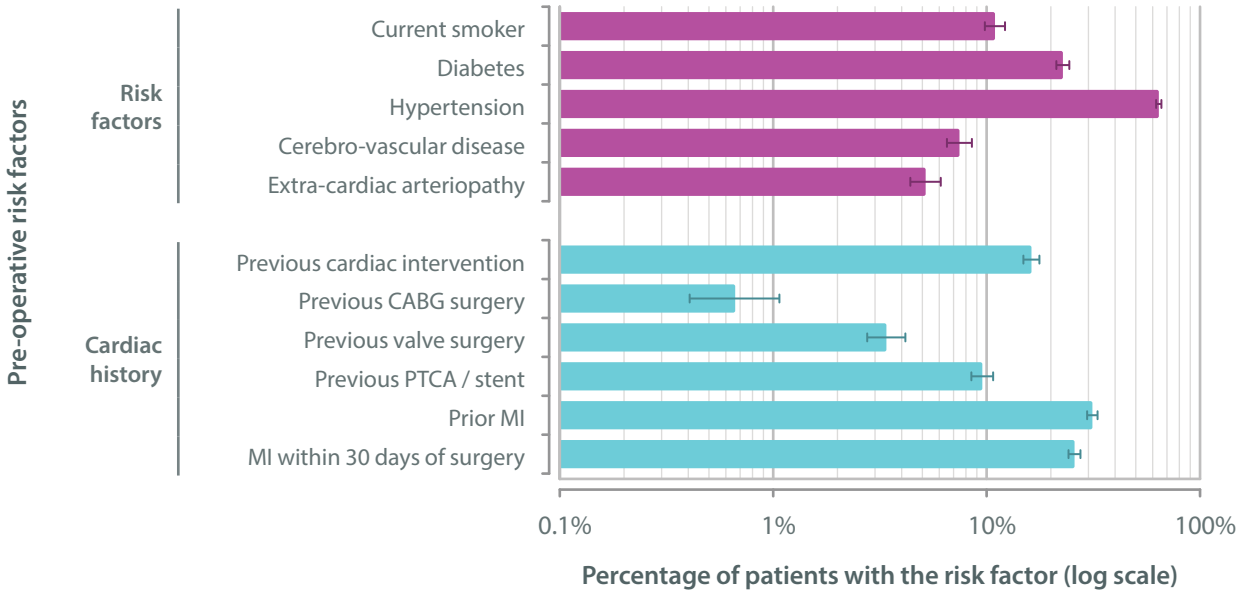
The risk of heart disease is influenced by a number of factors. These include age, sex, lifestyle choices (*e.g.,* smoking), elevated cholesterol levels (familial, high cholesterol diet, lack of exercise), high blood pressure and diabetes. The risk factor spectrum continues to remain similar. Further analysis of this will need to be undertaken over the coming years to determine variation within diverse ethnic groups and areas for targeted improvement.

- One in 10 patients were still smoking at the time of surgery in 2017; in 2016 this figure was higher with one in eight patients still smoking at the time of surgery.
- Approximately one-quarter of the patients had diabetes.
- Over 60% of patients had high blood pressure.

Table 3. All patients in 2017: pre-operative risk factors

		Risk factor present			
		No	Yes	Unspecified	Percentage with the risk factor
Risk factors	Current smoker	2,424	298	5	10.9%
	Diabetes	2,102	620	5	22.8%
	Hypertension	977	1,746	4	64.1%
	Cerebro-vascular disease	2,517	203	7	7.5%
	Extra-cardiac arteriopathy	2,581	141	5	5.2%
Cardiac history	Previous cardiac intervention	2,282	442	3	16.2%
	Previous CABG surgery	2,694	18	15	0.7%
	Previous valve surgery	2,620	92	15	3.4%
	Previous PTCA / stent	2,463	260	4	9.5%
	Prior MI	1,871	853	3	31.3%
	Prior MI within 30 days of surgery	2,019	703	5	25.8%

Fig. 3 **All cardiac surgery patients: Risk factors; calendar year 2017**



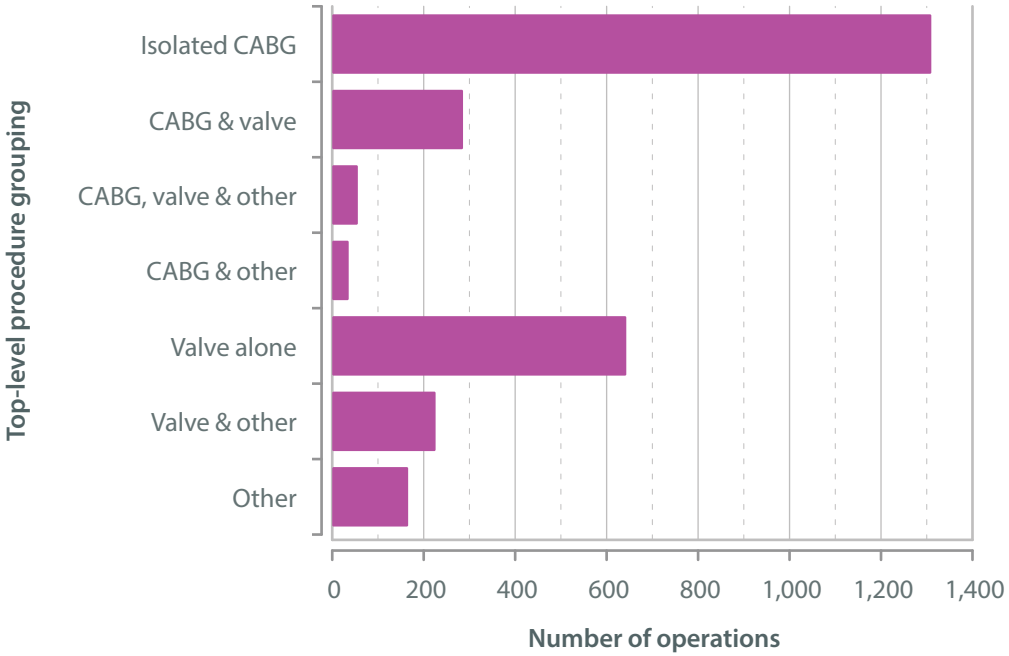
Types of operations performed

- Isolated coronary artery bypass accounted for 48.1% of the total volume of cases.
- Isolated heart valve operations were 23.6%.
- Combined valve and coronary artery bypass 10.5%.
- Approximately 15% of cases were for *Other*, less common procedures.

Table 4. Procedures performed in 2017

		Count	Percentage
Top-level procedure grouping	CABG	1,310	48.1%
	CABG & valve	286	10.5%
	CABG, valve & other	56	2.1%
	CABG & other	36	1.3%
	Valve alone	643	23.6%
	Valve & other	226	8.3%
	Other	166	6.1%
	Unspecified	4	
	All	**2,727**	

Fig. 4 **Operations performed in the calendar year 2017**



Isolated coronary artery bypass surgery

Coronary artery bypass grafting (CABG) is an operation undertaken to bypass blocked arteries of the heart in patients who are not suitable for a non-surgical treatment option (stent placement) or due to failure of stents. The aim of the procedure is to improve quality of life and minimise the risk of a heart attack.

This procedure is the most commonly-performed operation by a cardiac surgeon. In the year 2017 a total of 1,307 patients underwent a publicly-funded isolated CABG operation (47.9%) of the total volume of cardiac surgery. (Table 4). The volumes of the procedure is consistent over the past three years audited.

Coronary artery disease is a condition where cholesterol deposition occurs in the arteries supplying blood to the heart. Multiple risk factors contribute to occurrence of the disease. The risk factors include diabetes, high blood pressure, smoking and obesity (Table 7; Fig. 6) or a combination of them. Some people unfortunately have a genetic predisposition. Other risk factors can enhance early progression of the disease in those with a familial predisposition. They also impact on outcome in terms of complications and early recovery from heart surgery.

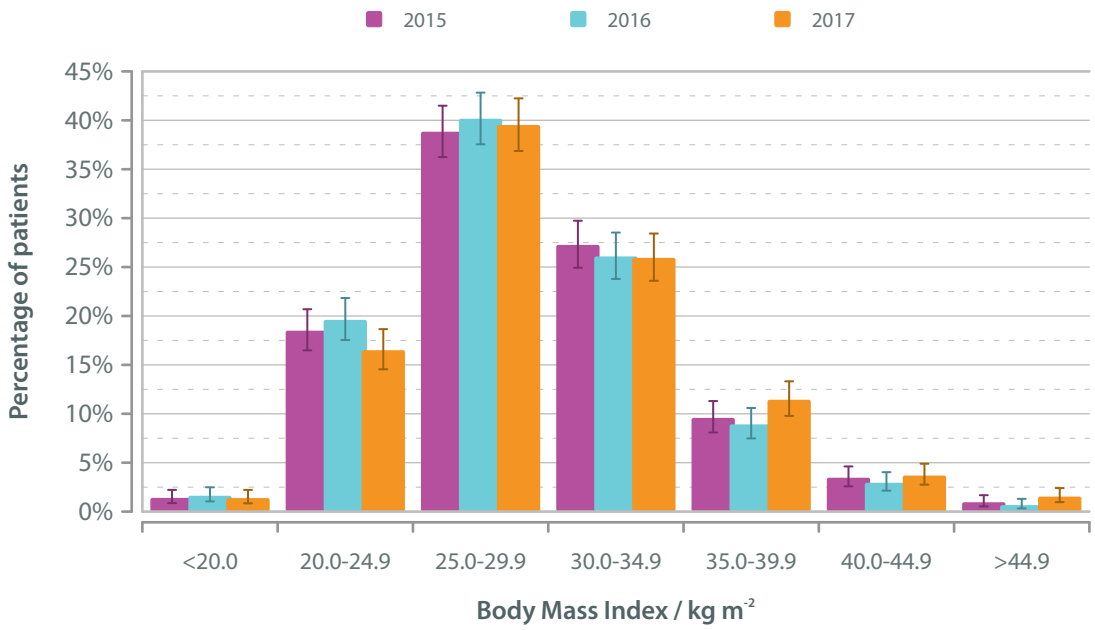
Body Mass Index (BMI) is an indicator of a patients size. BMI is calculated by the patient's mass in kg ÷ height in metres squared (Table 5).

