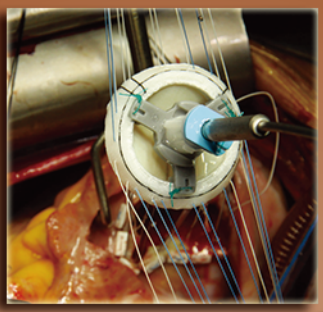

Cardiac Surgery Biennial Report 2014-2015

Department of Cardiothoracic Surgery

瑪麗醫院
Queen Mary Hospital

醫院管理局
HOSPITAL AUTHORITY

Cardiac Surgery Biennial Report 2014-2015

Department of Cardiothoracic Surgery

Abbreviations List

ABC Level	Aristotle Basic Complexity Level
ABC Score	Aristotle Basic Complexity Score
ASD	Atrial Septal Defect
ASO	Arterial Switch Operation
AVR	Aortic Valve Replacement
AVSD	Atrioventricular Septal Defects
BDCPA	Bidirectional Cavopulmonary Anastomosis
CABG	Coronary Artery Bypass Grafting
CAVSD	Complete Atrioventricular Septal Defects
CHD	Congenital Heart Disease
CPB	Cardiopulmonary Bypass
CUSUM	Cumulative sum
DCRV	Double-Chambered Right Ventricle
DIRV	Double Inlet Right Ventricle
DORV	Double Outlet Right Ventricle
EACTS	European Association for Cardio-Thoracic Surgery
ECHSA	European Congenital Heart Surgeons Association
ECMO	Extracorporeal Membrane Oxygenation
EuroSCORE	European System for Cardiac Operative Risk Evaluation
HLHS	Hypoplastic Left Heart Syndrome
HOCM	Hypertrophic Obstructive Cardiomyopathy
IABP	Intra-aortic Balloon Pump
IPCCC	International Pediatric and Congenital Cardiac Code
IVS	Intact Ventricular Septum
LAD	Left Anterior Descending Artery
LIMA	Left Internal Mammary Artery
LV aneurysmectomy	Left Ventricular Aneurysmectomy
LVAD	Left Ventricular Assist Device
LVEF	Left Ventricular Ejection Fraction
MBTS	Modified Blalock-Taussig Shunt
MVR	Mitral Valve Replacement
MICS	Minimally Invasive Cardiac Surgery
NACSD	National Adult Cardiac Surgical Database
O/E Ratio	Observer *versus* Expected ratio
PAB	Pulmonary Artery Banding
PAVSD	Partial Atrioventricular Septal Defect
PCI	Percutaneous Coronary Intervention
PVR	Pulmonic Valve Replacement
QMH	Queen Mary Hospital
SCTS	Society of Cardiothoracic Surgeons
STS	Society of Thoracic Surgeons
TAPVC	Total Anomalous Pulmonary Venous Connection
TAVI	Trans-catheter Aortic Valve Implantation
TCPC	Total Cavopulmonary Connection
TEVAR	Thoracic Endovascular Aortic Repair
TGA, IVS	Transposition of the Great Arteries with Intact Ventricular Septum
TGA,VSD	Transposition of the Great Arteries, Ventricular Septal Defect
TOF	Tetralogy of Fallot
TOF,PA	Tetralogy of Fallot, Pulmonary Atresia
VAD	Ventricular Assist Device

VA-ECMO	VenoArterial Extracorporeal Membrane Oxygenation
VLAD	Variable Life-adjusted Display
VSD	Ventricular Septal Defect
VSD-MAPCA	Ventricular Septal Defect, and Major Aortopulmonary Collateral Arteries
VV-ECMO	VenoVenous Extracorporeal Membrane Oxygenation

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Foreword

This is the 3rd biennial cardiac surgery audit report from Queen Mary Hospital, for the years 2014-2015. I am pleased to present the results, which demonstrate the high standard of care provided by the Department of Cardiothoracic Surgery of Queen Mary Hospital.

The health care system in Hong Kong has been facing numerous challenges over the years. We foresee that the pressure on the health care system would rise with the increase in the ageing population. This is projected to increase the burden of heart disease and a major responsibility falls on cardiac surgery for clinical management. I truly believe that surgical audit is the way to gain the trust of the public and at the same time it serves as a driving force for improving the services.

The volume of cardiac surgery performed has continuously and steadily increased, with an especially high demand for mechanical circulatory support in adult and pediatric patients. Besides increase in volume, the complexity of the surgeries has also increased, as reflected by the risk scoring system. Although the department is facing challenges and obstacles, the key performance index - the 30-day mortality rate for pediatric cardiac surgery and the in-hospital mortality rate for adult cardiac surgery is only 2.5% and 4.5% respectively. Given the complexity of the patients operated on, the observed number of surgical mortalities at QMH is less than the expected number of mortalities standing at 0.8 and 0.4. These results have demonstrated that our cardiac surgery service has kept up with the international standard, and even performed better in some areas.

The department does not only perform run-of-the-mill surgeries. Through continuous training, communication with international experts and careful step-by-step planning, innovative approaches to treatment were introduced. Robotic-assisted cardiac surgery and transcatheter aortic valve implantation are such examples in this report and it also showed an increased demand for minimally invasive surgery.

I would like to congratulate the Department of Cardiothoracic Surgery for its success in making new achievements and yet, maintaining the high standard of care. May I thank the dedicated staff and encourage them to continue striving for the best interests of Hong Kong cardiac patients.

Dr CC Luk
Hospital Chief Executive,
Queen Mary Hospital

Introduction

Outcome audit is an important strategy in maintaining standards in surgical care. The publication of this 2014-2015 report is another step forward in our efforts in upholding and maintaining the highest standards of surgical care. I am pleased to share some of our key accomplishments over the past two years.

Our surgical volumes have grown steadily over the years. In the past 4 years, cardiac surgical procedures have grown 6-7% biennially . Part of the growth is attributed to advanced treatment programs of ECMO, VAD, Heart and Lung Transplantation. In addition, the use of minimally invasive techniques has grown substantially.

As well as looking at Minimally Invasive Surgery in more detail in this report, we have also looked in- depth at some procedures like TAVI and pediatric ECMO and reported their overall trends and outcomes over time. Also, in this report we present the results of the most recent risk-adjusted model, EuroSCORE-II which was applied to our patients from 2014 onwards.

This report contains analyses of data of 991 adult and 712 pediatric cardiac surgery cases during the period January 1, 2014 through December 31, 2015. Our Department collects, monitors and validates patient specific data. The data collection, verification and audit implemented in this report are comprehensive and reliable. Data are verified through a review of medical records for a randomly selected sample of cases by comparing the data entered into the databases with the actual patient records. Less than 10% (7.5%) had significant data entry errors.

I would like to thank all clinicians, nurses, administrative and support staff whose hard work and dedication contributed to the success of this report. I sincerely hope that this report provides valuable information leading to quality improvement and supports our commitment to transparency and accountability.

Dr Timmy Wing Kuk Au
Chief of Service,
Department of Cardiothoracic Surgery,
Queen Mary Hospital

Part 1: Adult cardiac surgery

Database overview

Database overview: Adult cardiac surgery

The overall workload at QMH, Hong Kong for the calendar years 2014-2015

Procedure groupings

- All comparisons with the data from the United Kingdom come from results published by the Society for Cardiothoracic Surgeons in Great Britain & Ireland in their Sixth National Adult Cardiac Surgical Database (NACSD) Report 2008, and relate to the most up-to-date data in that document, from the financial year ending 2008.
- In total we have performed 991 Adult Cardiac Surgeries– defined as open heart surgeries in patients older than 18 years.
- During the last four years, QMH's adult cardiac surgery has seen a steady and continued growth in patient volumes (867 in 2010-2011, 922 in 2012-2013 and 991 in 2014-2015).
- Coronary Artery Bypass Graft (CABG) surgeries represent 25% of all surgery types which was lower than those in the UK (58%).
- There has been a decrease in the proportion of cardiac surgery workload that is Isolated CABG surgery from 31.8% (2012-2013) to 25.1%. There has been a corresponding increase in valve surgery, including both Isolated valves and Valve surgery in combination with other procedures from 39.9% (2012-2013) to 44%.
- The proportion of our valve surgeries was higher than in the UK (Isolated Valve + Valve & Others is 44% in QMH vs 23% in UK).
- We also have a higher work load percentage of Adult Congenital Heart Surgery, Aortic Surgery and Heart Transplantation as compared to the UK data under the 'Other' category.

Overall workload at Queen Mary Hospital, Hong Kong: calendar years 2014-2015

		Data		
		Count	Proportion	Proportion in the UK *
Procedure grouping	Isolated valve	267	26.9%	18.9%
	Isolated CABG	249	25.1%	58.3%
	Other	189	19.1%	3.2%
	Valve & other	169	17.1%	4.5%
	CABG & valve	68	6.9%	11.5%
	CABG & other	28	2.8%	2.0%
	CABG, valve & other	21	2.1%	1.6%
	All	**991**		

* Data from financial year 2008; Sixth National Adult Cardiac Surgical Database Report 2008: Demonstrating quality. The Society for Cardiothoracic Surgery in Great Britain & Ireland.

Procedure detail

- The category of *CABG , Valve & Other* refers to Atrial Septal Defect (ASD) , Ventricular Septal Defect (VSD) , Aortic Surgery, Radiofrequency Ablation Surgery (MAZE) and Thoracic Resection *etc.* (see Appendix 1, Adult cardiac database- Database form)
- 3 grafts or more were performed in 214 Isolated CABG surgeries, a figure which was higher than the UK data (86% in QMH vs 74% in UK).
- More detailed descriptions and explanations can be found in our CABG and Heart Valves sections.

Procedure detail

			Procedure grouping							
			Isolated CABG	Isolated valve	CABG & valve	CABG & other	Valve & other	CABG, valve & other	Other	**All**
Procedure detail	CABG surgery	1 graft	9	0	29	9	0	10	0	**57**
		2 grafts	26	0	18	4	0	7	0	**55**
		3 grafts	163	0	18	13	0	3	0	**197**
		4 grafts	50	0	2	2	0	1	0	**55**
		>4 grafts	1	0	0	0	0	0	0	**1**
	Valve surgery	Aortic alone	0	76	31	0	43	4	0	**154**
		Mitral alone	0	50	19	0	36	9	0	**114**
		Tricuspid alone	0	21	0	0	19	0	0	**40**
		Pulmonary alone	0	10	0	0	8	0	0	**18**
		Aortic & mitral	0	28	4	0	13	0	0	**45**
		Mitral & tricuspid	0	46	6	0	33	7	0	**92**
		Other valve combinations	0	36	8	0	17	1	0	**62**

Other procedure detail

- It is important to remember that the patient may have had more than one of the other procedures.
- Some of the more significant areas of case-volume growth compared to 2012-13 is surgery on the aorta (96 Vs. 131) and cardiac surgeries with Radio-frequency ablation (84 Vs.108).
- The group '*other procedures not listed above*' includes all those patients for whom there was another procedure of some kind recorded, but who do not fall into any of the categories listed above such as patients who underwent Hypertrophic Obstructive Cardiomyopathy (HOCM), Myomectomy Surgery, Thoracic Organ Resections, Atrial Reduction Plasty, concomitant peripheral vascular procedures and Thoracic Endovascular Aortic/Aneurysm Repair (TEVAR) under bypass.
- This category of '*other procedures not listed above*' also includes our advanced mechanical support program, Extracorporeal Membrane Oxygenation (ECMO) and Ventricular Assist Device (VAD) implantations, for patients who have severe heart failure.

Other procedures performed

		Data	
		Count	Proportion
Other procedures	No other procedures	584	58.9%
	All operations with an other component	407	41.1%
	Surgery on the aorta	131	13.2%
	Radio-frequency ablation	108	10.9%
	Adult congenital surgery	46	4.6%
	ASD	35	3.5%
	Cardiac transplant	22	2.2%
	Pulmonary transplant	17	1.7%
	Atrial myxoma	10	1.0%
	LV aneurysmectomy	9	0.9%
	Pulmonary embolectomy	7	0.7%
	Epicardial pacemaker	5	0.5%
	Acquired VSD	3	0.3%
	Pericardiectomy	1	0.1%
	ECMO	13	1.3%
	Ventricular assist device	33	2.8%
	Other procedure not listed above	47	5.2%

Previous cardiac surgery

- The proportion of Isolated CABG with previous cardiac surgery was 1.2% compared to 1.6% in UK.
- The complexity and risk associated with re-operations, are greater than with primary (first-time) operations.
- Patients with coronary artery disease with a history of previous cardiac surgery who then require further coronary intervention may now more frequently undergo Percutaneous Coronary Intervention (PCI) rather than surgery and the situation is similar in UK.
- The proportion of 'Isolated valve' surgery with previous cardiac surgery was 31.8% in QMH while 'Valve & other' surgery with previous cardiac surgery was 16.6%. In comparison, UK data shows 9% for isolated Aortic Valve Replacement (AVR) with previous cardiac surgery and 2% for isolated Mitral Valve Repair (MVR) with previous cardiac surgery.
- Overall 16.8% of our Adult Cardiac Surgery patients had previous cardiac surgery performed.

Previous surgery

		Previous cardiac surgery		
		No	Yes	Proportion prior surgery
Procedure grouping	Isolated CABG	246	3	1.2%
	Isolated valve	182	85	31.8%
	CABG & valve	62	6	8.8%
	CABG & other	27	1	3.6%
	Valve & other	141	28	16.6%
	CABG,valve & other	20	1	4.8%
	Other	146	43	22.8%
	All	**824**	**167**	**16.8%**

In-hospital mortality

- In-hospital mortality was used as our primary outcome instead of 30 days mortality.
- Our isolated CABG crude mortality was at par with the UK data and European Association for Cardio-Thoracic Surgery (EACTS) database.
- The crude mortality rate of our Isolated valve surgery was at par with the UK data and the EACTS database whereas, valves combined with other surgeries was lower than the UK data and the EACTS database.
- However, the crude mortality rate of our CABG combined with other surgery groups was higher than the UK data and EACTS database. In 2014-2015 QMH database, the *'CABG & other'* mortality was 14.2% vs 7.8% in UK and our *'CABG, valve & other'* mortality was also 14.2% vs 11.5% in UK.
- The mortality rate for combined CABG with valve, CABG with other surgery and CABG with valve is higher than either Isolated CABG or Isolated valve. Combined procedures involve more than one procedure during surgery and are generally more complex than isolated procedures.
- Compared to our report of 2012-2013, mortality rate for Isolated CABG has fallen whereas the rate for combined CABG and valve surgery the rate has increased.

International comparison of in-hospital, post-operative mortality rates for each procedure group

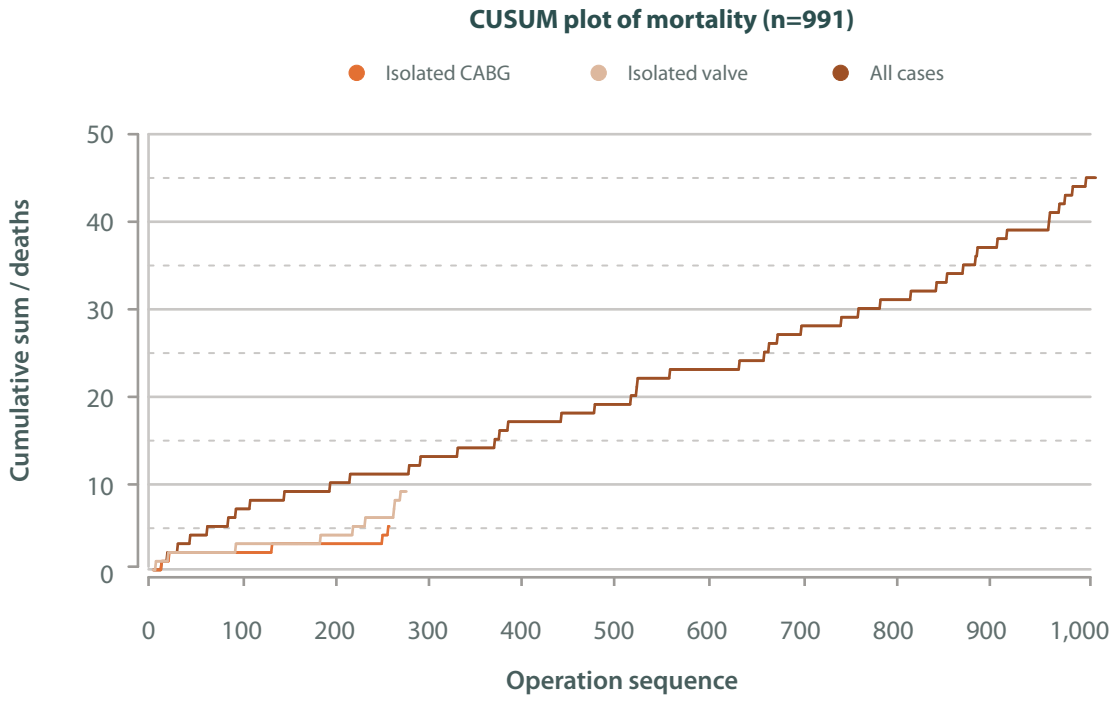
		Mortality data					
		Alive	Died	QMH 2014-2015	QMH 2012-2013	United Kingdom NACSD 2008	EACTS database 2006-2008
Procedure grouping	Isolated CABG	244	5	2.0% (249; 0.7-4.9%)	2.7% (294; 1.3-5.5%)	1.5% (22,808; 1.3-1.6%)	2.2% (219,053; 2.2-2.3%)
	Isolated valve	258	9	3.3% (267; 1.7-6.7%)	3.5% (229; 1.6-7.0%)	3.5% (7,379; 3.1-4.0%)	3.4% (75,247; 3.3-3.5%)
	CABG & valve	62	6	8.8% (68; 4.0-20%)	2.0% (51; 0.1-11.8%)	6.1% (4,508; 5.4-6.8%)	6.2% (37,721; 6.0-6.5%)
	CABG & other	24	4	14.2% (28; 5.4-38.1%)	13.8% (29; 4.5-32.6%)	7.8% (766; 6.1-10.0%)	7.0% (4,327; 6.3-7.8%)
	Valve & other	164	5	2.9% (169; 1.1-7.3%)	2.1% (140; 0.6-6.6%)	5.5% (1,780; 4.5-6.7%)	4.9% (12,883; 4.5-5.3%)
	CABG, valve & other	18	3	14.2% (21; 4.4-42.2%)	17.6% (17; 4.7-44.2%)	11.5% (617; 9.2-14.4%)	11.3% (3,097; 10.2-12.5%)
	Other	176	13	6.8% (189; 4.1-12.5%)	9.9% (162; 6.1-16.3%)	7.9% (1,271; 6.5-9.5%)	7.7% (11,562; 7.2-8.2%)

Overall mortality and risk scores, 2014-2015

- Overall hospital mortality in this cohort was 4.5%.
- Risk stratification models, such as European System for Cardiac Operative Risk Evaluation (EuroSCORE)- Logistic EuroSCORE and EuroSCORE-II, were used to predict mortality.
- Logistic EuroSCORE predicted a mortality of 11.01%.
- EuroSCORE-II predicted a mortality of 5.72%.
- EuroSCORE-II yielded the higher predictive value in our patient population.