- A BMI of less than 18.5 is defined as underweight; currently less than 1.4% of the CABG patient population fall within this category.
- Approximately 16.5 % of CABG patients are classified within the healthy BMI range NZ European (18.5-24.9).
- The remaining 80% of CABG patients were in the overweight (25.0-29.9), obese (30.0-34.9) or morbidly obese (>35.0) categories.

Table 5. First-time isolated CABG: Body Mass Index in each of the last 3 calendar years

		2015		2016		2017	
		Count	Percentage	Count	Percentage	Count	Percentage
BMI / kg m^{-2}	<20.0	19	1.4%	22	1.6%	18	1.4%
	20.0-24.9	251	18.5%	266	19.6%	215	16.5%
	25.0-29.9	527	38.8%	545	40.2%	515	39.5%
	30.0-34.9	370	27.3%	354	26.1%	338	25.9%
	35.0-39.9	130	9.6%	121	8.9%	149	11.4%
	40.0-44.9	47	3.5%	40	2.9%	48	3.7%
	>44.9	13	1.0%	9	0.7%	20	1.5%
	Unspecified	12		3		4	
	All	**1,369**		**1,360**		**1,307**	

Fig. 5 **First-time isolated CABG: BMI distributions over the last three calendar years; (n=4,017)**



BMI classifications

Ministry of Health New Zealand. Body size. Retrieved from: http://www.health.govt.nz/ourwork/populations/maori-health/tatau-kahukura-maori-health-statistics/nga-tauwehe-tupono-me-temarumaru-risk-and-protective-factors/body-size.

Table 6. International BMI cut-off points for adults aged 18 years and over

Classification	BMI range (kg m^{-2})	Risk of health conditions
Underweight	<18.5	Low risk
Normal range	18.5-24.9	Average risk
Overweight	25.0-29.9	Increased risk
Obese	>29.9	Substantially increased risk

Isolated CABG

In the New Zealand population entered in the registry, the incidence of these risk factors was:

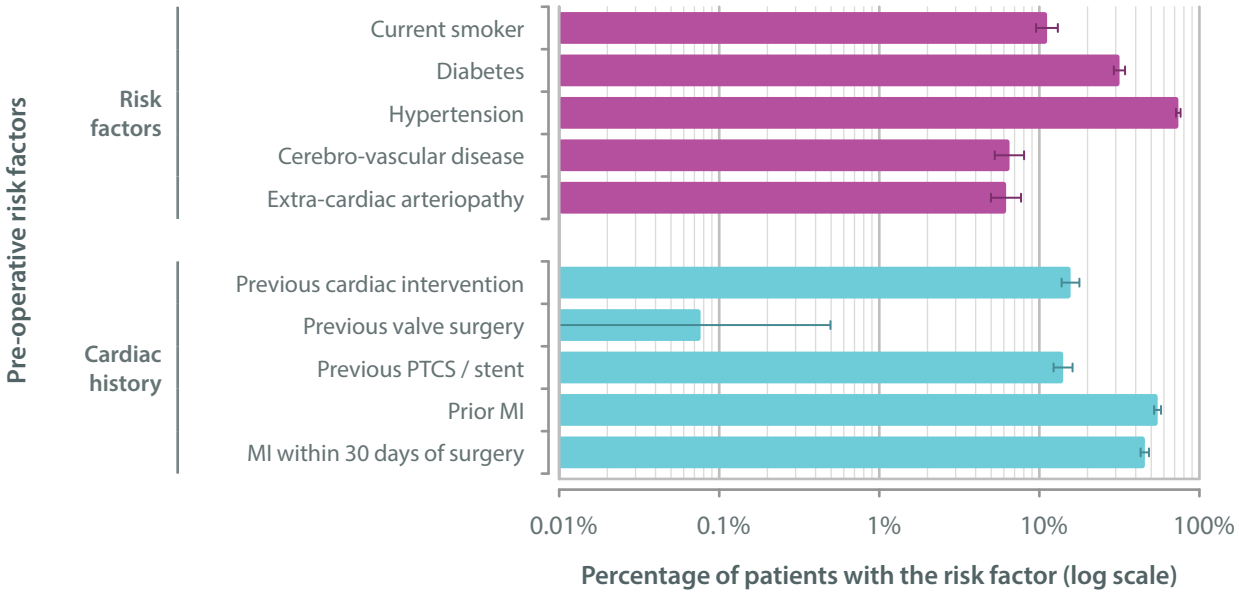
- One in ten patients (11.2%) were current smokers.
- One-third of the patients (31.7%) were diabetic.
- More than 70% of the patients had high blood pressure (hypertension).

The incidence rate has remained consistent over the last 3 years of reporting.

Table 7. First-time isolated CABG in 2017: pre-operative risk factors

		Risk factor present			
		No	Yes	Unspecified	Percentage with the risk factor
Risk factors	Current smoker	1,160	146	1	11.2%
	Diabetes	892	414	1	31.7%
	Hypertension	341	966	0	73.9%
	Cerebro-vascular disease	1,220	85	2	6.5%
	Extra-cardiac arteriopathy	1,225	81	1	6.2%
Cardiac history	Previous cardiac intervention	1,102	205	0	15.7%
	Previous valve surgery	1,306	1	0	0.1%
	Previous PTCA / stent	1,122	184	1	14.1%
	Prior MI	590	717	0	54.9%
	Prior MI within 30 days of surgery	710	596	1	45.6%

Fig. 6 **First-time isolated CABG: Risk factors; calendar year 2017**

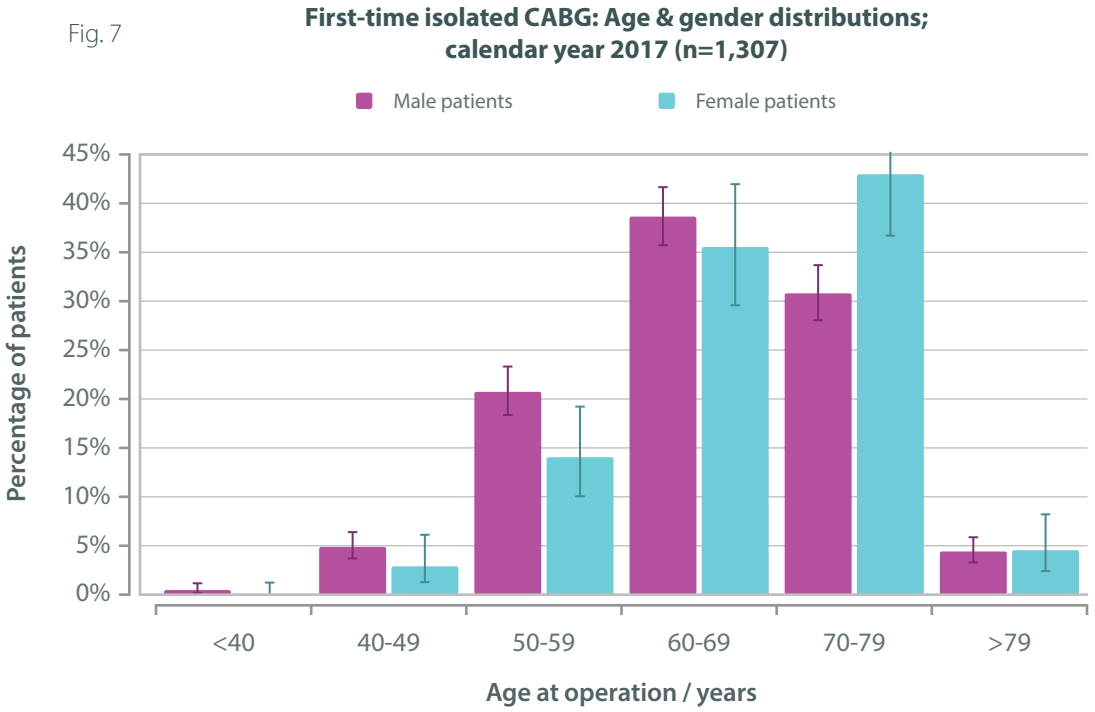


The most common presentation of these patients is between 50 to 75 years of age, which accounts for over 85% of the total volume. The majority of these patients present between 50 to 79 years of age, with men presenting at an earlier age than female patients. The overall male to female ratio is 4.4 : 1.

Table 8. First-time isolated CABG in 2017: age and gender

		Gender		
		Male	Female	All
Age at operation / years	<40	5	0	**5**
	40-49	52	7	**59**
	50-59	221	34	**255**
	60-69	412	86	**498**
	70-79	328	104	**432**
	>79	47	11	**58**
	Unspecified	0	0	**0**
	All	**1,065**	**242**	**1,307**

Fig. 7

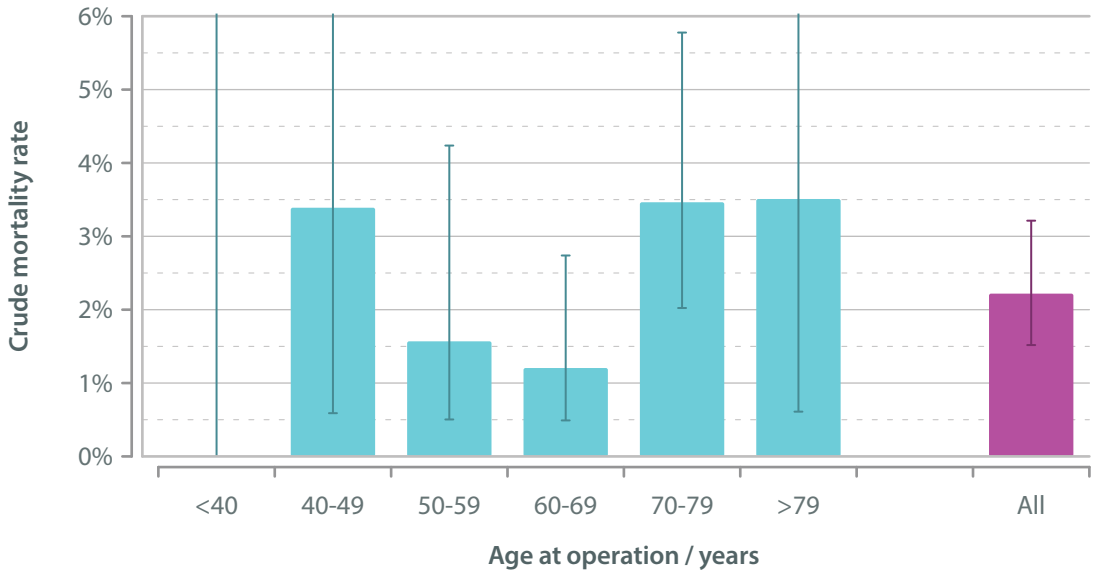


The overall survival results of isolated CABG operations nationwide is well within the International standard bench mark of care at 97.8% [1]. This is similar to the previous year before.

Table 9. First-time isolated CABG in 2017: age and in-hospital mortality

Age at operation / years	In-hospital mortality			
	No	Yes	All	Mortality rate (95% CI)
<40	5	0	**5**	0.0% (0.0-45.1%)
40-49	57	2	**59**	3.4% (0.6-12.7%)
50-59	251	4	**255**	1.6% (0.5-4.2%)
60-69	492	6	**498**	1.2% (0.5-2.7%)
70-79	418	15	**433**	3.5% (2.0-5.8%)
>79	55	2	**57**	3.4% (0.6-13.2%)
Unspecified	0	0	**0**	NA
All	**1,278**	**29**	**1,307**	**2.2% (1.5-3.2%)**

Fig. 8 **First-time isolated CABG: In-hospital mortality and age; calendar year 2017 (n=1,307)**

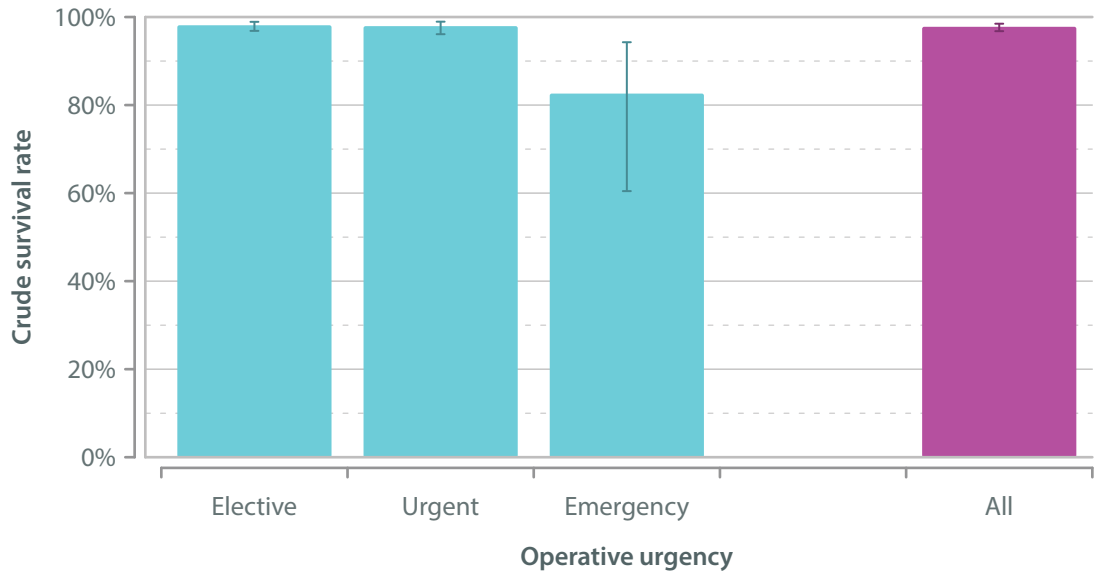


1. http://anzscts.org/wp-content/uploads/2018/11/181024-ANZSCTS-2017-National-Annual-Report-v2.6.3-electronic-version.pdf.

Table 10. First-time isolated CABG in 2017: operative urgency and in-hospital survival

		In-hospital survival			
		Yes	No	All	Survival rate (95% CI)
Operative urgency	Elective	786	15	**801**	98.1% (96.9-98.9%)
	Urgent	473	10	**483**	97.9% (96.1-98.9%)
	Emergency / salvage	19	4	**23**	82.6% (60.5-94.3%)
	All	**1,278**	**29**	**1,307**	**97.8% (96.8-98.5%)**

Fig. 9 **First-time isolated CABG: In-hospital survival rates; calendar year 2017 (n=1,307)**

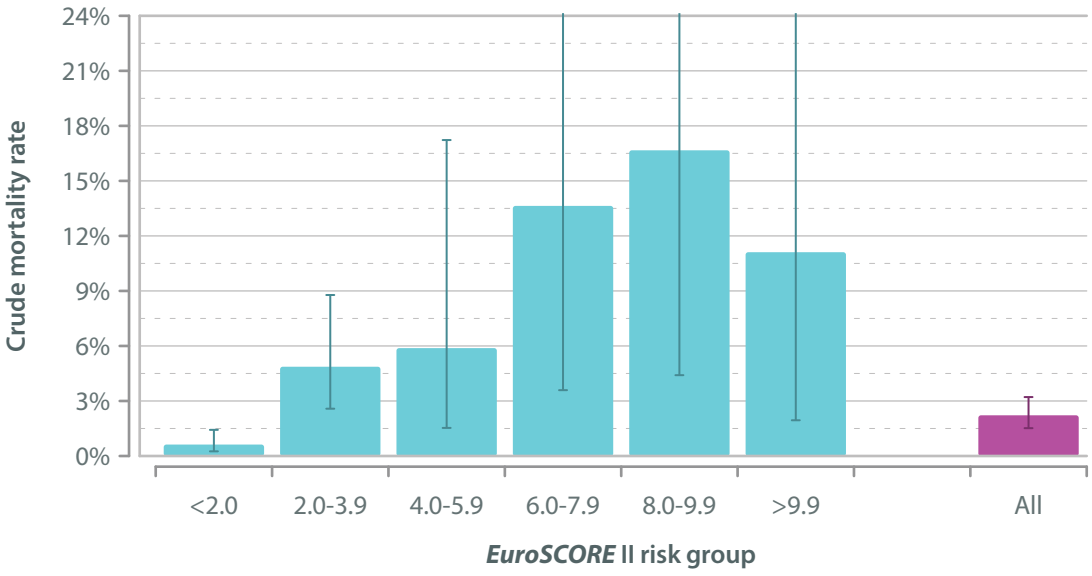


The majority of the deaths were in the high-risk group of patients. As expected the salvage and emergency procedures had a higher mortality. The risk of the patient was based on a ***EuroSCORE*** [2]. This takes into account risk factors associated with coronary artery disease and the higher the score the greater risk of morbidity and mortality post-surgery (*e.g.,* ***EuroSCORE*** 6.0-7.9).

Table 11. First-time isolated CABG in 2017: ***EuroSCORE*** II risk score and in-hospital mortality

EuroSCORE II	In-hospital mortality			
	No	Yes	All	Mortality rate (95% CI)
<2.0	955	6	**961**	0.6% (0.3-1.4%)
2.0-3.9	215	11	**226**	4.9% (2.6-8.8%)
4.0-5.9	48	3	**51**	5.9% (1.5-17.2%)
6.0-7.9	19	3	**22**	13.6% (3.6-36.0%)
8.0-9.9	15	3	**18**	16.7% (4.4-42.3%)
>9.9	16	2	**18**	11.1% (1.9-36.1%)
Unspecified	10	1	**11**	9.1% (0.5-42.9%)
All	**1,278**	**29**	**1,307**	**2.2% (1.5-3.2%)**

Fig. 10 **First-time isolated CABG: In-hospital mortality and pre-operative risk; calendar year 2017**



2. ***EuroSCORE*** II is a method of calculating predicted operative mortality for patients undergoing cardiac surgery (Table 11). It is not a determinant factor for precluding any patient from having surgical intervention.

Quality of care of cardiac surgical patients

The success and quality of care provided for a cardiac surgical patient is determined far more on the journey of the patient. From the time of being accepted for surgery to discharge from the hospital following surgery and not only the mortality associated with the procedure. The impact of the team in delivery of a satisfactory outcome cannot be underestimated.

The registry is designed to measure these quality measures to allow us to identify and focus on specific areas and help improve quality of care. Some of these measures include mechanical ventilation, time spent in the intensive care unit, hospital stay and wound infection.

Mechanical ventilation is temporarily required following cardiac surgery. The duration of ventilated assistance is determined to a large extent by the complexity of the patient's procedure and the presence or absence of pre-existing risk factors such as obesity and lung function (Table 12). The median ventilation time for 2017 was 6 hours.