CUSUM plots of in-hospital mortality

- The cumulative sum (CUSUM) technique is a method of graph plotting of an accumulation of events [in-hospital mortality] over time.
- Cumulative risk-adjusted mortality plot provides a visual representation of the performance against the expected outcome rate of a particular risk scoring protocol.
- Observed CUSUM mortality plot allows the detection of trends and corrective actions and it provides an excellent audit to surgeons and hospital administrators.
- There were no indications of odd results in the CUSUM plot for Queen Mary Hospital.



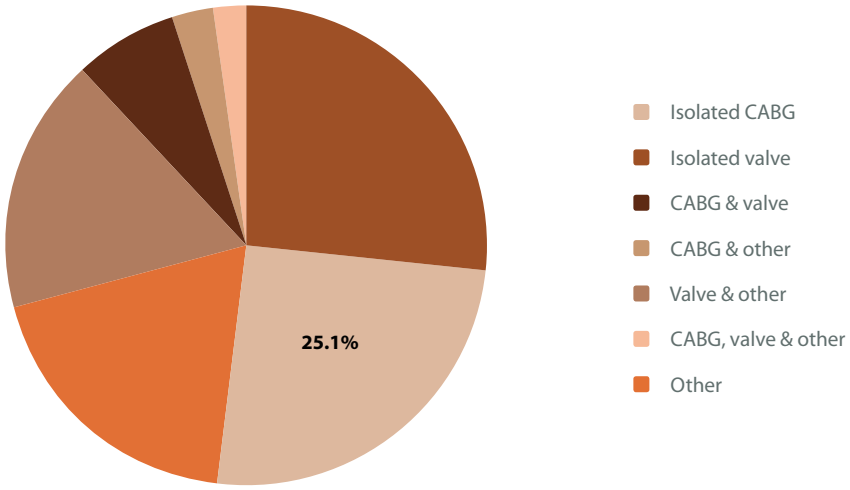
Isolated CABG surgery

Isolated CABG surgery

CABG in the context of overall workload

- Total 249 patients had isolated CABG in the year 2014 to 2015.
- Coronary surgery contributed to 25.1% of the workload (adult cardiac surgery) in our department, there has been a steady biennial decrease (31.9% in 2012-2013, and 33.0% in 2010-2011).
- This distribution was different from Western countries where CABG is usually 70% of the case load.

Workload overview (n=991)

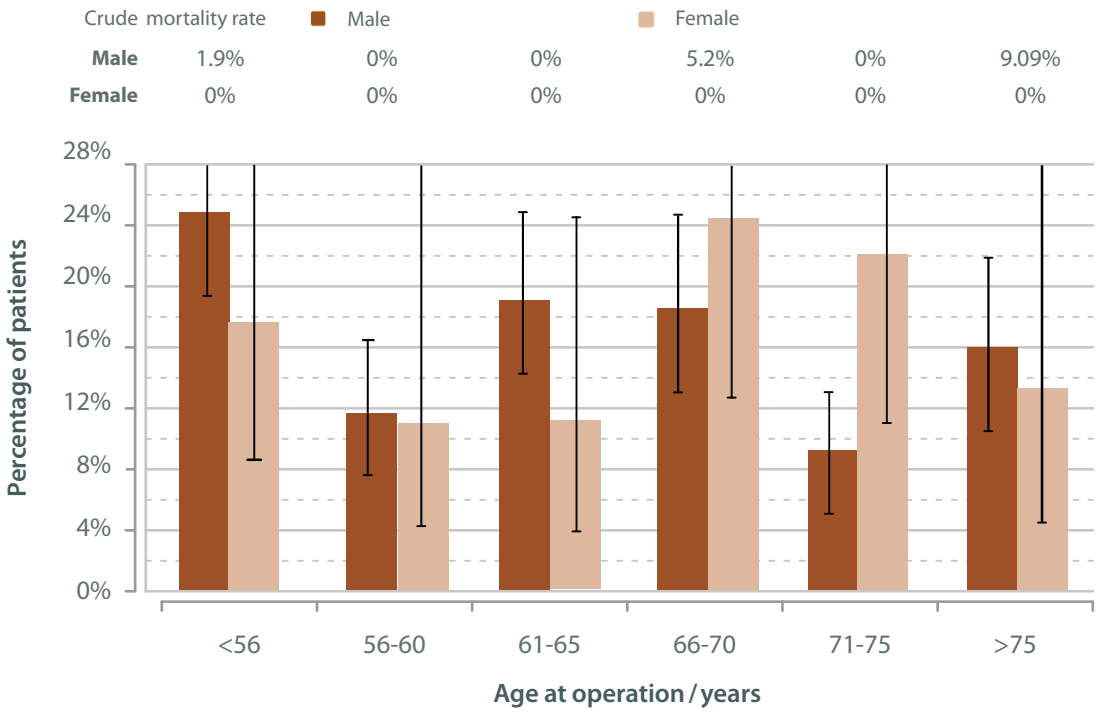


Pre-operative risk factors

Age and gender

- More male patients (204) underwent CABG compared to female (45) patients. A similar trend was also seen in our previous two reports.
- Old age and female gender are considered as risk factors for CABG in general.
- Our crude mortality figures showed that older men (>75 years old) had a higher mortality.
- No mortality was seen in females in this cohort although it is considered as a risk factor.

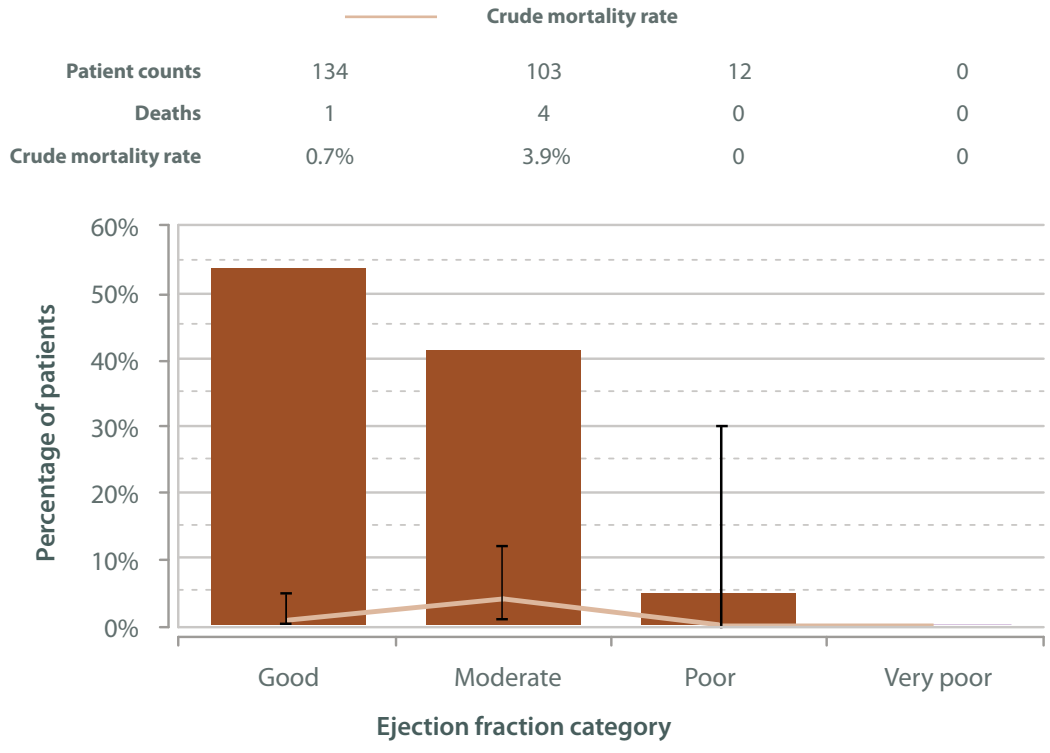
Isolated CABG: Age, gender and crude mortality (n=249)



Left ventricular ejection fraction and crude mortality distribution

- Ventricular function is mainly assessed by an echocardiogram and expressed as Left Ventricular Ejection Fraction (LVEF).
- Poor left ventricular function is a well known risk factor in re-vascularization surgery.
- European System for Cardiac Operative Risk Evaluation ***(EuroSCORE II)*** has four categories of Left Ventricular Ejection fraction- Good (LVEF>50%,) Moderate (LVEF 31-50%), Poor (LVEF 21-30%), Very poor (LVEF 20% or less).
- The proportion of patients with good ejection fraction was 53.8% .
- Moderate ejection fraction group mortality was 3.9%
- There were no patients with 'Very poor' ejection fraction and only 4.8% with 'Poor 'ejection fraction in this cohort.

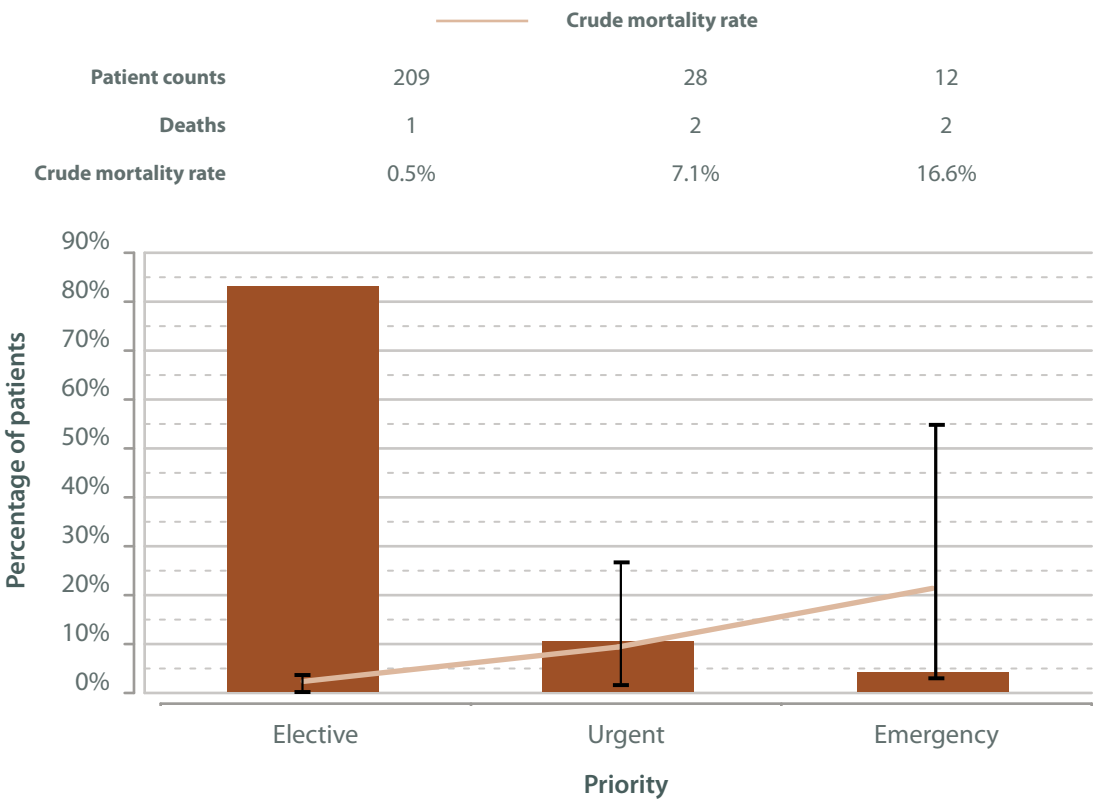
Isolated CABG: Ejection fraction and crude mortality (n=249)



Priority distribution and mortality

- As shown in the chart, most of the patients underwent CABG on an elective basis (83.9%).
- Urgent CABG is defined as operation on the next available working day while emergent CABG (including salvaging surgery) indicates patients need surgery the same day because of their clinical situation. These represent 11.2% and 4.8% of all coronary operations respectively.
- This report showed a higher rate of urgent and emergency operations compared the United Kingdom NACSD report 2008 (2.5% of all cases 560/22831).
- Operative priority is generally associated with in-hospital mortality. Patients in urgent or emergency situations might have on-going ischemia of the myocardium, frequent malignant arrhythmia or even unstable haemodynamics.
- Mortality was 7.1% in urgent situations and 16.6% in emergency settings compared to 0.5% in those performed electively.
- According to the United Kingdom NACSD Report 2008 the mortality rate was 10.5% (59/560).

Isolated CABG: Priority and crude mortality (n=249)



Mortality and other risk factors

- The table below shows certain pre-operative risk factors affecting surgical outcome in coronary surgery.
- The proportion of patients with hypertension and pre-op Intra-aortic Balloon Pump (IABP) insertion in isolated CABG was 87.9%, and 5.6% respectively.
- Similar to our report of 2012-2013, the risk factors for coronary artery surgery remain nearly the same in this cohort as well. Mortality for patients with left main disease, hypertension, pre-op IABP insertion is higher than those without.
- Among all the risk factors, the mortality rate for pre-op IABP usage is the highest, 7.1%.

Isolated CABG surgery: In-hospital, post-operative mortality rates for various risk factors

			Mortality		
			Alive	Dead	Rate
Risk factors	Gender	Male	199	5	2.5%
		Female	45	0	0.0%
	Body mass index	≥25 kg m^{-2}	112	2	1.8%
		<25 kg m^{-2}	132	3	2.2%
	Left main stem disease	No	116	2	1.7%
		Yes	128	3	2.3%
	Previous cardiac surgery	No	241	5	2.0%
		Yes	3	0	0.0%
	Diabetes	No	124	3	2.4%
		Yes	120	2	1.6%
	Hypertension	No	30	0	0.0%
		Yes	214	5	2.3%
	Extra-cardiac arteriopathy	No	223	5	2.2%
		Yes	21	0	0.0%
	Previous `CVA	No	214	5	2.3%
		Yes	30	0	0.0%
	Pre-op IABP insertion	No	231	4	1.7%
		Yes	13	1	7.1%
	Renal failure requiring dialysis	No	229	5	2.1%
		Yes	15	0	0.0%

The grafting process

Arterial grafting

Total number of grafts = 755 in 249 patients.

Average number of grafts= 2.95

Patients with LIMA graft= 236/ 249 (94.7%)

Patients with LIMA and Radial Artery graft = 38/ 249 (15.2%)

Arterial grafting

- There were 755 distal anastomoses made in 249 patients . On average, each patient received 3.0 grafts in isolated CABG.
- Arterial grafts, especially the Left Internal Mammary Artery (LIMA), are considered as better conduits in CABG. Younger patients may benefit from a second arterial graft, usually the radial artery or the right internal mammary artery.
- Arterial grafting was performed in 94.7% of 249 Isolated CABG. 236 patients had the LIMA grafted to the Left Anterior Descending (LAD) artery in isolated CABG.
- 3 grafts or more were performed in 214 Isolated CABG surgeries which was higher than the UK data (85.9 % in QMH vs 74% in UK).
- In addition to internal thoracic arteries, other arteries are available for use as conduits. Radial arteries were the second most common conduit used for arterial grafts (38/249).

Endoscopic harvest of conduits

- Our department began to use endoscopic vein harvesting techniques in 2005 and endoscopic radial artery harvesting in 2007. This has now become the standard and preferred way of harvesting these conduits in our practice.
- As seen from the table below, the usage rate of the endoscopic method was100% for the radial artery and increased from 88.9% to 92.0% for vein graft harvest when compared to the previous report.

Isolated CABG surgery: endoscopic conduit harvest for patients where the named conduit was used in the CABG

		Endoscopic harvest of the names conduit		
		No	Yes	Endoscopic harvest rate
Conduit	Radial artery used	0	38	100.0%
	Any vein used	16	185	92.0%

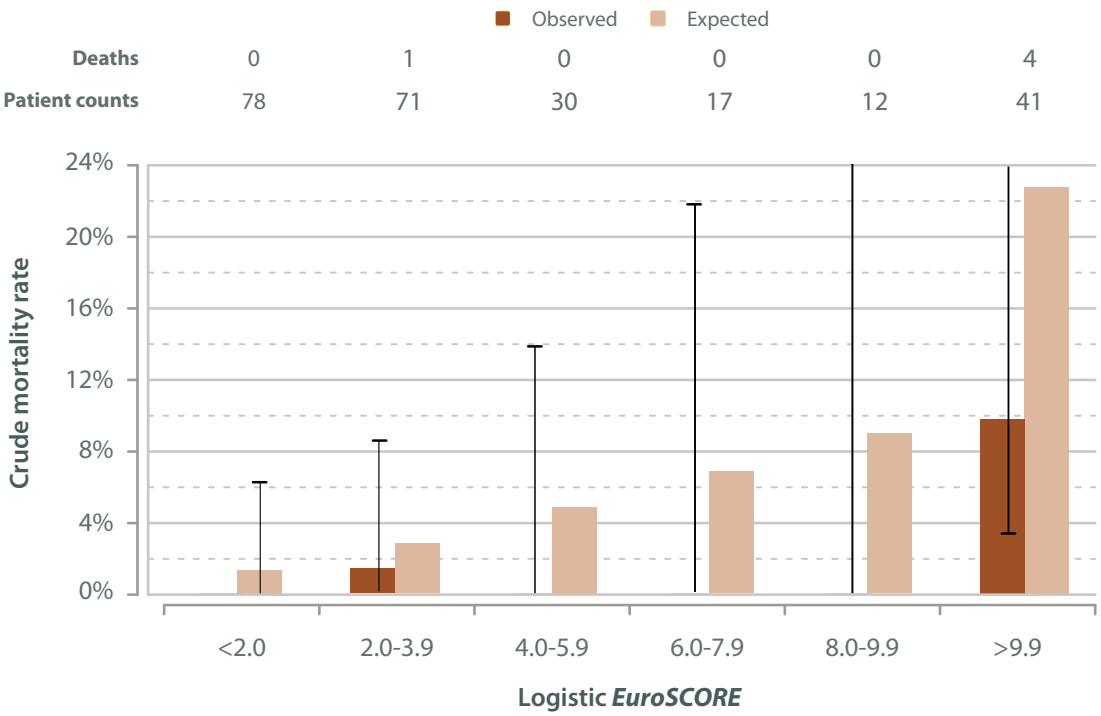
Isolated CABG: Radial artery graft usage at each of the coronary artery sites treated (n=38 grafts)

		Data	
		Count	Proportion
Coronary site	Diag 1	2	5.3%
	Distal Cx	2	5.3%
	Int	4	10.5%
	OM1	23	60.5%
	OM2	6	15.8%
	RCA-PDA	1	2.6%
	All	**38**	

Logistic *EuroSCORE, EuroSCORE II* and mortality

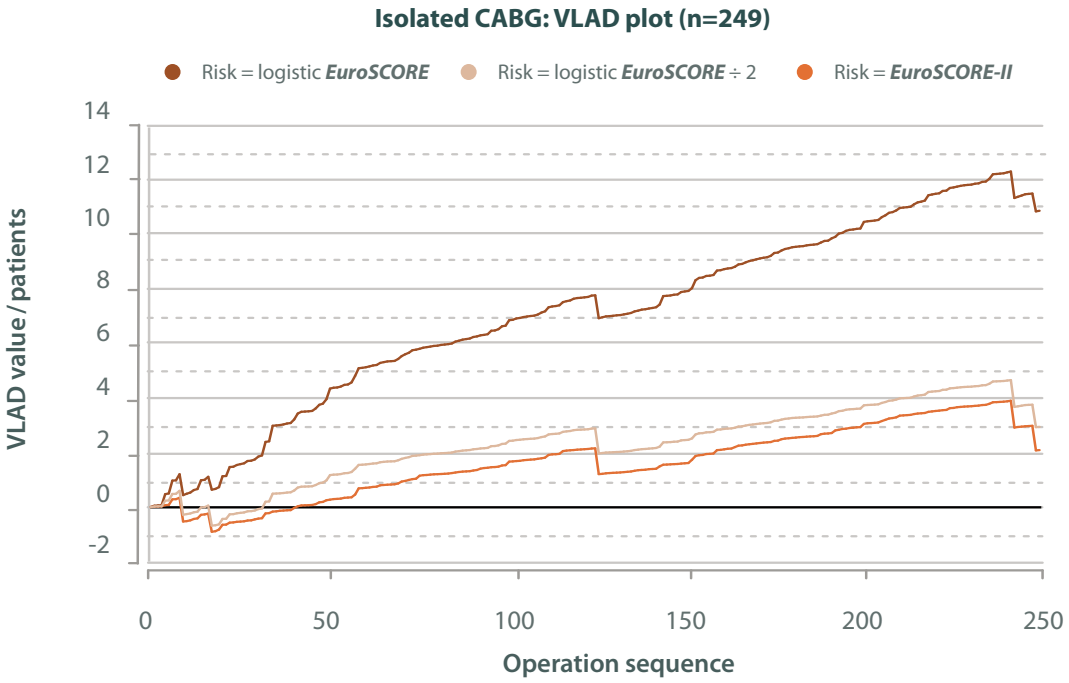
- Logistic EuroSCORE is a commonly used risk stratification and prediction method in cardiac surgery. The value equals to the expected mortality risk for a particular patient.
- At QMH, the patient risk profile was higher since a EuroSCORE higher than 9.9 contributes 16.5% of patients, which was only 13.6% in the last report. We performed more high risk coronary surgeries as compared to UK data, 8.1% of their patients fell into EuroSCORE >9.9 group.
- Most of the mortality was associated with the higher-risk groups.
- The overall expected mortality in isolated CABG group of patients was 6.32% (16 patients). While the observed mortality was 2.0% (5 patients). Thus, the observed *versus* expected mortality ratio was 0.31 for isolated CABG. In 2012-2013 we reported observed *versus* expected mortality ratio of 0.47. *EuroSCORE II* predicted an overall mortality of 2.86% (7 patients).

Isolated CABG: Logistic *EuroSCORE* distribution (n=249)



VLAD plot for isolated CABG

- The following Variable Life-Adjusted Display (VLAD) graph covers all risk-scored isolated CABG procedures performed during 2014 and 2015.
- The plot is risk adjusted and performance as predicted should run approximately around the horizontal zero line (the heavy black line).
- The plotted line goes up for each survival and down for each death. The degree of rise and fall is determined by the predicted risk associated with the case.
- The upslope of the curve demonstrated a net gain of patients' life and that the performance was better than expected. At the end of the curve, almost 11 extra lives had been saved at Queen Mary Hospital.
- A Logistic EuroSCORE divided by 2 is also shown in the graph. This graph demonstrates performance very close to the expected value.



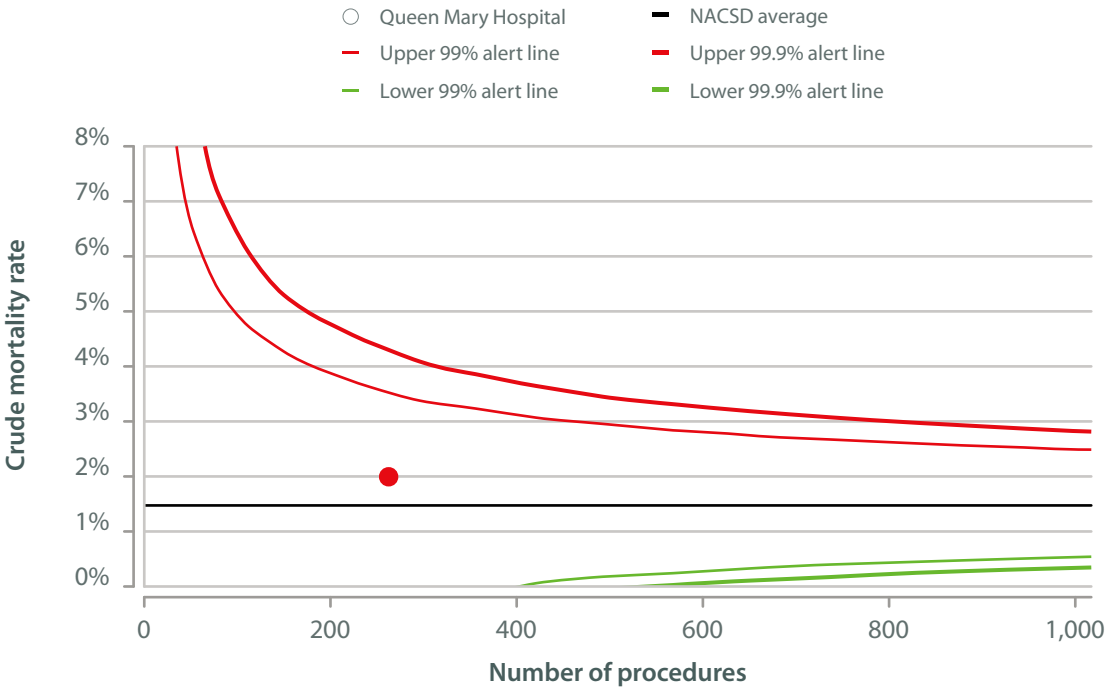
International benchmarking of results

- Funnel plots are a graphical means of displaying outcomes compared to a given standard, with upper and lower control limits to define a range of acceptable results.
- The following pages show funnel plots for the outcomes:
    - Crude mortality
    - Re-operation for bleeding
    - Post-operative stroke
    - New haemofiltration / dialysis
- All three of the following charts compare the results at Queen Mary Hospital against the 2008 results from the United Kingdom NACSD Report, with alert and alarm lines set at 99.0% and 99.9% respectively.
- The first plot shows that the crude mortality at Queen Mary Hospital rate (2.0%) fell well within the alert lines. Although it was higher than the average from United Kingdom, it is not risk adjusted. The higher number of emergency CABG and higher risk profile of patients could account for the higher mortality.
- Queen Mary Hospital did not have any re-operation for bleeding in this group of patients.
- The third and fourth charts represent the crude stroke rate and the proportion of patients that need haemofiltration / dialysis for acute renal failure; the rates for both of these outcomes at Queen Mary Hospital again fell well within the funnel plot alert lines, and QMH has a much lower dialysis rate compared to United Kingdom data.
- The results of these four key outcomes at Queen Mary Hospital demonstrated that the performance is at par with the internationally-published results from the United Kingdom.

Isolated CABG surgery

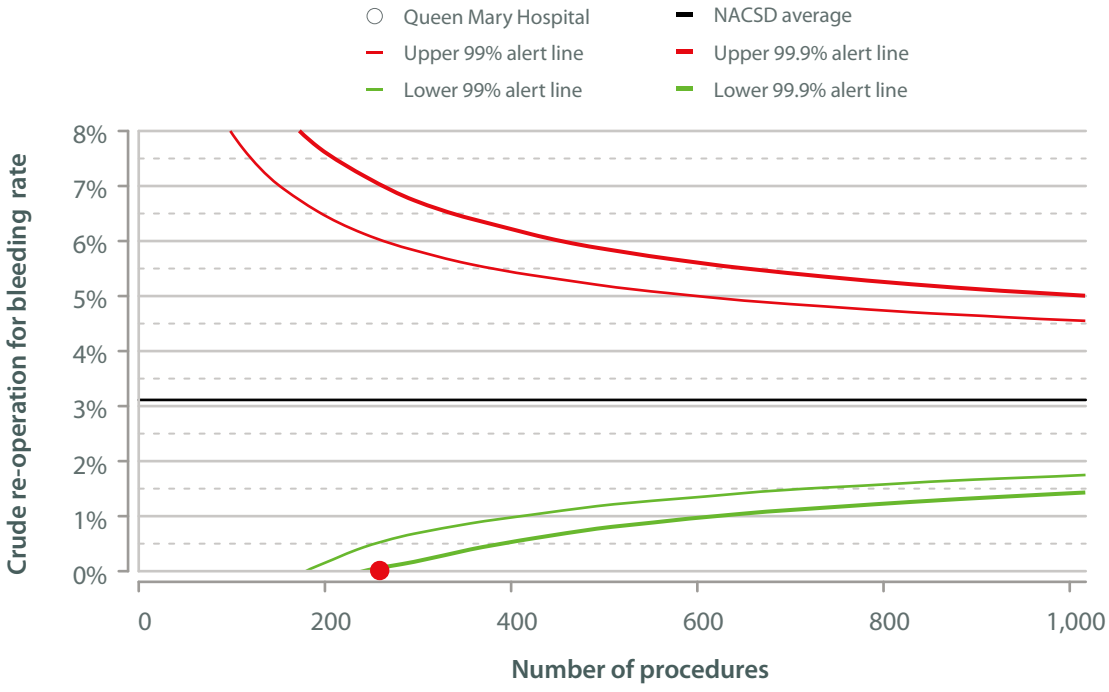
In-hospital mortality

Isolated CABG: Crude mortality rate for QMH (n=249) compared to the data from the financial year 2008 in the United Kingdom NACSD



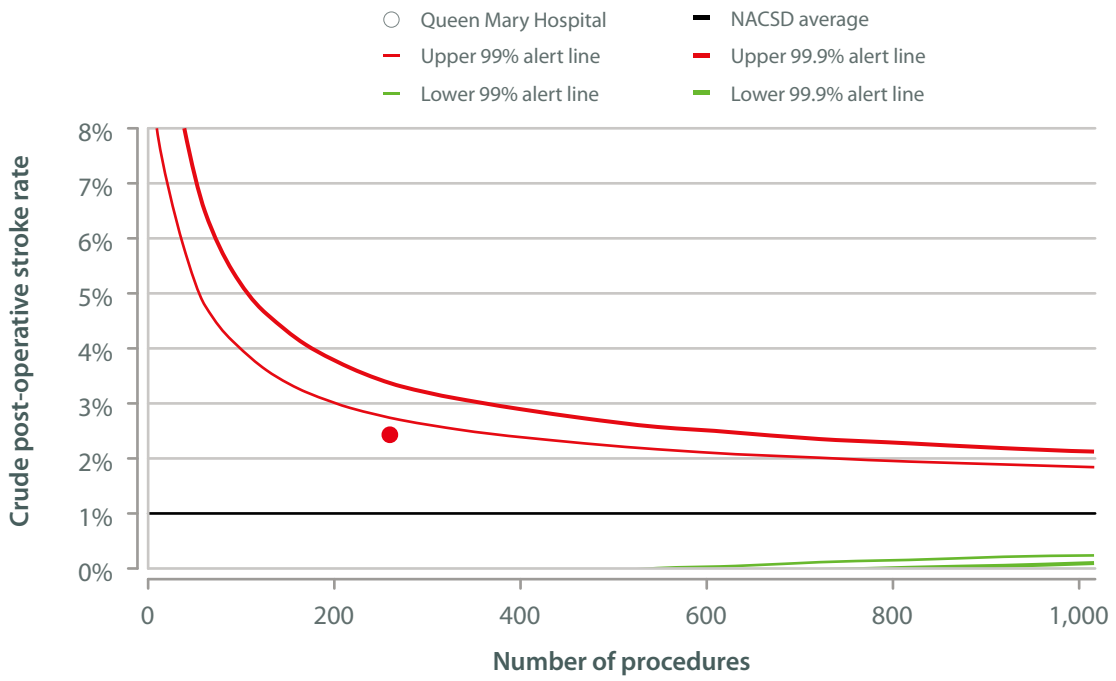
Re-operation for bleeding

Isolated CABG: Crude re-operation for bleeding rate for QMH (n=249)compared to the data from the financial year 2008 in the United Kingdom NACSD