Following cardiac surgery patients usually spend a period of time in intensive care (ICU) and are transferred to the ward once fully recovered. The median time spent in ICU for 2017 was 23 hours. Time spent in ICU is determined by how quickly the patients recover, which is impacted by comorbidity conditions and complications of the procedure.

Patients' length-of-stay in hospital following a CABG procedure was on average 6 days. These all compare favourably with the international literature [3]. These rates have consistently been similar for the last three years. Taking these data into consideration, continued improvement initiatives for the patient journey through cardiac surgery are being considered at individual DHB levels. These pilot programs should help improve quality of care Nationally.

Table 12. First-time isolated CABG in 2017: hospital resource utillisation

		No	Yes	Rate
Resource utilisation	Same day admission	1,267	40	3.1%
		Count	**Median**	**Inter-quartile range**
	Ventilation time / hours	1,283	6.0	4-11
	Time on ICU / hours	1,284	23.0	20-44
	Post-operative stay / days	1,303	6.0	5-7
	Hospital stay / days	1,301	10.0	7-16

3. http://anzscts.org/wp-content/uploads/2017/11/171128-ANZSCTS-2016-National-Annual-Report-FINAL-medium.pdf.

Complications following cardiac surgery are not only determined by patient conditions, but also reflect the quality of care that the patient receives; commonly monitored by measurement of:

- Deep sternal wound infection.
- Return to theatre.
- Readmission rates following surgery.

It is encouraging to note improvement in deep sternal wound infections as compared to the previous year. The surgical site infection programme (SSI) is implemented in all cardiac surgery units. Results are reported by the Health Quality and Safety Commission New Zealand [4]. Results have improved and continue to be within internationally accepted guidelines. Changing guidelines for pre-surgical antiplatelet therapy [5] continues to limit the anticipated improvement in post-surgical bleeding. The data so far for the three years compares favourably with international guidelines. It is the intention that this continued analysis of quality of care will ensure all New Zealanders benefit from high standards of cardiac surgery and further improvement measures can be identified. We anticipate the cardiac surgical registry will allow us to review and analyse other improvement measures.

Table 13. First-time isolated CABG in 2017: complications

		Complication			
		No	Yes	Unspecified	Rate (95% CI)
In-hospital	Deep sternal wound infection	1,297	9	1	0.7% (0.3-1.4%)
	Any return to theatre	1,237	70	0	5.4% (4.2-6.8%)
	Return to theatre for bleeding	1,261	40	6	3.1% (2.2-4.2%)
30-day	Readmission	1,161	143	3	11.0% (9.3-12.8%)
	Deep sternal wound infection	1,283	18	6	1.4% (0.8-2.2%)

4. www.hqsc.govt.nz
5. New guidelines for pre surgical cessation of anti platelet therapy https://academic.oup.com/eurheartj/article/39/3/213/4095043#108531397.

Aortic valve surgery

Aortic valve replacement (AVR) is undertaken to replace a diseased aortic valve. This is done with either a synthetic mechanical valve or a valve made from animal tissue. Damage to the native aortic valve leads to symptoms that may include shortness of breath, chest pain, dizziness or fainting. Internationally AVR is the most commonly performed isolated valve procedure performed by a cardiac surgeon. It is used internationally as an index procedure for benchmarking and reporting of key performance indicators and quality of care reporting.

Surgical aortic valve replacement (sAVR) is the gold standard intervention for the majority of patients with aortic valve disease and is performed by a cardiac surgical team utilising an incision in the chest and with the use of a heart and lung / cardiopulmonary bypass machine.

Transcatheter aortic valve interventions (TAVI or TAVR) are also performed in New Zealand for patients with aortic stenosis. At this time TAVR is currently performed in high-risk surgical patients and is used in a smaller patient population when compared to sAVR. The decision to perform TAVR in an individual patient is made by a multi-disciplinary team of physicians, surgeons and allied health specialists in combination with the patient and their Whanau. The outcomes of TAVR are not currently discussed in this report. A New Zealand TAVR database is currently in development and in collaboration with the National cardiac Network will be linked to the National Cardiac Surgical Registry to enable future reporting that can compare and contrast the patient populations undergoing each treatment. Future reporting of TAVR outcomes in the cardiac surgical report will allow us to gain further insights into the appropriateness of each treatment in a New Zealand context and further allow us to define the optimal patient population for treatment modality. At the current time however, all patients presented in this current report underwent standard open surgical aortic valve replacement performed by a cardiac surgical team.

Table 14. Valve surgery in 2017

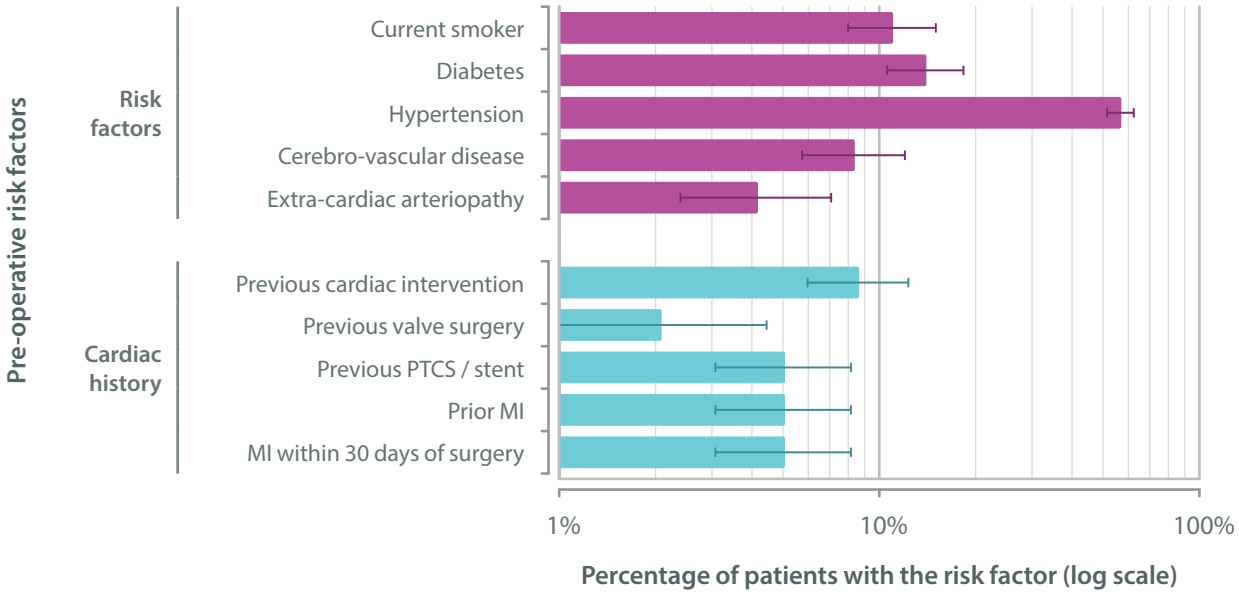
		Top-level procedure classification	
		Valve alone	CABG & valve
Valves treated	Aortic valve alone	354	213
	Mitral valve alone	159	45
	Aortic & mitral valves	42	13
	Mitral & tricuspid valves	52	4
	Others	33	2
	Unspecified	3	9
	All	**643**	**286**

Table 15. First-time isolated AVR in 2017: pre-operative risk factors

		Risk factor present			
		No	Yes	Unspecified	Percentage with the risk factor
Risk factors	Current smoker	298	37	0	11.0%
	Diabetes	288	47	0	14.0%
	Hypertension	144	191	0	57.0%
	Cerebro-vascular disease	306	28	1	8.4%
	Extra-cardiac arteriopathy	321	14	0	4.2%
Cardiac history	Previous cardiac intervention	306	29	0	8.7%
	Previous CABG surgery	328	7	0	2.1%
	Previous PTCA / stent	318	17	0	5.1%
	Prior MI	318	17	0	5.1%
	Prior MI within 30 days of surgery	318	17	0	5.1%

Fig. 11

First-time isolated AVR: Risk factors; calendar year 2017



In the New Zealand registry 334 isolated first-time AVRs have been performed, which is approximately 12% of the overall surgical volume (Table 14). This is not significantly different when compared to the previous year's volume.

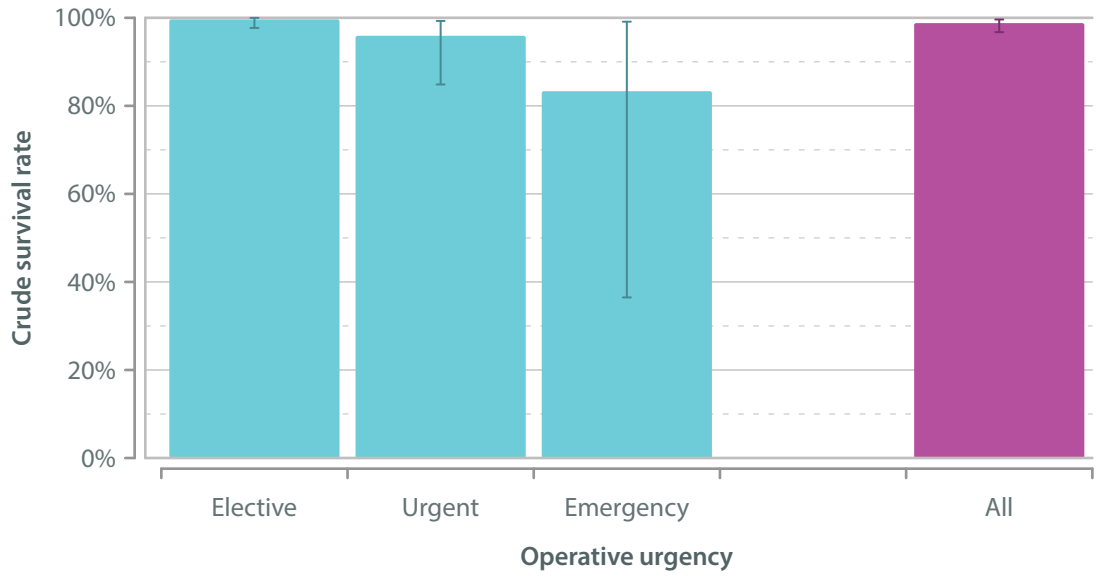
Most patients undergo surgery in a planned or elective fashion with smaller numbers undergoing urgent, emergency or salvage surgery (Table 16; Fig. 12) . As expected a significant number of the patients have additional cardiovascular risk factors including: 14.0% diabetics, 57.0% with hypertension and 8.4% having had a previous cardiovascular intervention (Table 15; Fig. 11).