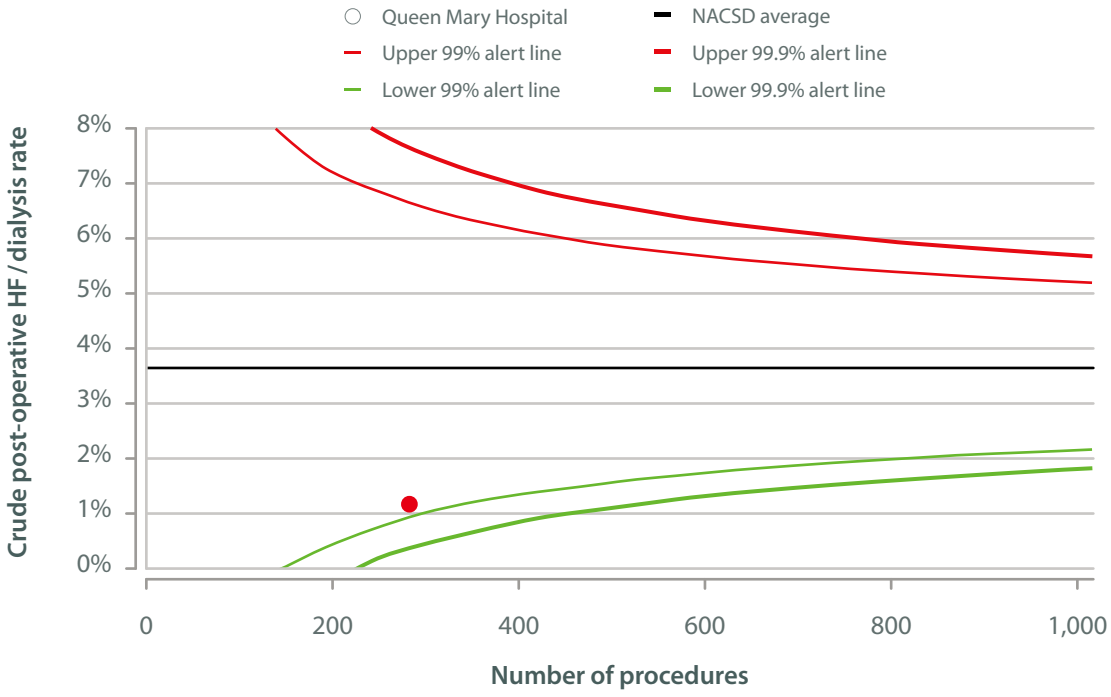
Post-operative stroke

Isolated CABG: Crude post-operative stroke rate for QMH (n=249) compared to the data from the financial year 2008 in the United Kingdom NACSD



Post-operative HF / dialysis

Isolated CABG: Crude post-operative HF / dialysis rate for QMH (n=249) compared to the data from the financial year 2008 in the UK NACSD

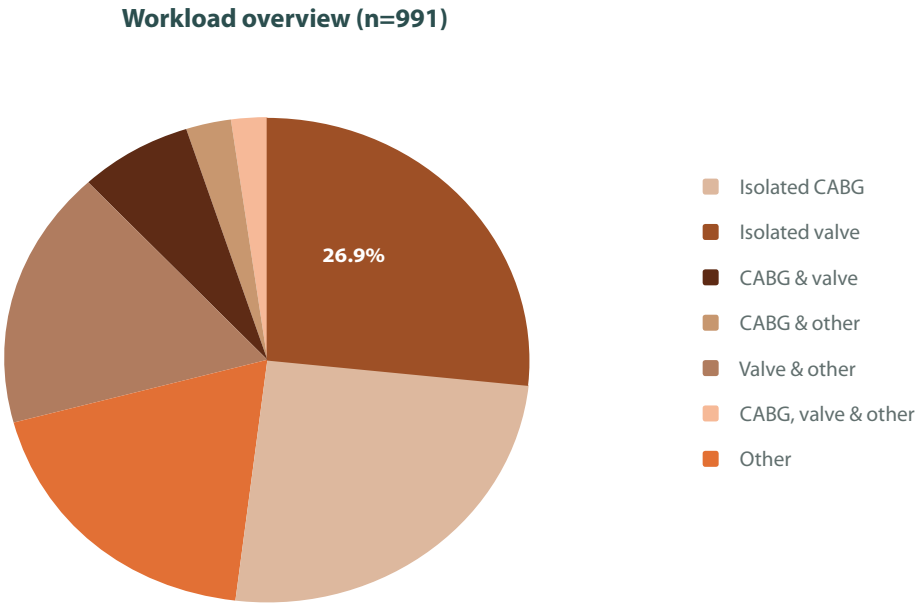


Isolated valve surgery

Isolated valve surgery

Isolated valve surgery in the context of overall workload

- During the year 2014 & 2015, there were 267 isolated valve operations performed at Queen Mary Hospital, contributing to 26.9 % of the overall adult cardiac surgery workload.
- Other than that, there were 258 (26%) valvular operations performed in combination with the other procedures like CABG, radiofrequency atrial ablation, aortic surgery, septal defect repair, *etc.*



Priority

- There were 157 isolated single valve operations performed during 2014-2015.
- 144 out of 157 (92.3%) isolated single valve operations were performed electively.
- The remaining urgent or emergency operations were carried out for infection(7/13), or acute pulmonary edema (5/13).

Isolated single valve surgery: operative urgency

		Valve treated		
		Aortic alone	Mitral alone	Other singles
Priority	Elective	66	47	31
	Urgent	6	2	0
	Emergency	4	1	0
	All	**76**	**50**	**31**

Previous cardiac surgery

- Redo operations contributed a significant workload in the isolated valve operation group. Out of 267 isolated valve surgeries in the years 2014 & 2015, 85 (31.8%) operations were redo cardiac operations.
- The majority of isolated single valve procedures (69.4%) at QMH were first-time operations.
- Among all isolated single valve operations, 48 (30.5%) had previous cardiac operations.
- Among those redo cardiac operations, some of them were second or more redo operations.

Isolated single valve surgery: prior cardiac surgery

		Valve treated		
		Aortic alone	Mitral alone	Other singles
Previous surgery	No previous cardiac surgery	64	41	4
	Previous cardiac surgery	12	9	27
	All	**76**	**50**	**31**

Haemodynamic pathology

- More than half of the isolated aortic valve operations, 41/76 (53.9%), were for patients with aortic stenosis.
- Among all patients who had isolated mitral valve surgery, 37/50 (74.0%) had mitral regurgitation.

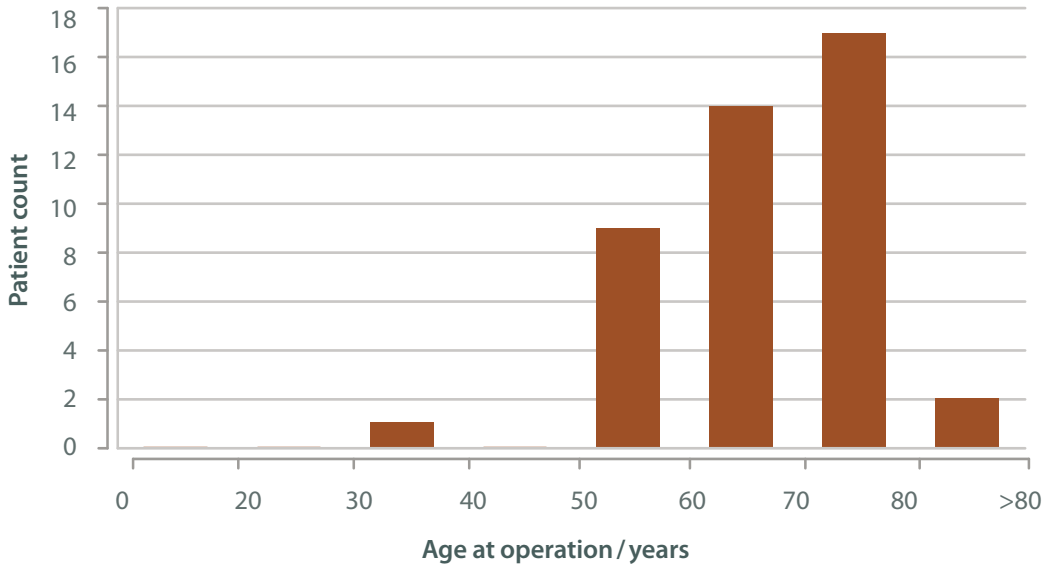
Isolated single valve surgery: haemodynamic pathology

		Valve treated		
		Aortic alone	Mitral alone	Other singles
Haemodynamic pathology	Stenosis	41	8	1
	Regurgitation	24	37	30
	Mixed	11	5	0
	All	**76**	**50**	**31**

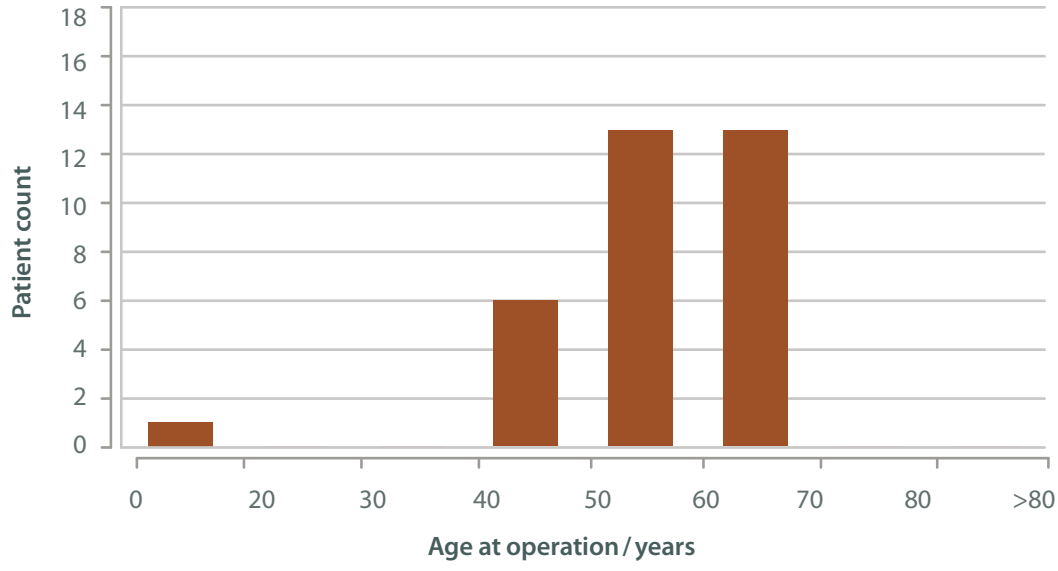
Aortic valve implants

- Most of the biological prostheses were implanted in patients above 65 years of age, however since the last few years, younger patients (<65 years) also received biological aortic valve prostheses.
- A majority of the prostheses for all AVR were biological, 43 (56.5%) received biological valves while the remaining 33 (43.4%) received mechanical prostheses.
- Compared to the previous reports(42.6% in 2012-2013, 31.3% in 2011-2012) we used more biological prostheses during 2014-2015 (56.5%). Over time, there has been a trend of using less and less mechanical prostheses.

Aortic valve implants: Biological (n=43)



Aortic valve implants: Mechanical (n=33)



Native valve pathology

- Majority of aortic valve pathology was calcific degeneration.
- Dominant pathology for mitral valve surgery was degenerative valve disease .
- Chronic rheumatic changes of mitral and tricuspid valves also accounted for one of the major cause of valvular heart disease.
- In the 'Other singles' group, tricuspid valve pathology was all rheumatic. Pathology of the pulmonary valve was all congenital, all patients had previous congenital cardiac surgery and now presented with pulmonary regurgitation.

Isolated single valve surgery: native valve pathology

		Valve treated		
		Aortic alone	Mitral alone	Other singles
Native valve pathology	Calcific degeneration	32	3	0
	Degenerative	26	23	0
	Congenital	20	0	10
	Rheumatic	11	10	11
	Native valve not present	4	2	0
	Active infective endocarditis	3	5	2
	Previous infective endocarditis	3	8	0
	Annuloaortic ectasia	2	1	1
	Other native valve pathology	2	4	2
	Ischaemic	0	0	0
	Functional regurgitation	0	0	8

Mitral valve surgery

Mitral valve repair and replacement in the context of all mitral valve surgeries

- Majority of mitral valve repairs were for mitral regurgitation. Regurgitation was mainly due to degenerative valve disease (39/65). 65 out of 85 native regurgitant valves were successfully repaired (76.40%), which is slightly lower compared to our rate reported in the previous two reports (81.1% in 2010-2011 and 87.5% in 2012-2013).
- Mitral valve replacement was most performed for mitral stenosis which was mainly of rheumatic aetiology (31/41). Replacement was also performed for mitral regurgitation caused by paravalvular leakage at old prostheses, infective endocarditis and rheumatic aetiologies.
- Based on The Society for Cardiothoracic Surgery (SCTS) in Great Britain & Ireland, 6th NACSD Report, in 2008, 67% underwent mitral valve repair for degenerative mitral valve disease.

Isolated mitral valve surgery: haemodynamic pathology and valve procedure

		Haemodynamic pathology		
		Stenosis	Regurgitation	Mixed
Valve procedure	Replacement	41	18	18
	Repair	0	65	2
	All	**41**	**85**	**20**

Type of mitral valve repair

- Most of the isolated mitral valve repair operations were complex repairs, involving two or more repair procedures.
- Most (76.1%) of mitral valve repair operations had ring annuloplasty.
- Artificial chordal implantation and leaflet resection were the two most commonly performed techniques in mitral valve repair surgery following annuloplasty.

Isolated valve repair involving the mitral valve: type of valve repair

		Data	
		Count	Proportion
Type of mitral valve repair	Annuloplasty (ring)	51	76.1%
	Leaflet resection	22	32.8%
	Artificial chord	18	26.8%
	Other	11	16.4%
	Annuloplasty (suture)	4	5.9%
	Commisurotomy	3	4.4%
	Leaflet extension	3	4.4%
	Chordal transfer	3	4.4%
	Subvalvar release	3	4.4%
	Decalcification / debridement	2	2.9%
	Leaflet patch	2	2.9%
	Resuspension	2	2.9%
	Chordal shortening	0	0.0%
	Papillary muscle repositioning	0	0.0%

Tricuspid valve surgery

Tricuspid valve repair in the context of all tricuspid valve surgeries

- 103/267, (38.5%) of all isolated valve(s) surgeries involved tricuspid valve procedures.
- Isolated single valve tricuspid surgery was rare, only 21 patients during the year 2014-2015 had the isolated single valve tricuspid operation.
- Majority of isolated single valve tricuspid repairs were for regurgitation (95.2%) and rheumatic disease was the most common pathology (52.3%). Tricuspid valve repair using an annuloplasty ring was the preferred surgical approach (61.9%).

Isolated valve surgery involving the tricuspid valve: type of valve procedure

		Tricuspid valve procedure		
		Replacement	Repair	All
Valve treated	Tricsupid alone	4	17	**21**
	Tricuspid plus another valve	4	78	**82**
	All that include tricuspid valve surgery	**8**	**95**	**103**

Details of Isolated tricuspid valve surgery

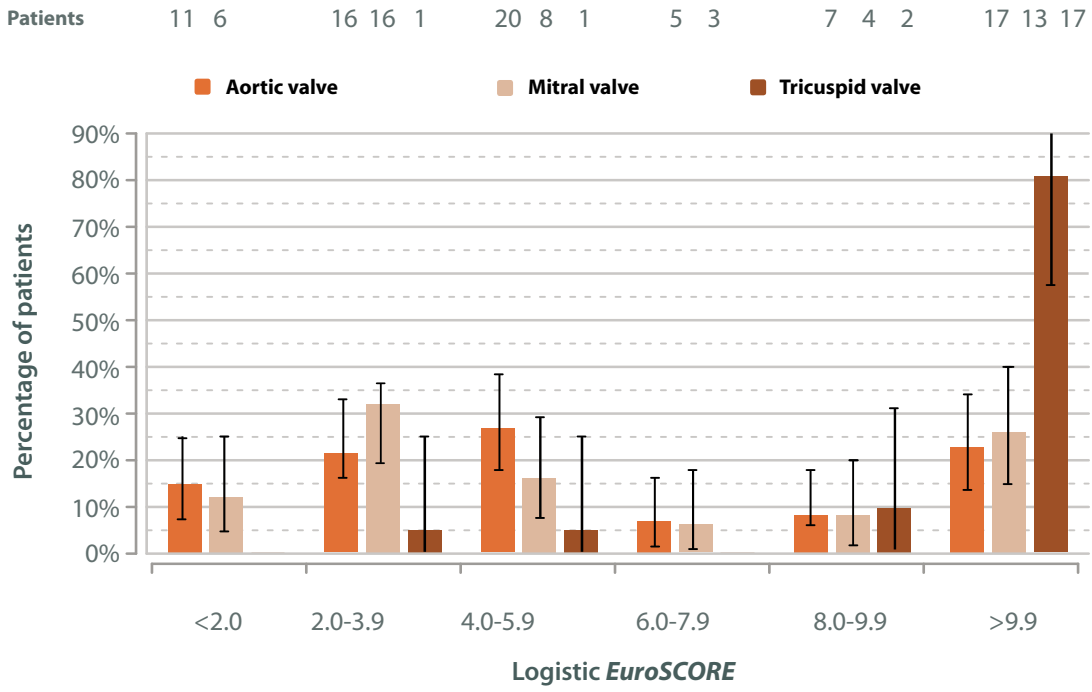
		Data	
		Count	Percentage
Haemodynamic pathology	Regurgitation	20	95.2%
	Stenosis (previous TVR)	1	4.76%
	All	**21**	
Previous cardiac surgery	No previous cardiac surgery	4	19.04%
	1 previous cardiac surgery	13	61.9%
	2 previous cardiac surgeries	4	19.04%
	All	**21**	
Repair technique	Annuloplasty ring	13	61.9%
	Annuloplasty suture	1	4.76%
Valve pathology	Rheumatic	11	52.3%
	Infective (endocarditis)	2	9.5%
	Functional Regurgitation	8	38.0%
	All	**21**	

Logistic *EuroSCORE and EuroSCORE II*

EuroSCORE distributions

- The expected mortality risk for isolated aortic valve surgery alone as predicted by Logistic ***EuroSCORE and EuroSCORE II*** was 9.36% and 3.61% respectively.
- The expected mortality risk for isolated mitral valve surgery alone as predicted by Logistic ***EuroSCORE and EuroSCORE II*** was 7.17 % and 2.36% respectively.
- The expected mortality risk for isolated tricuspid valve surgery alone as predicted by Logistic ***EuroSCORE and EuroSCORE II*** was 13.5% and 5.48% respectively.