Aortic valve surgery may be required because of either leakage of the valve (aortic regurgitation) or blockage of the valve (aortic stenosis). These conditions can occur for a variety of reasons, the most common being degenerative age-related calcification or hardening or the valve. Dysfunction of the valve may also be due to conditions such as rheumatic fever that can damage the structure of the valve or in some cases be due to a congenital abnormality (bicuspid aortic valve) that causes it to fail at an earlier age. In some cases the valve may need to be replaced because of infection on the leaflets that lead to valve destruction.

Table 16. First-time isolated AVR in 2017: operative urgency and in-hospital survival

		In-hospital survival			
		Yes	No	Unspecified	Survival rate (95% CI)
Operative urgency	Elective	277	1	1	99.6% (97.7-100.0%)
	Urgent	47	2	1	95.9% (84.9-99.3%)
	Emergency / salvage	5	1	0	83.3% (36.5-99.1%)
	All	**329**	**4**	**2**	**98.8% (96.7-99.6%)**

Fig. 12 **First-time isolated AVR: In-hospital survival rates; calendar year 2017 (n=333)**

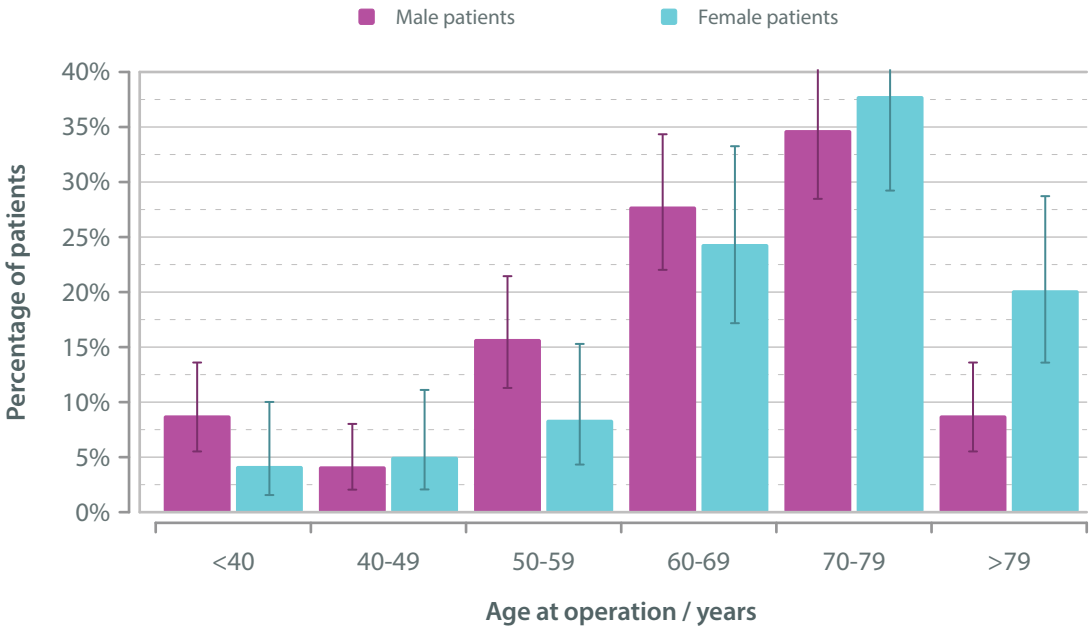


The majority of patients have age related calcific aortic stenosis and this tends to occur later in life in particular in the >70 years of age group (Table 17; Fig. 13) . Younger patients are more likely to have an AVR due to rheumatic fever, a bicuspid valves or infection on the leaflets. The total male to female ratio in this report is 1.8:1.

Table 17. First-time isolated AVR in 2017: age and gender

		Gender		
		Male	Female	All
Age at operation / years	<40	19	5	**24**
	40-49	9	6	**15**
	50-59	34	10	**44**
	60-69	60	29	**89**
	70-79	75	45	**120**
	>79	19	24	**43**
	Unspecified	0	0	**0**
	All	**216**	**119**	**335**

Fig. 13 **First-time isolated AVR: Age & gender distributions; calendar year 2017 (n=335)**



The ***EuroSCORE*** II is an internationally recognised tool used to predict mortality in patients undergoing cardiac surgery. It is a tool that we have used in this report to risk stratify patients undergoing AVR and to assess our performance against expected outcomes. From 2016 all units were collecting ***EuroSCORE*** II and the 2017 report has ***EuroSCORE*** II generated for all but 2 of 335 patients and gives a better reflection of risk-adjusted outcomes for the entire New Zealand surgical population.

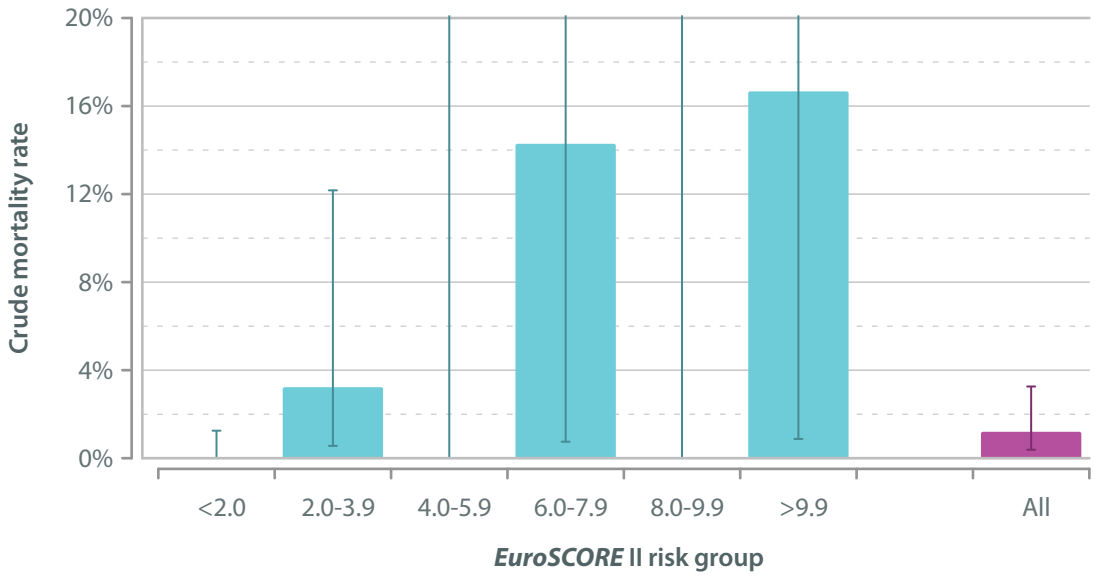
Table 18 shows the distribution of risk profiles in patients undergoing isolated AVR and the observed mortality rate. The overall observed mortality for isolated AVR in New Zealand was extremely low (1.2%), which is favourably compared to internationally accepted outcomes. The 2017 ANZCTS publication of surgical outcomes reported a 1.6% mortality for isolated AVR in a similar cohort of patients.

As can be seen the majority of NZ patients (238) are in the low-risk category (ES <2.0% predicted mortality) with an observed mortality of 0.0% in this group of patients. Therefore, for the majority of patients in New Zealand being referred for AVR, and in the absence of major comorbidity, AVR is performed with extremely low mortality. As such AVR remains the gold standard intervention in this group with which emerging therapies such as TAVR need to be compared within a New Zealand health care context.

Table 18. First-time isolated AVR in 2017: ***EuroSCORE*** II risk score and in-hospital mortality

		In-hospital mortality			
		No	Yes	Unspecified	Mortality rate (95% CI)
EuroSCORE II	<2.0	238	0	0	0.0% (0.0-1.3%)
	2.0-3.9	60	2	0	3.2% (0.6-12.2%)
	4.0-5.9	12	0	0	0.0% (0.0-22.1%)
	6.0-7.9	6	1	0	14.3% (0.8-58.0%)
	8.0-9.9	3	0	0	0.0% (0.0-63.2%)
	>9.9	5	1	0	16.7% (0.9-63.5%)
	Unspecified	5	0	2	0.0% (0.0-45.1%)
	All	**329**	**4**	**2**	**1.2% (0.4-3.3%)**

Fig. 14 **First-time isolated AVR: In-hospital mortality and age; calendar year 2017 (n=333)**



6. http://anzscts.org/wp-content/uploads/2018/11/181024-ANZSCTS-2017-National-Annual-Report-v2.6.3-electronic-version.pdf

Reported outcomes in groups with fewer numbers of patients are heavily influenced by those small numbers and therefore mortality rates have to be interpreted in the context of statistical variance. It was however reassuring to see very low mortality in the higher-risk cohort of patients.