Isolated single valve surgery: Logistic *EuroSCORE* distribution (n=147)



Logistic *EuroSCORE* and mortality

- There was no observed mortality for isolated aortic and mitral valve surgery whereas isolated tricuspid valve surgery had a mortality rate of 9.5 % which was lower than the expected mortality, resulting in low O/E mortality ratio.
- Predominant multiple-valve surgery at QMH was combined mitral and tricuspid valve surgery. This is usually undertaken for a combination of primary mitral pathology with associated tricuspid regurgitation.
- Mortality for combined mitral and tricuspid valve surgery was 6.52%, which was the highest among all multiple-valve surgeries.
- Despite the increased complexity QMH had a low O/E mortality ratio for multiple-valve surgery.

Isolated single valve surgery: EuroSCORE and mortality

		Count		Mortality		
		All	Deaths	Observed(0)	Expected(E)	**O/E Ratio**
Valve treated	Aortic alone	76	0	0	0.093	**0**
	Mitral alone	50	0	0	0.071	**0**
	Tricuspid alone	21	2	0.095	0.135	**0.70**

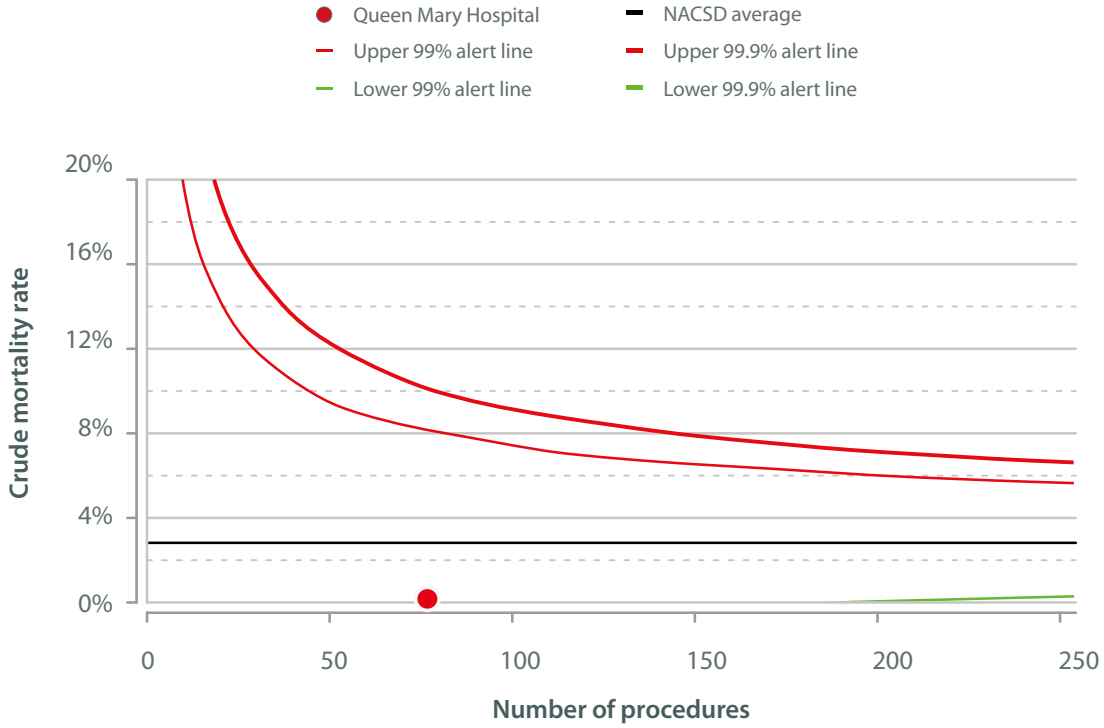
Isolated multiple valve surgery: EuroSCORE and mortality

		Count		Mortality		
		All	Deaths	Observed(O)	Expected(E)	**O/E Ratio**
Valve treated	Aortic & mitral	28	1	0.035	0.101	**0.34**
	Mitral & tricuspid	46	3	0.065	0.132	**0.49**
	Aortic, mitral & tricuspid	21	1	0.047	0.108	**0.43**

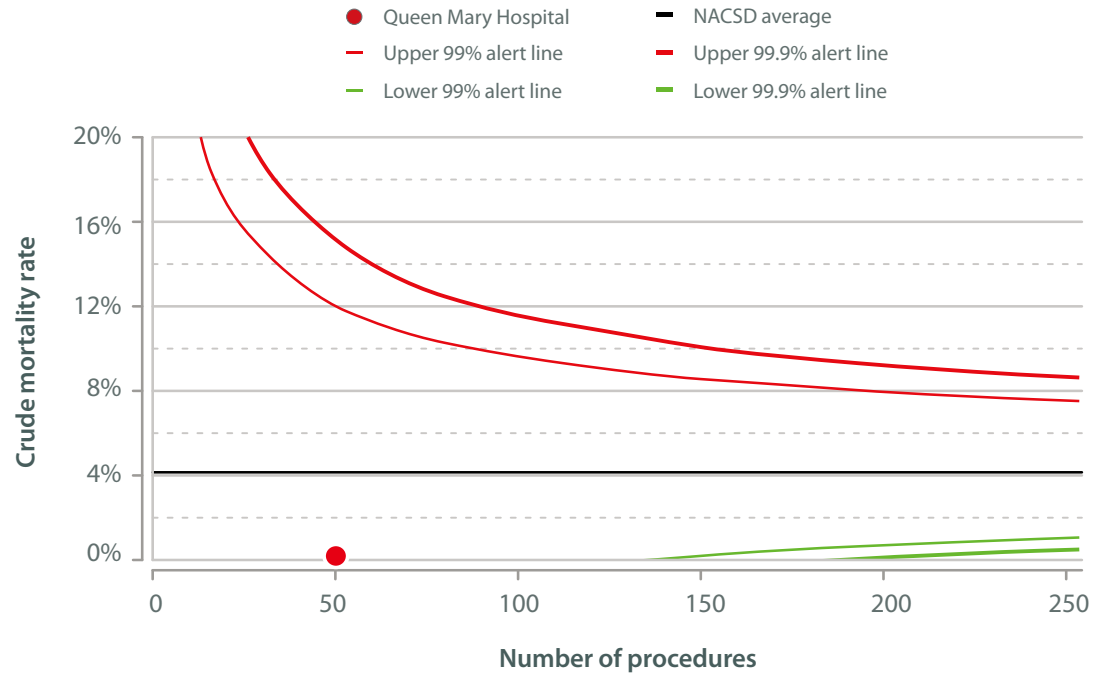
International benchmarking of mortality

- The graph here is a funnel plot of in-hospital crude mortality for isolated aortic valve and isolated mitral valve surgery . In 2014-2015 there was no mortality for isolated aortic valve and isolated mitral valve surgery.

Isolated aortic valve surgery: No mortality for QMH (n=76) compared to the data from the financial years 2004-2008 in the United Kingdom NACSD



Isolated mitral valve surgery: No mortality for QMH (n=50) compared to the data from the financial years 2004-2008 in the United Kingdom NACSD



Minimally Invasive Cardiac Surgery (MICS)

Developments and workload in QMH

- Our department started performing minimally invasive cardiac surgery since 2007.
- In 2014-2015, about 11.4% of cardiac surgical procedures were performed using a minimally invasive approach.
- MICS is associated with decreased mortality as well as less postoperative pain, reduced risk of stroke, avoidance of blood products, quicker return to daily activities, and improved quality of life.
- Robotic-assisted procedures undertaken so far were mainly for mitral valve annuloplasty and an atrial septal defect closure.

MICS approach

		Data	
		Count	Proportion
Type of MICS approach	Mini-thoracotomy	62	54.9%
	Hemi-sternotomy	44	38.9%
	Robot-assisted surgery	5	4.4%
	Parasternal approach	2	1.8%
	Total	**113**	**100%**

Procedures performed using MICS

- A wide range of MICS procedures for heart conditions were performed.
- In 2014-2015, more than 25.09% (67/113) of isolated valve procedures were performed using a MICS technique.

Procedures performed using MICS

		Data	
		Count	Proportion
Procedure grouping	MICS for valve alone	67	59.3%
	MICS for valve and other surgery	28	24.8%
	MICS for surgery other than valve	18	15.9%
	Total	**113**	

Other surgeries with valve surgery using MICS approach

- It was not uncommon to correct more than one heart problem during a minimally invasive procedure.
- Along with the valve surgery following procedures were done during the same operation without opening the chest.

Other surgeries with valve using MICS

		Data	
		Count	Proportion
Other surgery	Atrial Ablation	20	71.4%
	ASD closure	3	10.7%
	ASD closure, Atrial Ablation	3	10.7%
	Other procedure not listed above	2	7.1%
	Total	**28**	

Procedures other than valve surgery using MICS

		Data	
		Count	Proportion
Other procedures	ASD closure	6	33.3%
	Other procedure for congenital condition	6	33.3%
	ASD closure, Atrial Ablation	1	5.6%
	ASD closure, Other procedure not listed above	1	5.6%
	Atrial myxoma	1	5.6%
	Atrial myxoma, ASD closure	1	5.6%
	Ascending aorta replacement	1	5.6%
	Ventricular assist device- LVAD CentriMag	1	5.6%
	Total	**18**	

MICS and mortality

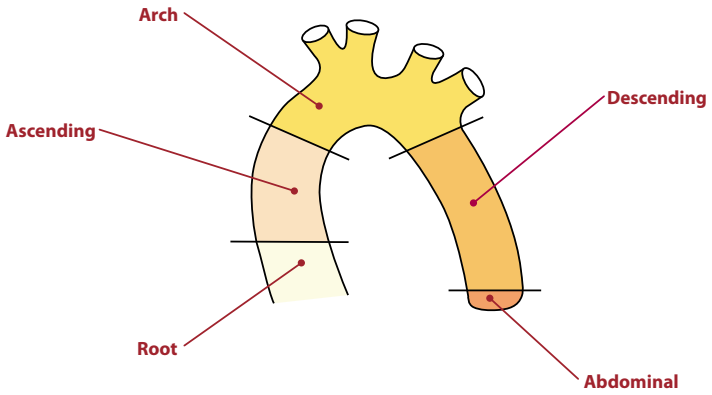
- There was no in-hospital mortality in this group of patients. There were no major complications except 4 patients (3.5%) had re-operation due to bleeding and 1 patient had transient stroke (0.9%).

Surgery on the aorta and Other cardiac procedures

Surgery on the aorta and other cardiac procedures

Surgery on the aorta

- The number of thoracic aortic surgeries increased from 96 (2012-2013) to 131 (2014-2015).
- Between 2014-2015 there were 50 (38.1%) patients who had aortic surgery at more than one location.
- Aortic surgery at one location was most commonly performed (61.8%).
- The ascending aorta was the most common site for aortic surgery (44.2%).
- Involvement of ascending aorta frequently occurs with the involvement of other parts of the aorta too (35.8%).



Surgery on the aorta: number and details of segments treated

			Cardiac procedure group				
			CABG & other	Valve & other	CABG, valve & other	Other	**All**
Segments treated	1	Root	0	0	0	7	**7**
		Asecending	6	20	0	32	**58**
		Arch	1	4	0	4	**9**
		Descending	0	0	0	7	**7**
	2	Root & ascending	2	8	5	11	**26**
		Ascending & arch	0	0	0	8	**8**
		Descending & arch	0	0	0	1	**1**
		Descending & abdominal	0	0	0	2	**2**
	3	Root, ascending & arch	0	0	0	1	**1**
		Ascending, arch & descending	1	0	0	11	**12**
	4	Root, ascending, arch & descending	0	0	0	0	**0**
		All	**10**	**32**	**5**	**84**	**131**

Pathology and Surgical technique

- The most common pathology that affected the aorta was aneurysm with dissection. Aneurysms may affect any part of the aorta. Operations for thoracic aortic dissection constituted the main workload 84/131 (64.1%) followed by surgery for a non-dissected thoracic aneurysm 37/131 (28.2%).
- The most common aortic root procedure performed was Bentall 29/38 (root replacement with composite graft and coronary re-implantation), only 1/38 underwent root replacement with preservation of valve, 3 underwent repair of Sinus Valsalva Aneurysm.

Surgery on the aorta: pathophysiology

		Count
Pathophysiology	Aneurysm	37
	Aneurysm with dissection	
	Acute	58
	Chronic	25
	Subacute	1
	Infection	3
	Aortic valve prosthesis complication	3
	Congenital	2
	Aortic valve stenosis	2
	Patient count	**131**

Surgery on the aorta: root

		Count
Aortic procedure	Bentall	29
	Valve-sparing	1
	Sinus of valsalva aneurysm repair	3
	Konno procedure	2
	Repair of root abscess	1
	Ascending reduction aortoplasty	1
	Other	1
	Patient count	**38**

- Axillary/subclavian and ascending aorta cannulation for arterial inflow were the most commonly used cannulation strategies in QMH (113/131).
- Femoral cannulation is particularly useful in emergency situations with haemodynamically unstable patients (28/131).
- Antegrade cerebral perfusion is beneficial for reducing neurologic injury during hypothermic circulatory arrest and was used in 50/65 patients.

Surgery on the aorta: cerebral perfusion

		Count
Cerebral perfusion	None	12
	Antegrade	50
	Retrograde	3
	All	**65**

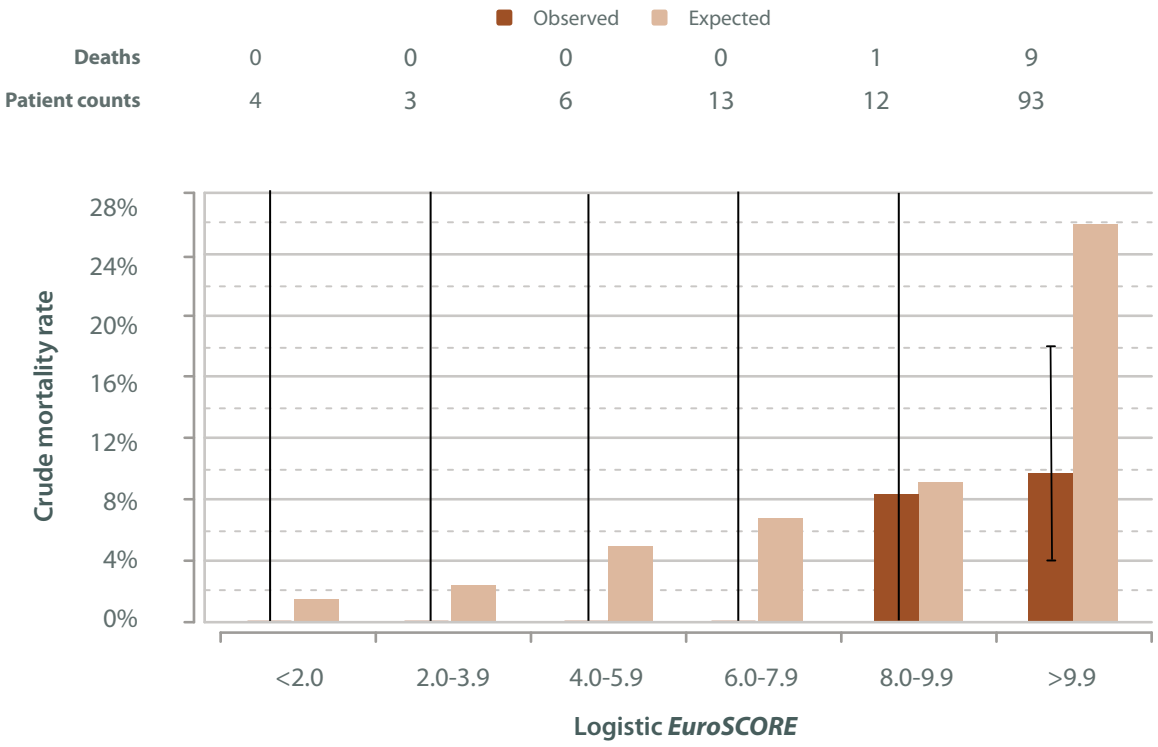
Surgery on the aorta: cannulation

		Count
Arterial cannulation	Ascending aorta	43
	Arch	3
	Axillary/subclavian	70
	Femoral	28
	Other	0
	Patient count	**131**

Mortality and morbidity

- Overall expected and observed mortality for aortic surgery was 20.3% and 7.6% respectively with O/E ratio of 0.374 indicating better than expected performance.
- Highest mortality was observed in the high-risk Logistic EuroSCORE group (>9.9). This group had the most challenging patients with acute dissection (4/9 had previous aorta replacement surgery).
- Inspite of these high-risk group procedures being particularly challenging, QMH observed mortality rate (9.6%) in this group was less than the expected mortality rate(26%).