There were 2 deaths recorded in patients with a ***EuroSCORE*** II >4.0.

Major morbidity compares favourably to international reported results [7] . This includes low incidence of deep sternal wound infection rates (0.3%) and return to theatre for bleeding (3.9%).

Reported results suggest that for isolated AVR all DHBs and NZ surgeons as a collective group are performing within accepted standards when benchmarked to results observed within the United Kingdom and Australia.

Table 19. First-time isolated AVR in 2017: hospital resource utillisation

		No	Yes	Rate
	Same day admission	328	7	2.1%
		Count	**Median**	**Inter-quartile range**
Resource utilisation	Ventilation time / hours	332	5.5	4.0-11.0
	Time on ICU / hours	330	23.0	20.0-41.5
	Post-operative stay / days	334	6.0	5.0-8.0
	Hospital stay / days	333	8.0	7.0-12.0

Table 20. Isolated aortic valve surgery in 2017: complications

		Complication			
		No	**Yes**	**Unspecified**	**Rate** (95% CI)
In-hospital	Deep sternal wound infection	334	1	0	0.3% (0.0-1.9%)
	Any return to theatre	316	19	0	5.7% (3.5-8.9%)
	Return to theatre for bleeding	322	13	0	3.9% (2.2-6.7%)
30-day	Readmission	296	39	0	11.6% (8.5-15.7%)
	Deep sternal wound infection	333	1	1	0.3% (0.0-1.9%)

7. http://anzscts.org/wp-content/uploads/2018/11/181024-ANZSCTS-2017-National-Annual-Report-v2.6.3-electronic-version.pdf

Summary

I would sincerely like to thank all New Zealand cardiothoracic units and the Ministry of Health (MOH) for the result of this enormous effort. The responsible collection and analysis of valid data by a national sub-specialty group has enhanced the monitoring of quality of care, contributed to improved outcomes and resource utilisation, and in a challenging healthcare economic environment has provided cardiothoracic surgeons with a tool to help protect our patients from poor outcomes. The National Adult Cardiac Surgery Database is increasingly utilised by the district health boards (DHB) and the MOH and by our colleagues as a tool and platform for the conduct of important clinical outcomes research.

Various local investigations by the DHBs and HDC for poor outcomes, such as the Bristol, United Kingdom (UK) Inquiry, often follow upon publication in the lay press of raw outcome data, cited out of context, often incomplete if not inaccurate, and virtually never enhanced by information regarding risk stratification. Furthermore, after the inquiry is completed and findings published, the lay press may never correct the original allegations and usually does not publish the findings of the inquiry, which may be unfavourable towards the surgeons and physicians. In the final analysis, the upshot of lengthy expensive inquiries of this sort uniformly has been the recommendation to establish and maintain a reliable registry database.

The National Adult Cardiac Surgery Database has numerous disease entities to analyse and by the nature of the sub-specialty requires increased complexity in data analysis in order to produce meaningful risk stratification. As the database matures in the coming years the usefulness of the data will become apparent.

First and foremost, participating units should not fear the potentially negative consequences of reporting less than stellar results. The point is to identify the problems and institute improvement initiatives, which can include inter-institutional team visits, mentoring schemes, and educational programs. Efforts must now focus on developing mechanisms for verification of data completeness and accuracy, improving and validating our methodology of complexity

Definitions

1. **Deep sternal wound infection**: is a serious post-operative complication of cardiac surgery.
2. **Elective**: the procedure could be deferred without the risk of compromised cardiac outcome.
3. **Emergency**: unscheduled surgery required in next available theatre on same day due to refractory angina or cardiac compromise.
4. ***EuroSCORE* II**: an internationally recognised tool used to predict mortality in patients undergoing cardiac surgery. It is a tool that is used to risk stratify patients. ***EuroSCORE*** II has been developed by studying large numbers of patients (22,381) undergoing cardiac surgery in 154 hospitals in 43 countries [1].
5. **ICU**: intensive care unit.
6. **MI**: myocardial infarction.
7. **Mortality**: includes all deaths at the 5 public hospitals where cardiac surgery is performed prior to discharge and within 30 days of the date of surgery.
8. **PTCA**: percutaneous transluminal coronary angioplasty.
9. **Salvage**: the patient is undergoing CPR *en route* to the operating room, that is, prior to surgical incision.
10. **Urgent**: not routine; there is a medical reason for operating this admission.

1. Nashef SA, Roques F, Sharples LD, Nilsson J, Smith C, Goldstone AR, Lockowandt U. ***EuroSCORE*** II. *European Journal of Cardiothorac Surgery*. 2012; **41(4)**: 734-745.

Appendix

New Zealand Ministry of Health

NZ Adult Cardiac Surgical Database

Baseline section; Page 1; Version 1.0 (13 Dec 2013)

Basic demographic data

All baseline data refer to the condition of the patient when they were originally diagnosed.

Unique patient identifier

Gender
- ○ Male
- ○ Female

Date of birth dd / mm / yyyy

Registry data

Admission information

Date of admission dd / mm / yyyy

Ethnicity 1
- ○ European
- ○ Maori
- ○ Pacific peoples
- ○ Asian
- ○ Middle Eastern / Latin American / African
- ○ Other ethnicity
- ○ Residual categories

Ethnicity 2
- ○ European not further defined
- ○ NZ European
- ○ Other European
- ○ NZ Maori
- ○ Pacific Island not further defined
- ○ Samoan
- ○ Cook Island Maori
- ○ Tongan
- ○ Niuean
- ○ Tokelauan
- ○ Fijian
- ○ Other Pacific Island
- ○ Asian not further defined
- ○ Southeast Asian
- ○ Chinese
- ○ Indian
- ○ Other Asian
- ○ Middle Eastern
- ○ Latin American / Hispanic
- ○ African
- ○ Other ethnicity
- ○ Don't know
- ○ Refused to answer
- ○ Response unidentifiable
- ○ Not stated

Date of surgery dd / mm / yyyy

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 2; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier	
Date of surgery	dd / mm / yyyy

Admission information continued …

Elective Day of Surgery Admit Patient	○ No	○ Yes
Insurance	○ Public ○ Private health insurance	○ Self funded ○ Other
Operation number	○ 1 ○ 2 ○ 3	○ 4 ○ 5 ○ 6
Height		cm
Weight		kg

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Appendix

New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 3; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH MANATŪ HAUORA

Unique patient identifier		
Date of surgery		dd / mm / yyyy

Patient risk factors

Smoking history	○ No	○ Yes
Current smoker	○ No	○ Yes
Family history of CAD	○ No ○ Yes	○ Undiscovered
Diabetes	○ No	○ Yes
Diabetes control	○ None ○ Diet	○ Oral ○ Insulin
Hypercholesterolaemia	○ No	○ Yes
Renal: last pre-op creatinine		µmol l^{-1}
Renal: dialysis	○ No	○ Yes
Renal: transplant	○ No	○ Yes
Renal: impairment	○ Normal (CC >85 ml min^{-1}) ○ Moderate (CC 50-85 ml min^{-1})	○ Severe (CC <50 ml min^{-1})
Hypertension	○ No	○ Yes
Cerebrovascular disease	○ No	○ Yes
Cerebrovascular disease: type	○ Coma ○ CVA	○ RIND or TIA ○ Carotid test
Cerebrovascular disease: when	○ Recent	○ Remote
PVD / extra-cardiac arteriopathy	○ No	○ Yes
Respiratory / pulmonary disease	○ No	○ Yes
Respiratory / pulmonary disease: type	○ Mild ○ Moderate	○ Severe
Infective endocarditis	○ No ○ Active	○ Treated
Immunosuppressive treatment	○ No	○ Yes
Poor mobility due to any non-cardiac reason	○ No	○ Yes

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 4; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier

Date of surgery dd/mm/yyyy

Pre-operative cardiac status

Pre-operative cardiac status

Myocardial infarction	○ No	○ Yes
Myocardial infarction: type	○ NSTEMI	○ STEMI
Myocardial infarction: when	○ <= 6 hours ○ 6-24 hours ○ 1-30 days	○ 31-90 days ○ >90 days
Date of last MI (if known)	dd/mm/yyyy	
Angina: CCS classification	○ 0 ○ 1 ○ 2	○ 3 ○ 4
Treatment of angina: iv GTN	○ No	○ Yes
Treatment of angina: iv heparin	○ No	○ Yes
Treatment of angina: full dose heparinoids	○ No	○ Yes
History of congestive heart failure	○ No	○ Yes
CHF at current admission	○ No	○ Yes
Dyspnoea: NYHA classification	○ 1 ○ 2	○ 3 ○ 4
Cardiogenic shock	○ No	○ Yes
Resuscitation within 1 hour of operation	○ No	○ Yes
Critical pre-operative state	○ No	○ Yes

Pre-operative cardiac status - arrhythmia

Arrhythmia	○ No	○ Yes
Arrhythmia: type	○ Sinus rhythm ○ Atrial ○ Heart block/pacing	○ Ventricular ○ Other abnormal rhythm
Atrial arrhythmia: type	○ Paraxysmal ○ Persistent	○ Permanent
Permanent pacemaker *in situ*	○ No	○ Yes

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Appendix

New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 5; Version 1.0 (13 Dec 2013)