Surgery on the aorta: Logistic *EuroSCORE* and mortality (n=131)



Other cardiac procedures

Other procedures

- 'Other procedures for congenital condition' performed mainly included VSD closure (10/22) , Fontan conversion(5/22) and Pulmonary valve replacement (4/22).
- VAD are used in patients with heart failure. Most of the implantable VAD (HeartMate II® & HeartWare®, 15/33) were performed for the intention of bridging to heart transplantation.
- External VAD (18/33) were used until myocardial recovery in 3/18, as a bridge to transplant in 4/18 and as bridge to implantable VAD in 1/18. 10/18 died while on support.
- ECMO completely takes over for the heart and lungs with isolated pulmonary failure or combined cardiopulmonary failure. Unlike the previous report, only post-cardiotomy ECMO are reported here.
- The number of lung transplants increased from 7 to 17 whereas the number of cardiac transplants decreased from 28 to 22 when compared to our report of 2012-2013.
- The number of atrial ablations performed have steadily increased biennially, 51 in 2010-2011, 84 in 2012-2013 and 108 in 2014-2015.

Procedure detail

Other cardiac procedures	Procedure grouping							
	CABG alone	Valve alone	CABG & valve	CABG & other	Valve & other	CABG, valve & other	Other	All
None	249	267	68	7	28	4	76	**699**
LV aneurysmectomy	0	0	0	3	1	5	0	**9**
Acquired VSD	0	0	0	2	0	0	1	**3**
Atrial myxoma	0	0	0	0	2	0	8	**10**
Pulmonary embolectomy	0	0	0	0	1	0	6	**7**
Cardiac transplant	0	0	0	0	0	0	22	**22**
Pulmonary transplant	0	0	0	0	3	0	14	**17**
Cardiac trauma	0	0	0	0	0	0	0	**0**
Epicardial pacemaker	0	0	0	0	0	0	5	**5**
Pericardiectomy	0	0	0	0	1	0	0	**1**
ASD closure	0	0	0	1	17	0	17	**35**
Other procedure for congenital condition	0	0	0	1	22	1	22	**46**
Atrial Ablation	0	0	0	10	83	9	6	**108**
Ventricular assist devise	0	0	0	0	9	0	24	**33**
ECMO	0	0	0	1	2	2	8	**13**
Other procedure not listed above	0	0	0	6	27	2	12	**47**
Patient count	249	267	68	28	169	21	189	**991**

Atrial ablation

Patients and procedure

- In 2014-2015, 108 atrial ablation procedures were performed to treat atrial fibrillation.
- In all cases, the surgery included treatment for atrial fibrillation and another cardiac procedure.
- In 89.2% of atrial ablation procedures another cardiac procedure was valve surgery.
- There has been an increase in number of atrial ablation procedures from 84 in 2012-2013 to 108 in 2014-2015.
- Most of the patients undergoing this procedure were relatively young patients <65 years of age (64.8%). Atrial ablation procedures were also performed on the elderly, including septuagenarians (35.1%).

Atrial ablation age and concomitant procedures

		Concomitant procedures					
		CABG & other	Valve & other	CABG, valve & other	Other	All	Percentage
Age at surgery / years	<56	1	29	1	4	35	32.4%
	56-60	1	14	0	1	16	14.8%
	61-65	0	14	4	1	19	17.6%
	66-70	6	16	2	0	24	22.2%
	71-75	2	9	2	0	13	12.0%
	>75	0	1	0	0	1	0.9%
	All	**10**	**83**	**9**	**6**	**108**	**100.0%**
	Percentage	**10.8%**	**89.2%**	**9.7%**	**6.5%**		

TAVI (Transcatheter Aortic Valve Implantation)

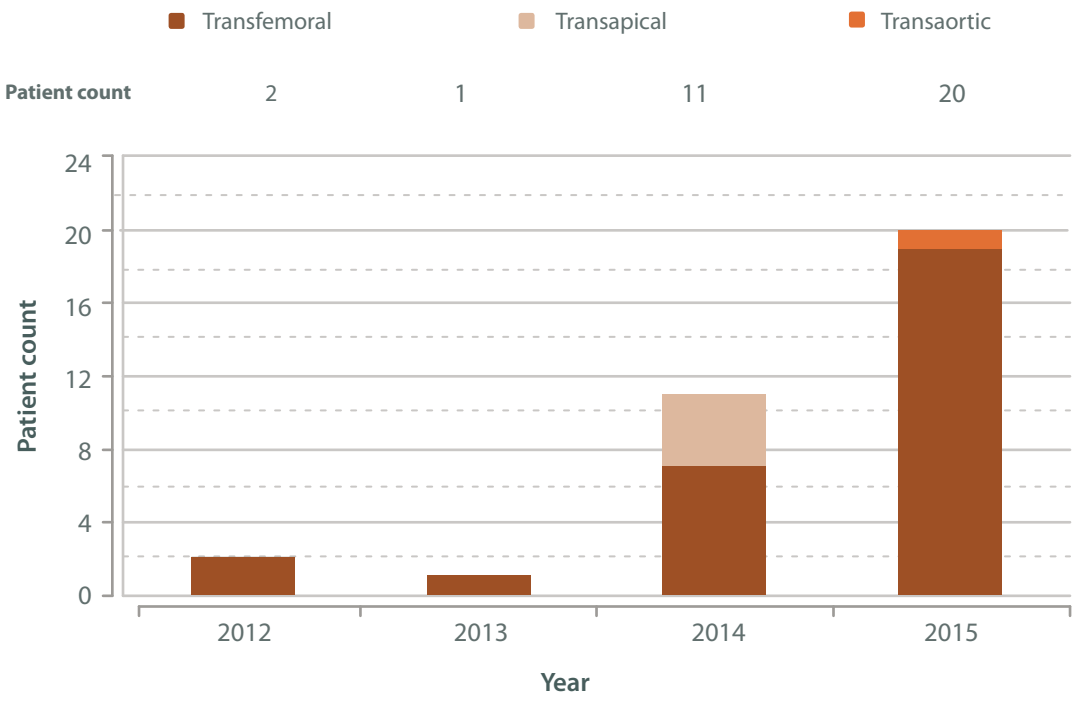
Overview

- TAVI is part of a growing trend in the field of minimally-invasive surgeries.
- TAVI is restricted to those patients who can't tolerate the traditional approach or they are deemed to be at high risk of suffering serious complications from open-heart surgery.
- Recovery time is much faster for TAVI patients.
- The TAVI procedure is more expensive than open-heart surgery because of the extra cost of these specialized valves.
- TAVI was a relatively new procedure during the time period in question. We began performing the procedure during 2012.

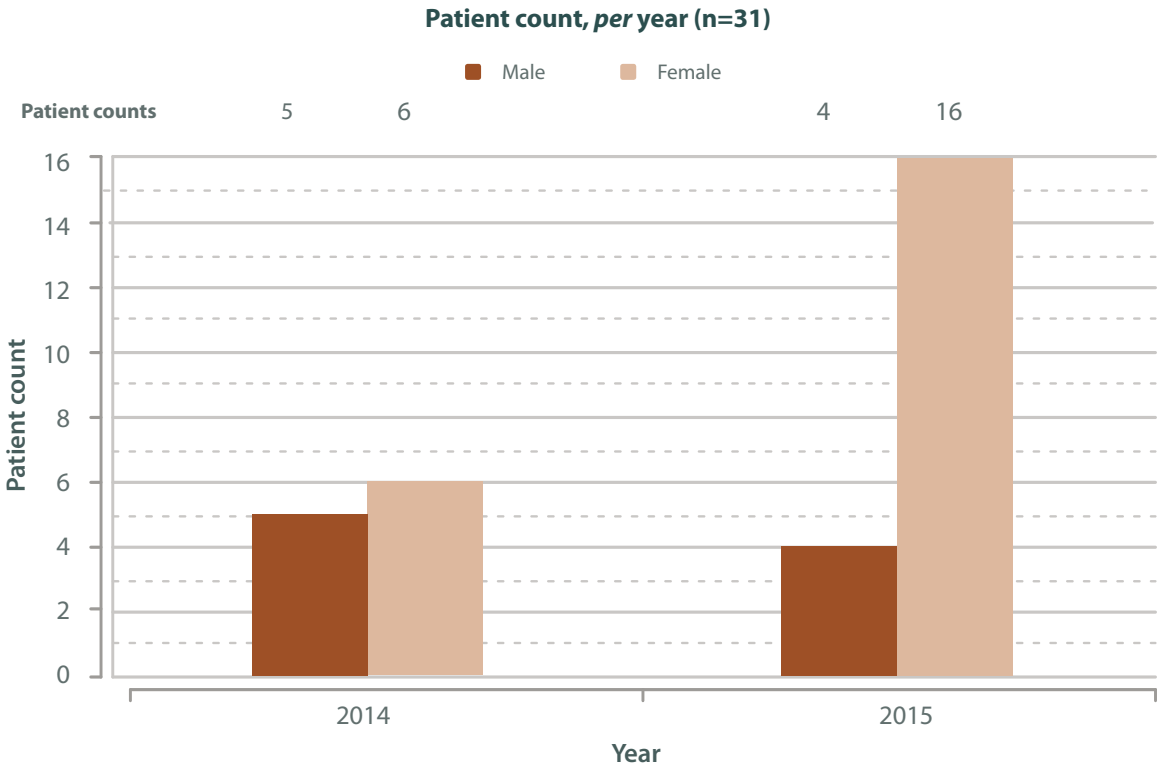
Number of TAVI procedures, per access type and year

- The transfemoral access route is the predominant choice .
- Alternative (non-femoral) access routes include transapical, subclavian, and transaortic access.
- Non-femoral access usually requires general anaesthesia, while most transfemoral cases are performed under local anaesthesia only.

Number of TAVI procedures, *per* access type and year (n=34)

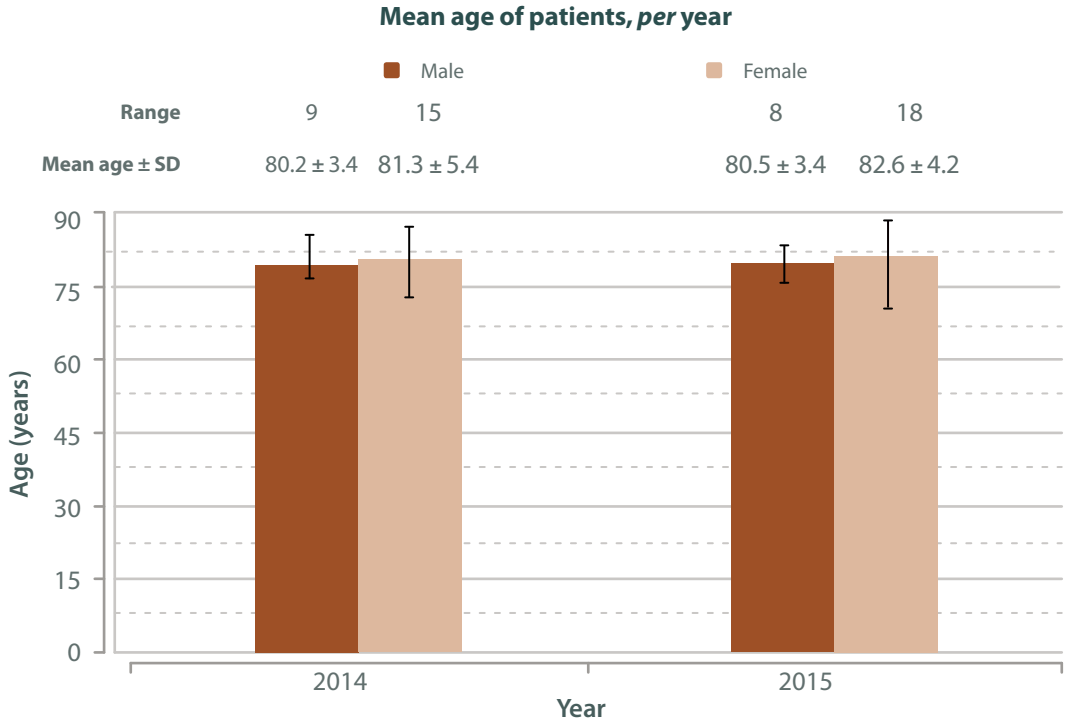


Patient count, per year, 2014–2015



Mean age of patients, per year, 2014–2015

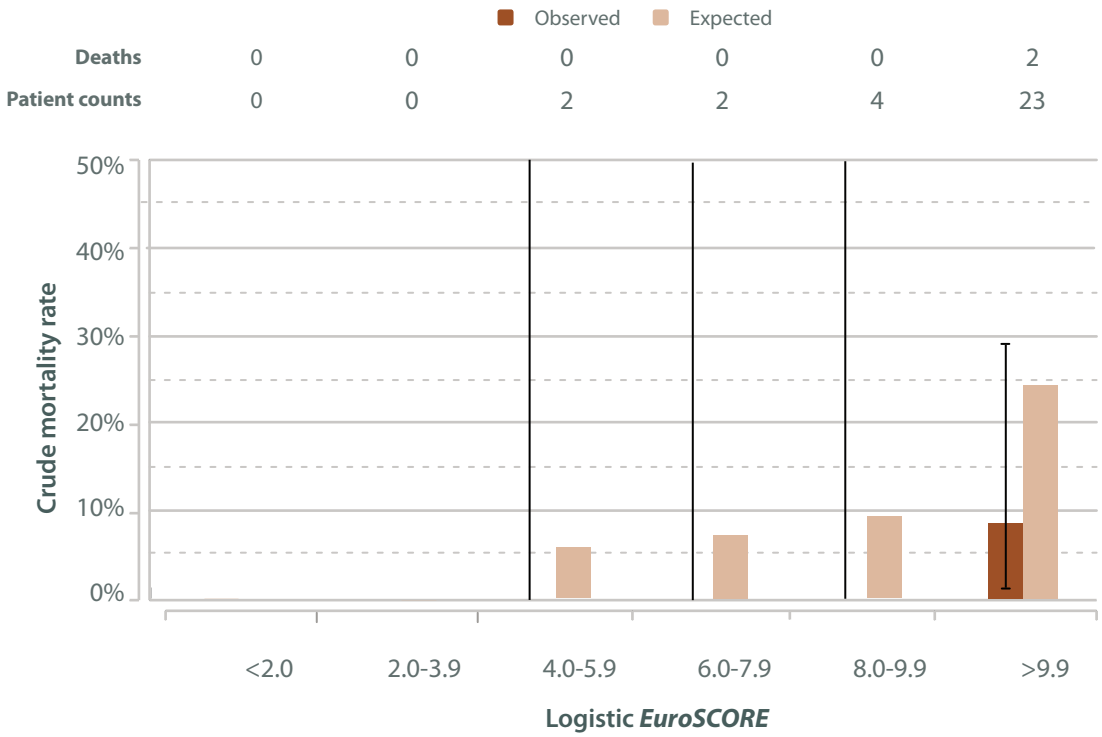
- The mean age of the patients is over 80 years, with no major change over the two years.
- This indicates that there has been no major change in the selection of patients between TAVI and surgical aortic valve replacement.



Mortality and morbidity

- Logistic EuroSCORE was high in a greater proportion of patients.
- This implies that among aortic stenosis patients, TAVI is offered mostly to high-risk patients, whereas the lower risk patients are still treated surgically.
- The rate of cerebrovascular accident was 6.4% (2/31), cardiac tamponade was 3.2%(1/31)
- Overall mean Logistic EuroSCORE for this group was 20.18 ± 13.0.
- Overall in-hospital mortality was 6.4% (2/31).

TAVI: Logistic *EuroSCORE* and mortality (n=31)



Part 2: Congenital cardiac surgery

Congenital cardiac surgery

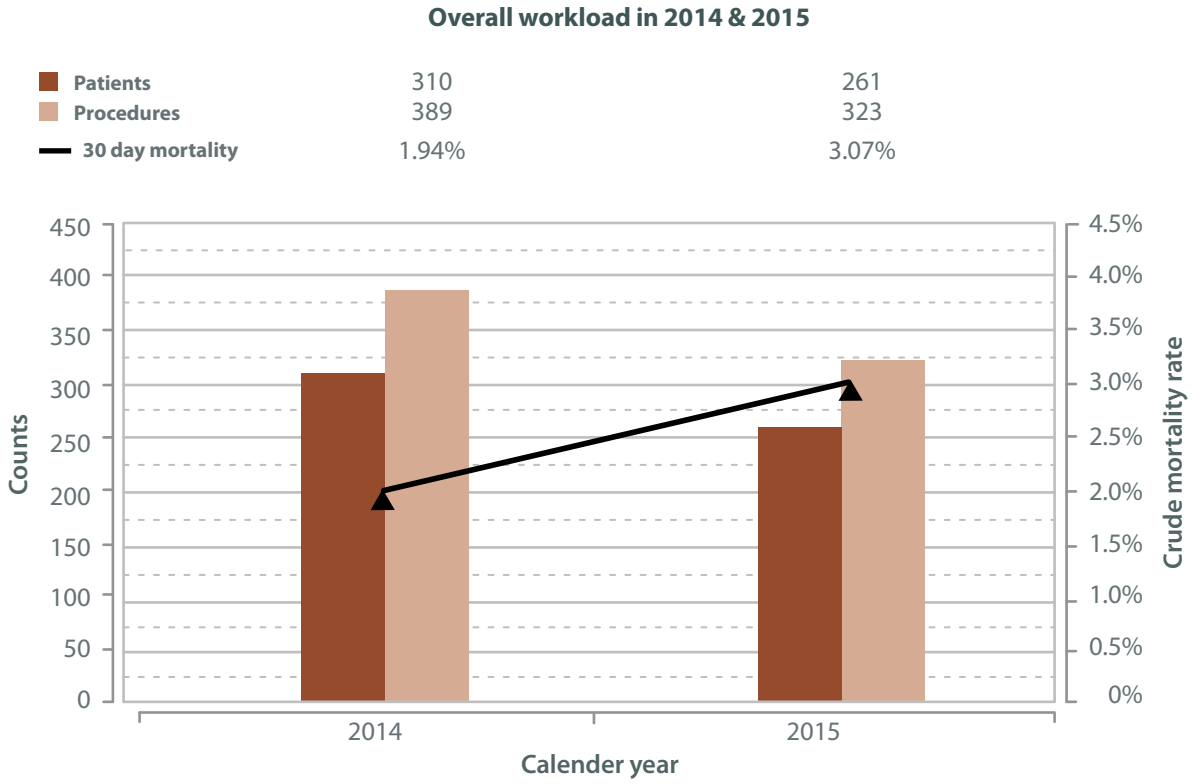
Database overview: Congenital cardiac surgery

- The paediatric and congenital cardiac surgical programme started in1967 in this unit. It is an important proportion of work at the Department of Cardiothoracic Surgery, Queen Mary Hospital now.
- We have always strived to improve patient safety and outcomes. One way we achieved this is by participating in the EACTS Congenital Heart Database , now under the name and under the flag of ECHSA, the organization that has been behind the database over the years.
- This database, one of the largest congenital heart databases in the world, offers an excellent platform for systematic data collection under a standard nomenclature (International Paediatric and Congenital Cardiac Code, IPCCC), and provides risk stratification tools (e.g. Aristotle Basic Complexity Score and Level) for benchmarking.
- This database provides a detailed report of our heart surgery program and compares our performance to other programs in the world. The data presented in this section is obtained directly from the data reports provided by the ECHSA Congenital Heart Surgery Database.
- Paediatric and adult patients undergoing congenital cardiac surgery in Queen Mary Hospital between 2014-2015 are included in this report.

The Overall Workload

Workload by year

- Overall 712 procedures were performed on 563 patients in the year 2014 and 2015 at QMH with a mean 30-day mortality of 2.49%. Total volumes of congenital cardiac surgery decreased by approximately 11% compared to the previous two years.



Workload by procedure category

- Open heart surgery accounted for about 2/3 of the workload in QMH. This is consistent with our previous report. The proportion was lower than that in the EACTS database.

Workload by procedure category

		Data		
		Count	Proportion	Proportion in the EACTS Database
Procedure Category	Open heart surgery	427	60.0%	74.2%
	Closed heart surgery	223	31.3%	19.0%
	Thoracic surgery	43	6.0%	3.2%
	ECMO (post-cardiotomy)	18	2.5%	2.0%
	VAD	1	0.1%	0.1%
	All	**712**		

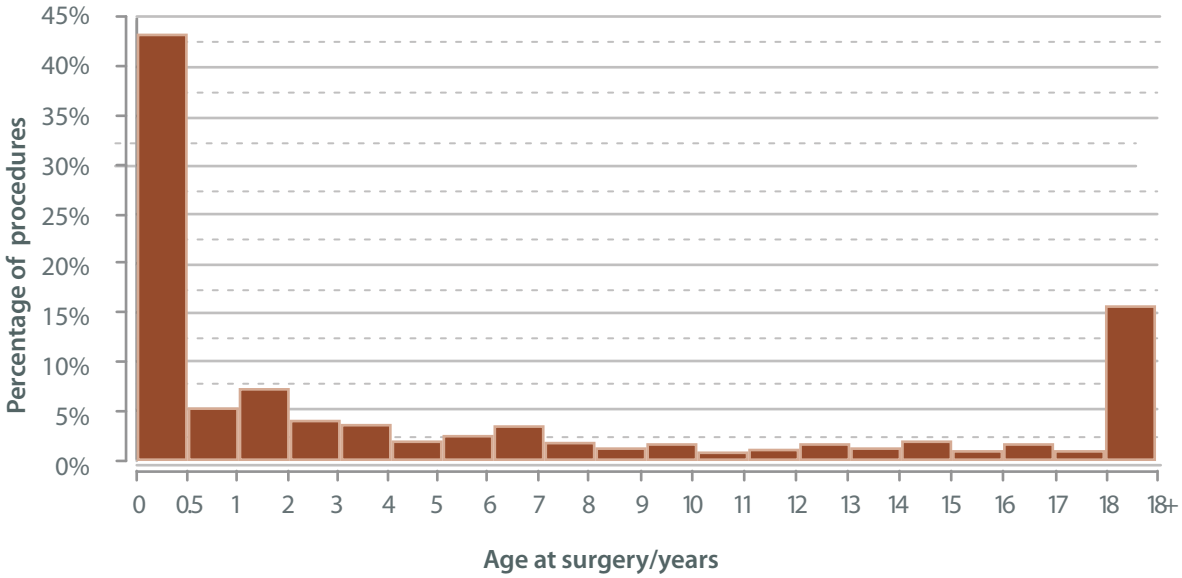
Workload by age Group

- Patients with congenital heart disease from birth through adulthood are operated upon in QMH.
- The most common age of congenital heart surgery is at age level 1-18 year (39.1%).
- Nearly 50% of the operations were performed on patients below 1 year of age.
- The proportion of the number of neonatal surgeries at QMH (21.3%) was higher than that in the EACTS database (15.3%).
- Adult congenital heart surgery contributed a considerable proportion (15.6%) of the workload at QMH.

Workload By age group

		Data		
		Count	Proportion	Proportion in the EACTS Database
Age group	Neonates (0-30 days)	152	21.3%	15.3%
	Infants (31-365 days)	193	27.1%	35.2%
	Children (1-18 years)	256	36.0%	39.1%
	Adults (>18 years)	111	15.6%	10.4%

Histogram of age at operation



Demographic and perioperative data

- In QMH, the average post-operative ventilation support time was 41 hours (1.7 days), which was much shorter than that in the EACTS Database (68.79 hours or 2.8 days). This is consistent with our previous report.

Demographic and perioperative data and data by procedure category

		Overall	
		QMH	EACTS
Mean value	Age at operation (months)	98.73	78.02
	Weight at operation (kg)	18.93	17.71
	Post-op ventilation time (hours)	41.01	68.79
	Length of stay (days)	16.24	14.04
	Total CPB time (min)	117.54	104.76
	Total aortic cross-clamp time (min)	74.5	60.67

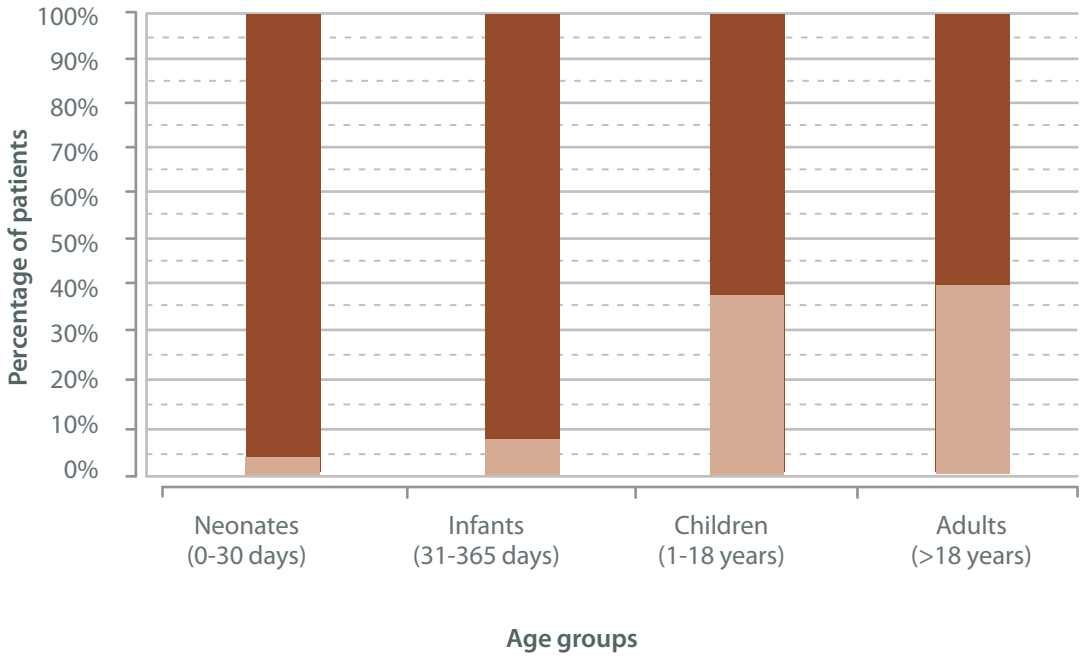
Previous cardiac surgery

Previous cardiac surgery within age groups

- Overall 23.6% of the patients had undergone previous cardiac surgery.
- In the under 1 year age group treated between 2012 and 2013, 26% had previously undergone surgery compared to 11.6% seen in this report.
- In adult congenital heart surgery about 41% of the patients had previous cardiac surgery done signifying that most of the adult congenital heart surgeries are related to surgeries performed in early life.
- For children aged between 1 and 18 years, 39.4% had undergone at least one cardiac surgical procedure which is consistent with the previous report (40.8%).

Previous cardiac surgery: Age groups

	Neonates (0-30 days)	Infants (31-365 days)	Children (1-18 years)	Adults (>18 years)
Previous surgery	6	15	101	46
Total procedures	152	193	256	111
Rate	3.9%	7.7%	39.4%	41.4%



List of primary diagnosis, primary procedures and complications in QMH, 2014-2015

Primary diagnosis

- To get a better understanding of the variety of diagnoses present in congenital cardiac surgery in QMH, the table lists the most frequent primary diagnoses with the number of cases and their proportion.
- The diagnosis listed in the table was the patient's most important or the primary diagnosis.
- Consistent with the previous report Patent ductus arteriosus, VSD (Perimembranous) and ASD (Secundum) were the three most frequent congenital heart defects at QMH.

25 most frequent primary cardiac diagnosis in QMH , 2014-2015

Primary diagnosis	Count	Proportion
Patent ductus arteriosus	95	16.8%
VSD, Type 2 (Perimembranous) (Paramembranous) (Conoventricular)	81	14.4%
ASD, Secundum	50	8.8%
VSD, Type 1 (Subarterial) (Supracristal) (Conal septal defect) (Infundibular)	38	6.7%
TOF, Pulmonary stenosis	29	5.1%
Coarctation of aorta	24	4.3%
Pulmonary insufficiency	15	2.6%
AVC (AVSD), Partial (incomplete) (PAVSD) (ASD, primum)	12	2.1%
Pulmonary atresia, VSD (Including TOF, PA)	13	2.3%
TGA, IVS	11	2.0%
Pulmonary stenosis, Valvar	9	1.5%
Pulmonary atresia, IVS	9	1.6%
Pulmonary atresia, VSD-MAPCA (pseudotruncus)	7	1.2%
Ebstein's anomaly	7	1.2%
Partial anomalous pulmonary venous connection (PAPVC)	7	1.2%
Single ventricle, Tricuspid atresia	6	1.1%
Cardiac tumor	6	1.1%
Aortic stenosis, Supravalvar	6	1.1%
AVC (AVSD), Complete (CAVSD)	5	0.8%
TGA, VSD	5	0.8%
Total anomalous pulmonary venous connection (TAPVC), Type 1 (supracardiac)	4	0.7%
Arrhythmia, Heart block, Acquired	3	0.5%
Interrupted aortic arch	3	0.5%
Coronary artery anomaly, Anomalous pulmonary origin (includes ALCAPA)	2	0.4%
Diaphragm disease, Other	1	0.1%

Primary procedures

- The following table lists the top 25 procedures by quantity undertaken for congenital heart disease between 2014-2015.
- It does not equate to the number of patients, as a proportion of patients will have had more than one procedure during this two year period.
- The top 25 procedures accounted for 72% of the workload.
- VSD repair and PDA closure remain the most frequent procedures consistently over past four years.

25 most frequent primary cardiac procedures in QMH , 2014-2015

Primary procedure	Count	Proportion	ABC score
VSD repair, Patch	118	16.5%	6.0
PDA closure, Surgical	97	13.6%	3.0
Mediastinal exploration	40	5.6%	1.5
ASD repair, Patch	33	4.6%	3.0
Valvuloplasty, Mitral	20	2.8%	8.0
Fontan, TCPC, External conduit, Fenestrated	18	2.5%	9.0
PA, reconstruction (plasty), Branch, Peripheral	15	2.1%	8.8
TOF repair, Ventriculotomy, Transanular patch	14	2.0%	8.0
Valve replacement, Pulmonic (PVR)	14	2.0%	6.5
Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS)	13	1.8%	6.3
ECMO cannulation	13	1.8%	6.0
ECMO decannulation	12	1.7%	6.0
Pericardial drainage procedure	12	1.7%	3.0
Arterial switch operation (ASO)	11	1.5%	10.0
ASD repair, Primary closure	11	1.5%	3.0
Coarctation repair, End to end	11	1.5%	6.0
RVOT procedure	11	1.5%	6.5
Coarctation repair, End to end, Extended	10	1.4%	8.0
Thoracic and/or mediastinal procedure, Other	10	1.4%	-
Valve replacement, Aortic (AVR), Mechanical	9	1.3%	7.0
TAPVC repair	8	1.1%	9.0
Fontan revision or conversion (Re-do Fontan)	7	1.0%	12.5
TOF repair, Ventriculotomy, Nontransanular patch	7	1.0%	7.5
Valvuloplasty, Tricuspid	6	0.8%	7.0
Conduit placement, RV to PA	6	0.8%	7.5

Common post operative events/ major complications

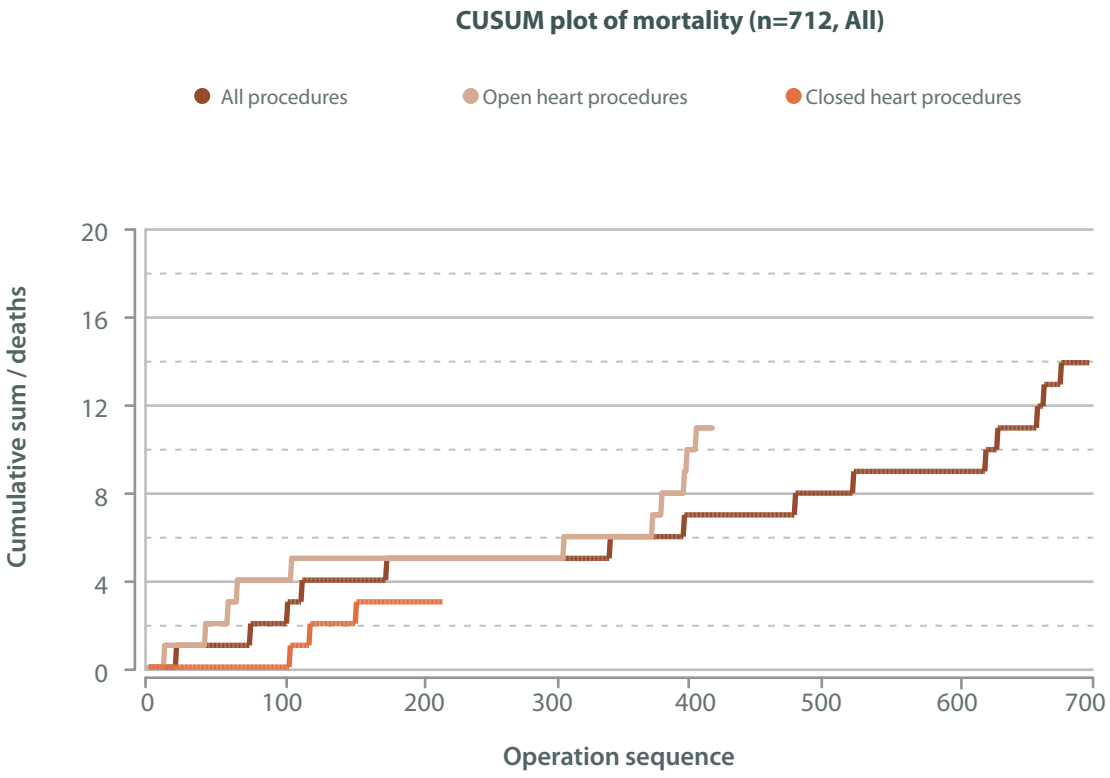
- The following table lists the common post-operative events and major complications.
- A total of 419 complications were observed in 161 patients. The most frequent complication was a sternum which was left open in 11.4 % of the patients (n=48).
- Mechanical circulatory support, such as ECMO, is another vital component when attempting to reduce mortality in patients undergoing congenital heart surgery. In QMH 15 patients needed ECMO in the early post-operative period due to cardiac arrest or low cardiac output. One patient was bridged from ECMO to Berlin Heart EXCOR®, Pediatric Ventricular Assist Device.
- Other frequent complications are listed below.