Unique patient identifier		
Date of surgery		dd / mm / yyyy

Medication at the time of surgery

Inotropes	○ No	○ Yes
iv nitrates	○ No	○ Yes
Anticoagulation therapy	○ No	○ Yes
Steroids	○ No	○ Yes
Thrombolysis (this admission)	○ No	○ Yes
Thrombolysis: interval		hours
Aspirin within 7 days of surgery	○ No	○ Yes
Aspirin: when	○ ≤2 days	○ 3-7 days
Clopidogrel within 7 days of surgery	○ No	○ Yes
Clopidogrel: when	○ ≤2 days	○ 3-7 days
IIb / IIIa blockade within 7 days of surgery	○ No	○ Yes
IIb / IIIa blockade: when	○ ≤2 days	○ 3-7 days
Aggrostat within 7 days of surgery	○ No	○ Yes
Aggrostat: when	○ ≤2 days	○ 3-7 days
Other antiplatelet therapy within 7 days of surgery	○ No ○ Yes	
Other antiplatelet: when	○ ≤2 days	○ 3-7 days

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 6; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier

Date of surgery dd / mm / yyyy

Previous interventions (surgical or percutaneous)

Previous cardiothoracic intervention ○ No ○ Yes

Previous surgery ○ No ○ Yes

Type of previous surgery
- ☐ CABG
- ☐ Off-pump CABG
- ☐ Valve
- ☐ Congenital cardiac
- ☐ Aortic surgery (ascending / arch)
- ☐ Other cardiac

Number of prior cardiac operations requiring cardiopulmonary bypass
○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

Number of prior cardiac operations without cardiopulmonary bypass
○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9

Previous percutaneous intervention ○ No ○ Yes

PTCA / stent ○ No ○ Yes

PTCA / stent: which admission ○ Prior admission ○ This admission

PTCA / stent: interval (same admission) hours

Other percutaneous interventions
- ☐ Non-surgical balloon valvuloplasty
- ☐ ASD device closure
- ☐ VSD device closure
- ☐ Percutaneous SVT / VT ablation

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Appendix

New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 7; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH MANATŪ HAUORA

Unique patient identifier	
Date of surgery	dd / mm / yyyy

Haemodynamic data

Cardiac catheterisation	○ No ○ Yes
Date of cardiac catheterisation	dd / mm / yyyy
LVEF method	○ Not measured ○ LV gram ○ Echo ○ Radionuclide ○ MRI
EF	%
EF estimate	○ Normal ○ Moderate ○ Mild ○ Severe
Left main stenosis >50%	○ No ○ Yes
Number of diseased coronary systems	○ None ○ Two ○ One ○ Three
PA systolic	mm Hg
Pulmonary hypertension	○ No ○ Moderate ○ Severe

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 8; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier

Date of surgery dd / mm / yyyy

Operation status / category

Surgery data

Consultant surgeon

Operating surgeon
- ○ Consultant
- ○ Senior registrar
- ○ Trainee
- ○ Overseas fellow
- ○ Oversight

Operative urgency / status
- ○ Elective
- ○ Urgent
- ○ Emergency
- ○ Salvage

Direct transfer from cath lab to theatre ○ No ○ Yes

Coronary artery bypass ○ No ○ Yes

Valve surgery ○ No ○ Yes

Valve type
- ☐ Aortic
- ☐ Mitral
- ☐ Tricuspid
- ☐ Pulmonary

Redo valve ○ No ○ Yes

Reason for repeat valve placement
- ☐ Prosthetic / homograft valve failure
- ☐ Thrombosis
- ☐ Dehiscence
- ☐ Embolism
- ☐ Infection
- ☐ Haemolysis
- ☐ Prior valve repair
- ☐ Other reason

Aortic procedure ○ No ○ Yes

Other cardiac procedures ○ No ○ Yes

Other non-cardiac procedures ○ No ○ Yes

Aortic procedure

Aortic aneurysm repair (type)
- ○ No repair
- ☐ Ascending
- ☐ Arch
- ☐ Descending
- ☐ Thoracic / abdominal

Aortic dissection repair (type)
- ○ No repair
- ○ Ascending
- ○ Descending

Aortic dissection: when ○ Acute ○ Non-acute

Acute traumatic aortic transsection ○ No ○ Yes

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Appendix

New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 9; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH MANATŪ HAUORA

Unique patient identifier	
Date of surgery	dd / mm / yyyy

Other cardiac surgery

Atrial arrhythmia surgery	○ No	○ Yes

Atrial arrhythmia surgery: lesion set	○ Cox Maze III	○ Pulmonary vein isolation
	○ Radial	○ Left atrial only
	○ Mini-Maze	○ Right atrial only
	○ Left atrial reduction	○ Other

Atrial arrhythmia surgery: energy source	○ Cut & sew	○ Microwave
	○ Unipolar RF	○ Laser
	○ Bipolar RF	○ Ultrasound
	○ Cryoablation	○ Other

Type of other cardiac surgery	☐ AF ablation surgery	☐ LV rupture
	☐ ASD	☐ Pericardiectomy
	☐ Atrial myxoma	☐ Peripheral vascular
	☐ Cardiac transplant	☐ Permanent LV epicardial lead
	☐ Cardiac trauma	☐ Primary VAD
	☐ Cardiac trauma - iatrogenic	☐ Pulm. thromboendarterectomy
	☐ Cardiac tumour	☐ Pulmonary embolectomy
	☐ Epicardial pacemaker	☐ Pulmonary transplant
	☐ Left ventricular reconstruction	☐ VSD (acquired)
	☐ LV aneurysm	☐ Other congenital
	☐ LVOT myectomy of HOCM	☐ Other

Other non-cardiac surgery

Carotid endarterectomy	○ No	○ Yes
Lung resection	○ No	○ Yes
Other vascular surgery	○ No	○ Yes
Other thoracic surgery	○ No	○ Yes
Other surgery	○ No	○ Yes

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 10; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier		
Date of surgery		dd / mm / yyyy

CPB and support

Minimally invasive

Minimally invasive techniques attempted	○ No	○ Yes
Minimally invasive techniques indication	○ Choice ○ Contraindication	○ Catheter
Performed off pump	○ No	○ Yes
Robotically assisted	○ No	○ Yes

CPB and mechanical support

Cardiopulmonary bypass used	○ No	○ Yes
Cardioplegia used	○ No	○ Yes
Cumulative cross clamp time		min
Cumulative cardiopulmonary bypass time		min
IABP	○ No	○ Yes
IABP: when inserted	○ Pre-op ○ Intra-op	○ Post-op
IABP: indication	○ Haemodynamic instability ○ PTCA support ○ Unstable angina	○ CPB wean ○ Prophylactic
Rota-pump	○ No	○ Yes
Rota-pump: when inserted	○ Pre-op ○ Intra-op	○ Post-op
Rota-pump: indication	○ Haemodynamic instability ○ PTCA support ○ Unstable angina	○ CPB wean ○ Prophylactic
Other mechanical support	○ No	○ Yes
Other mechanical support: when inserted	○ Pre-op ○ Intra-op	○ Post-op
Other mechanical support: indication	○ Haemodynamic instability ○ PTCA support ○ Unstable angina	○ CPB wean ○ Prophylactic

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Appendix

New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 11; Version 1.0 (13 Dec 2013)

Unique patient identifier		
Date of surgery		dd / mm / yyyy

CPB and support continued …

Other support

Intra-operative TOE	○ No	○ Yes
Intra-operative TOE: type	○ Non-elective	○ Elective
Intra-operative antifibrinolytic use	○ No	○ Yes
Intra-operative antifibrinolytic use: type	○ Trasylol ○ Tranexamic acid	○ Other

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New Zealand Ministry of Health
NZ Adult Cardiac Surgical Database
Baseline section; Page 12; Version 1.0 (13 Dec 2013)

MINISTRY OF HEALTH
MANATŪ HAUORA

Unique patient identifier		
Date of surgery		dd / mm / yyyy

Coronary bypass

Intra-operative decision to graft coronary artery	○ No ○ Yes	
IMA used	○ No	○ Yes
Which IMA used	☐ Left	☐ Right
Number of distal arterial grafts		integer: 0-9
Number of IMA distal anastomoses		integer: 0-6
Number of RA conduits harvested		integer: 0-2
Number of radial distal anastomoses		integer: 0-6
Number of vein distal anastomoses		integer: 0-9
Number of GEPA distal anastomoses		integer: 0-6
Were arterial T or Y grafts used	○ No	○ Yes
Total number of distal anastomoses		integer: 0-30

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Unique patient identifier	
Date of surgery	dd / mm / yyyy

Aortic valve surgery

Aortic valve procedure	○ Replacement ○ Repair / reconstruction without annuloplasty ○ Root reconstruction with valve conduit (Bentall procedure) ○ Root reconstruction with valve sparing (David procedure) ○ Resuspension aortic valve ○ Resection sub-aortic stenosis ○ Repair paravalvular leak ○ Valvotomy ○ Ross procedure ○ Inspection only ○ Decalcification of valve only
Implant - type	○ None ○ Autograft ○ Mechanical ○ Homograft / allograft ○ Bioprosthesis ○ Ring / band
Implant - manufacturer's model number	select from table
Implant - serial number	select from table
Implant - size	mm
Explant - type	○ None ○ Autograft ○ Mechanical ○ Homograft / allograft ○ Bioprosthesis ○ Ring / band
Explant - manufacturer's model number	select from table
Explant - serial number	select from table
Explant - size	mm
Aortic stenosis	○ No ○ Yes
Aortic regurgitation / insufficiency	○ None ○ Trivial ○ Moderate ○ Mild ○ Severe
Aortic pathology / aetiology	○ Rheumatic ○ Congenital ○ Previous infection ○ Ischaemic ○ Marfans ○ Idiopathic calcific ○ Annuloaortic ectasia ○ Myxomatous degen ○ Other degenerative disease ○ Failed prior repair ○ Dissection ○ Prosthetic valve failure ○ Tumour ○ Peri-prosthetic leak ○ Trauma ○ Prosthetic valve thrombosis ○ Iatrogenic ○ Active infection ○ Other

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Unique patient identifier	
Date of surgery	dd / mm / yyyy

Mitral valve surgery

Mitral valve procedure	○ Annuloplasty only ○ Replacement ○ Repair / reconstruction with annuloplasty ○ Repair / reconstruction without annuloplasty ○ Commissurotomy with annuloplasty ring ○ Commissurotomy without annuloplasty ring ○ Repair paravalvular leak ○ Inspection only ○ Decalcification of valve only
Implant - type	○ None ○ Autograft ○ Mechanical ○ Homograft / allograft ○ Bioprosthesis ○ Ring / band
Implant - manufacturer's model number	select from table
Implant - serial number	select from table
Implant - size	mm
Explant - type	○ None ○ Autograft ○ Mechanical ○ Homograft / allograft ○ Bioprosthesis ○ Ring / band
Explant - manufacturer's model number	select from table
Explant - serial number	select from table
Explant - size	mm
Mitral stenosis	○ No ○ Yes
Mitral regurgitation / insufficiency	○ None ○ Trivial ○ Moderate ○ Mild ○ Severe
Mitral pathology / aetiology	○ Functional or isolated annular dilataion ○ Rheumatic ○ Congenital ○ Active infection ○ Ischaemic ○ Previous infection ○ Idiopathic calcific ○ Marfans ○ Myxomatous degen ○ Other degenerative disease ○ Failed prior repair ○ Tumour ○ Prosthetic valve failure ○ Trauma ○ Peri-prosthetic leak ○ Iatrogenic ○ Prosthetic valve thrombosis ○ Other

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Date of surgery dd / mm / yyyy

Tricuspid valve surgery

Tricuspid valve procedure
- ○ Annuloplasty only
- ○ Replacement
- ○ Repair / reconstruction with annuloplasty
- ○ Repair / reconstruction without annuloplasty
- ○ Commissurotomy with annuloplasty ring
- ○ Commissurotomy without annuloplasty ring
- ○ Repair paravalvular leak
- ○ Valvectomy (no replacement)
- ○ Inspection only

Implant - type
- ○ None
- ○ Mechanical
- ○ Bioprosthesis
- ○ Autograft
- ○ Homograft / allograft
- ○ Ring / band

Implant - manufacturer's model number select from table

Implant - serial number select from table

Implant - size mm

Explant - type
- ○ None
- ○ Mechanical
- ○ Bioprosthesis
- ○ Autograft
- ○ Homograft / allograft
- ○ Ring / band

Explant - manufacturer's model number select from table

Explant - serial number select from table

Explant - size mm

Tricuspid stenosis
- ○ No
- ○ Yes

Tricuspid regurgitation / insufficiency
- ○ None
- ○ Trivial
- ○ Mild
- ○ Moderate
- ○ Severe

Tricuspid pathology / aetiology
- ○ Rheumatic
- ○ Congenital
- ○ Ischaemic
- ○ Idiopathic calcific
- ○ Myxomatous degen
- ○ Failed prior repair
- ○ Prosthetic valve failure
- ○ Peri-prosthetic leak
- ○ Prosthetic valve thrombosis
- ○ Active infection
- ○ Previous infection
- ○ Marfans
- ○ Other degenerative disease
- ○ Tumour
- ○ Trauma
- ○ Iatrogenic
- ○ Functional
- ○ Other

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MINISTRY OF HEALTH
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Unique patient identifier

Date of surgery dd / mm / yyyy

Pulmonary valve surgery

Pulmonary valve procedure
- ○ Replacement
- ○ Repair / reconstruction without annuloplasty
- ○ Commissurotomy without annuloplasty ring
- ○ Repair paravalvular leak

Implant - type
- ○ None
- ○ Mechanical
- ○ Bioprosthesis
- ○ Autograft
- ○ Homograft / allograft
- ○ Ring / band

Implant - manufacturer's model number select from table

Implant - serial number select from table

Implant - size mm

Explant - type
- ○ None
- ○ Mechanical
- ○ Bioprosthesis
- ○ Autograft
- ○ Homograft / allograft
- ○ Ring / band

Explant - manufacturer's model number select from table

Explant - serial number select from table

Explant - size mm

Pulmonary stenosis
- ○ No
- ○ Yes

Pulmonary regurgitation / insufficiency
- ○ None
- ○ Trivial
- ○ Mild
- ○ Moderate
- ○ Severe

Pulmonary pathology / aetiology
- ○ Rheumatic
- ○ Congenital
- ○ Ischaemic
- ○ Idiopathic calcific
- ○ Myxomatous degen
- ○ Failed prior repair
- ○ Prosthetic valve failure
- ○ Peri-prosthetic leak
- ○ Prosthetic valve thrombosis
- ○ Active infection
- ○ Previous infection
- ○ Marfans
- ○ Other degenerative disease
- ○ Tumour
- ○ Trauma
- ○ Iatrogenic
- ○ Functional
- ○ Other

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Unique patient identifier		
Date of surgery		dd / mm / yyyy

Post-operative data

RBC blood bank products	○ No	○ Yes
Non-RBC blood bank products	○ No	○ Yes
Peri-operative transfusion: bank RBC		units
Peri-operative transfusion: platelets		units
Peri-operative transfusion: Novo 7		units
Peri-operative transfusion: FFP		units
Peri-operative transfusion: Cryo		units
ICU admission: date and time		dd / mm / yyyy
Extubation: date and time		dd / mm / yyyy
ICU discharge: date and time		dd / mm / yyyy
Readmitted to ICU	○ No	○ Yes
Reintubated	○ No	○ Yes
Reintubation: date and time		dd / mm / yyyy
Reextubation: date and time		dd / mm / yyyy
ICC loss (first 4 hours post surgery)		dd / mm / yyyy

Returned to theatre

Return to theatre	○ No	○ Yes
Reason for re-operation	☐ Valve dysfunction ☐ Bleeding / tamponade ☐ Graft occlusion	☐ Sternal infection ☐ Other cardiac ☐ Other non-cardiac

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MINISTRY OF HEALTH
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Unique patient identifier	
Date of surgery	dd / mm / yyyy

Complications

Renal and neurological complications

New renal failure	○ No	○ Yes
Haemofiltration	○ No	○ Yes
Highest post-op creatinine	μmol l^{-1}	
Perioperative cardiogenic shock	○ No	○ Yes
New neurological status	○ No	○ Yes
Stroke permanent	○ No	○ Yes
Stroke transient	○ No	○ Yes
New continuous coma (≥24 hours)	○ No	○ Yes

Cardiac complications

Perioperative AMI	○ No	○ Yes
Cardiac inotrope use: >4 hours post-operatively	○ No ○ Yes	
Cardiac inotrope use: low cardiac output syndrome	○ No ○ Yes	
Cardiac inotrope use: low SVR syndrome	○ No	○ Yes
New cardiac arrhythmia	○ No	○ Yes
New heart block (requiring PPM)	○ No	○ Yes
New other brady arrhythmia (requiring PPM)	○ No	○ Yes
Cardiac arrest	○ No	○ Yes
New atrial arrhythmia (requiring Rx)	○ No	○ Yes
New ventricular tachycardia	○ No	○ Yes

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Unique patient identifier

Date of surgery dd / mm / yyyy

Complications continued …

Pulmonary, infection, vascular and other complications

Prolonged ventilation >24 hours	○ No	○ Yes
Pulmonary embolism	○ No	○ Yes
Pneumonia	○ No	○ Yes
Reintubation and ventilation	○ No	○ Yes
Deep sternal wound infection	○ No	○ Yes
Deep thoracotomy wound infection	○ No	○ Yes
Septicaemia	○ No	○ Yes
Aortic dissection (complication)	○ No	○ Yes
Acute limb ischaemia	○ No	○ Yes
Anti-coagulant complication	○ No	○ Yes
GIT complication	○ No	○ Yes
Multi-system failure	○ No	○ Yes

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MINISTRY OF HEALTH
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Unique patient identifier

Date of surgery dd/mm/yyyy

Discharge / mortality

Discharge
- ○ Home
- ○ Hospital in the home
- ○ Rehabilitation unit / hospital
- ○ Local or referring hospital
- ○ Hospital mortality

Date of discharge dd/mm/yyyy

Mortality post discharge
- ○ No
- ○ Yes

Mortality date dd/mm/yyyy

Mortality location
- ○ Operating room
- ○ Hospital
- ○ Home
- ○ Other facility

Mortality: primary cause
- ○ Cardiac
- ○ Neurological
- ○ Renal
- ○ Vascular
- ○ Infection
- ○ Respiratory failure
- ○ Multisystem failure
- ○ Pulmonary embolism
- ○ Aortic dissection
- ○ Valvular
- ○ Other
- ○ Unknown

Mortality: subsequent cause
- ○ Cardiac
- ○ Neurological
- ○ Renal
- ○ Vascular
- ○ Infection
- ○ Respiratory failure
- ○ Multisystem failure
- ○ Pulmonary embolism
- ○ Aortic dissection
- ○ Valvular
- ○ Other
- ○ Unknown

Cognisant patient withdraws from treatment
- ○ No
- ○ Yes

Readmission

Readmitted ≤30 days from surgery
- ○ No
- ○ Yes

Reason for readmission
- ○ Anticoagulant complication
- ○ Arrhythmia
- ○ Congestive heart failure
- ○ Valve dysfunction
- ○ Pericardial effusion
- ○ Cardiac tamponade
- ○ Deep sternal infection
- ○ Other incisional complication
- ○ Respiratory complication including pneumonia
- ○ Myocardial infarction
- ○ Recurrent angina
- ○ Other complication related to cardiac surgery
- ○ Other readmission unrelated to cardiac surgery

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