Postoperative event/complication details

		Data	
		Count	Event/ Complication rate
Post operative event/major complication	Sternum left open, Planned	48	11.4%
	Acute renal failure requiring temporary dialysis	43	10.2%
	Cardiac dysfunction resulting in low cardiac output	38	9.0%
	Pneumonia	36	8.5%
	Bleeding requiring re-operation	33	7.8%
	Arrhythmia necessitating temporary pacemaker	19	4.5%
	Sepsis	19	4.5%
	Pericardial effusion requiring drainage	17	4.0%
	Postoperative/Post-procedural mechanical circulatory support (IABP, VAD, ECMO)	15	3.5%
	Pneumothorax requiring intervention	14	3.3%
	Neurological deficit	14	3.3%
	Pleural effusion requiring drainage	12	2.8%
	Arrhythmia requiring drug therapy	10	2.3%
	Cardiac arrest (MI) during or following procedure	9	2.1%
	Postoperative/Post-procedural respiratory insufficiency requiring re-intubation	9	2.1%
	Pulmonary hypertensive crisis	9	2.1%
	Arrhythmia	8	1.9%
	Vocal cord dysfunction	8	1.9%

Cumulative sum(CUSUM) plot of mortality

- The cumulative sum (CUSUM) technique is a method of graph plotting of an accumulation of events [in-hospital mortality] over time.
- Cumulative risk-adjusted mortality plot provides a visual representation of the performance against the expected outcome rate of a particular risk scoring protocol.
- Observed CUSUM mortality plot allows the detection of trends and corrective actions and it provides an excellent audit to surgeons and hospital administrators.
- There were no indications of odd results in the CUSUM plot for Queen Mary Hospital.



Risk stratification

Complexity Score benchmarking

- To compare performance of congenital heart surgery , the Society of Thoracic Surgeons (STS) assigned scores for each surgical procedure based on the potential for mortality, the potential for morbidity, and surgical difficulty.
- The mean ABC score in QMH was lower than that in the EACTS database; the overall mortality at QMH in eligible patients was also lower than that in the EACTS database.

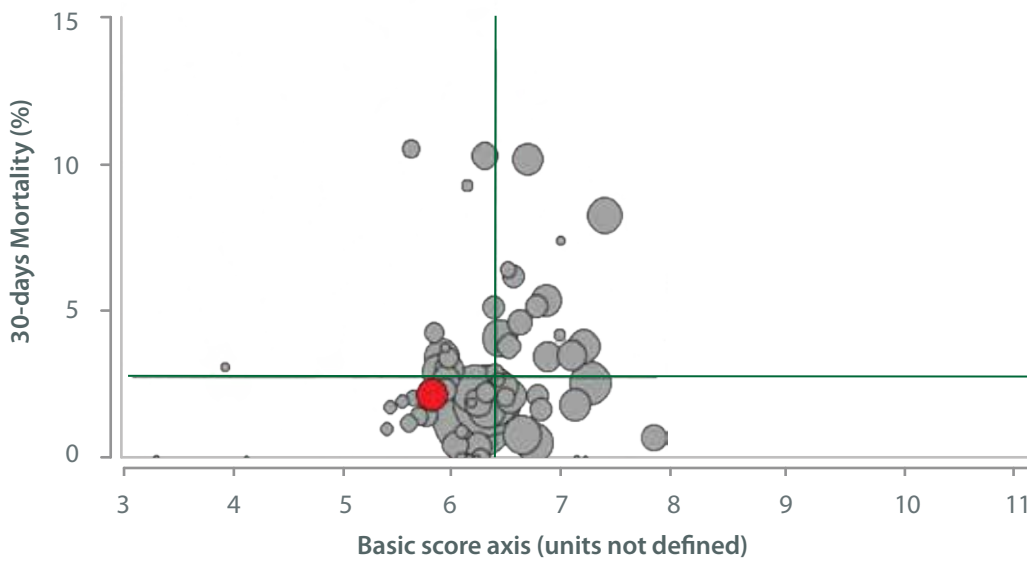
Complexity score and mortality 2014-2015

		Procedure count		Mortality		ABC score	
		All	Eligible*	QMH	EACTS	QMH	EACTS
Year	2014	389	337	1.9%	3.2%	5.8	6.9
	2015	323	280	3.0%	2.3%	5.9	6.8
	All	**712**	**617**	**2.4%**	**2.8%**	**5.9**	**6.9**

* Eligible procedures refer to the procedures with ABC scores.

- The bubble chart is a scatter chart showing a centre's performance in terms of mortality of the EACTS database.
- Every bubble represents one centre, with larger bubbles indicating a larger volume of the centre. The size of the QMH bubble suggests that the population is of considerable size in comparison to other centres.
- The green lines show the mean values in the EACTS database.
- The red bubbles relating to the QMH performances of each year located in the left lower quadrant, show a satisfactory performance . This figure reveals that the QMH population has an below average mortality and patient and procedural complexity.

International comparison of mortality rate and complexity score



Observed versus expected (O/E) mortality

- The overall mortality O/E ratio in QMH, 2014-2015 was 0.80, indicating a better outcome than expected.
- Operations were analysed taking into account the complexity of the patients. This tells us how well we are performing as compared to other hospitals by reporting whether our patient survival is better or worse than expected given how complex the patients are at QMH.
- The observed number of surgical mortalities at QMH is less than the expected number of mortalities given the complexity of the patients we are operating on.

Mortality O/E ratio by year

		Count			O/E ratio calculation		
		All procedures	Eligible procedures*	Eligible deaths**	Observed mortality	Expected mortality	O/E Ratio
Year	2014	389	337	6	1.9%	2.9%	0.65
	2015	323	280	7	3.0%	3.2%	0.90
	All	**712**	**617**	**13**	**2.4%**	**3.0%**	**0.80**

* Eligible procedures refer to procedures with expected mortalities.
**Eligible deaths refer to deaths occurring within the eligible procedures.

Mortality O/E ratio by age group

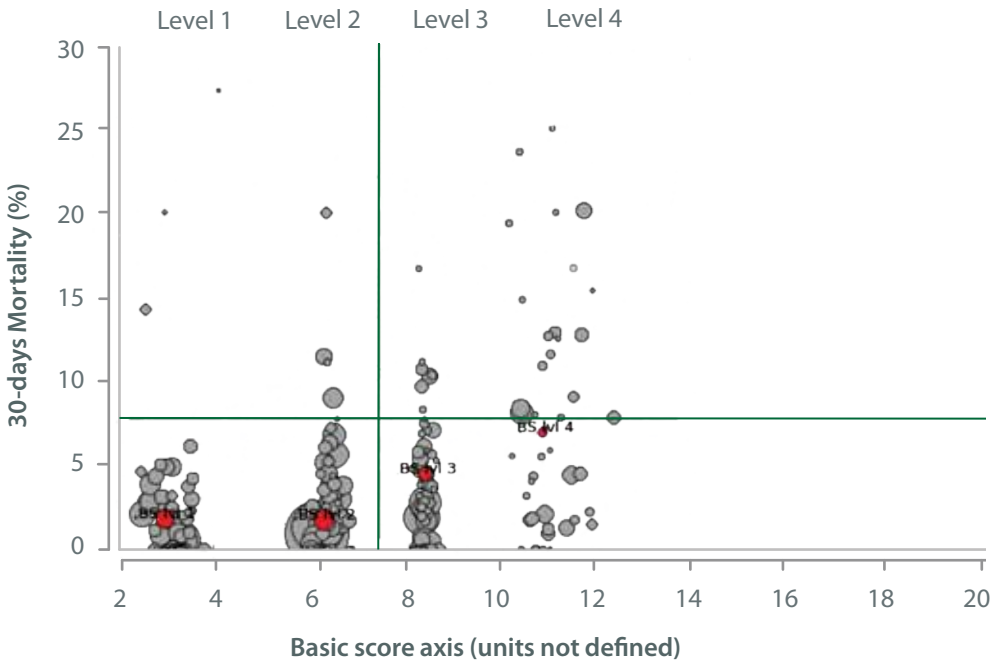
		Count			O/E ratio calculation		
		All procedures	Eligible procedures*	Eligible deaths**	Observed mortality	Expected mortality	O/E Ratio
Age group	Neonates (0-30 days)	152	122	7	6.41%	3.08%	2.0
	Infants (31-365 days)	193	173	3	1.92%	2.57%	0.74
	Children (1-18 years)	256	225	3	1.32%	3.30%	0.40
	Adults (>18 years)	111	97	1	1.10%	3.40%	0.32

*Eligible procedures refer to procedures with expected mortalities.
**Eligible deaths refer to deaths occurring within the eligible procedures

Risk adjusted mortality

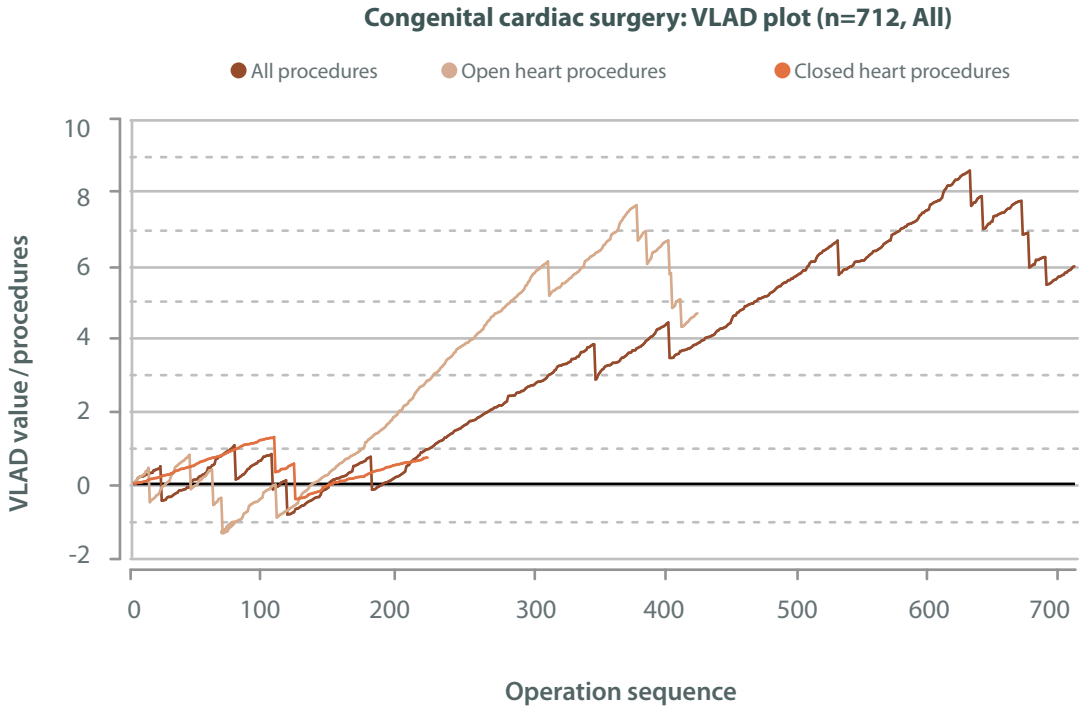
- This bubble chart shows the performances of the procedures with different risk levels according to the ABC scores.
- The ABC score allocates a basic score to each operation varying from 1.5-15, in addition each procedure is also assigned an ABC level, an integer from 1 to 4 (see appendix).
- ABC level 1 and level 2 procedures contributed to 68% of congenital cardiac procedures at QMH.
- ABC level 3 and level 4 procedures contributed to 22% of congenital cardiac procedures at QMH.
- Procedures like heart transplantation, VAD implantation, re-exploration for bleeding *etc.* which formed 10% of the procedures could not be assigned ABC score and ABC level.
- At QMH the mortality for all the four ABC levels was well below the EACTS mean mortality rate. In 2012 QMH mortality rate for ABC level 4 was higher than the EACTS mean rate.

International comparison of mortality rate and procedures by Basic Score Levels



Variable Life -Adjusted Display (VLAD) plot of risk adjusted mortality

- The following Variable Life-Adjusted Display (VLAD) graph covers all risk-scored procedures performed during 2014 and 2015.
- If the 30-day outcome is a survival then the VLAD plot goes up and if it is a death the VLAD plot goes down.
- A run of survivors will cause the VLAD plot to go up and a run of deaths will cause it to go down.
- Overall 6 extra lives had been saved at Queen Mary Hospital in 2014-2015 compared to 9 lives saved in 2012-2013.



Age group- Volume and Outcomes

Neonates (0-30 days)

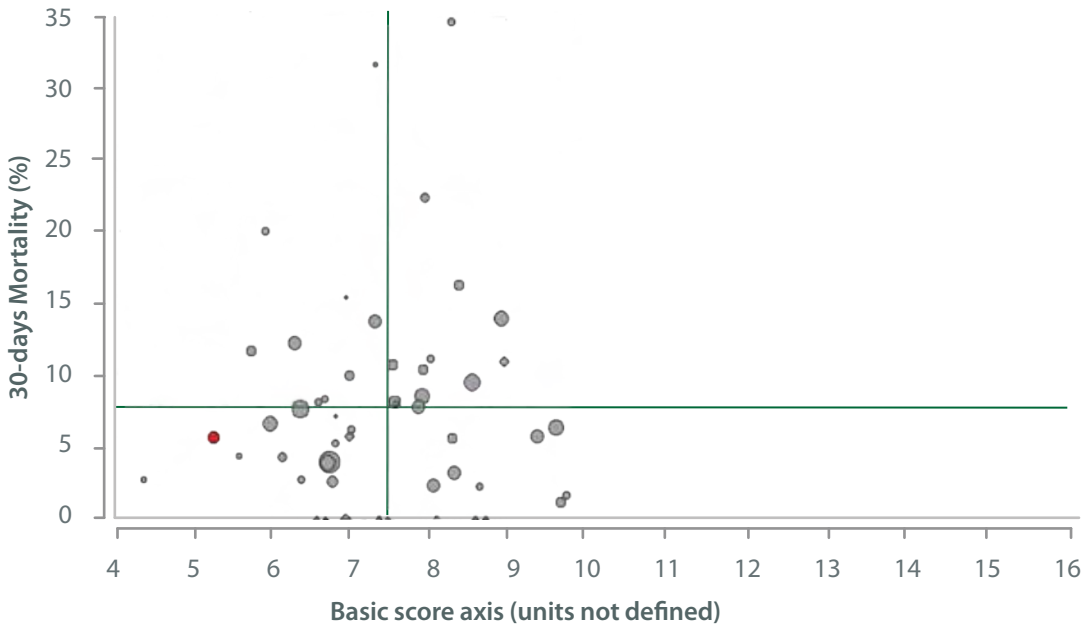
5 most frequent primary diagnosis in neonates

		Data	
		Count	Proportion
Diagnosis	Patent ductus arteriosus	49	45.3%
	Coarctation of aorta	17	15.7%
	TGA, IVS	10	9.2%
	Total anomalous pulmonary venous connection (TAPVC), Type 3 (infracardiac)	3	2.7%
	TOF, Pulmonary stenosis	3	2.7%

5 most frequent primary procedures in neonates

		Data		
		Count	Proportion	ABC score
Procedures	PDA closure, Surgical	52	34.2%	3
	Coarctation repair, End to end	19	12.5%	8
	Mediastinal exploration	16	10.5%	-
	Arterial switch operation (ASO)	11	7.2%	10
	Shunt, Systemic to pulmonary, Modified Blalock-Taussig Shunt (MBTS)	7	4.6%	6.3

Mortality and complexity benchmarking in neonates



Infants (31-365 days)

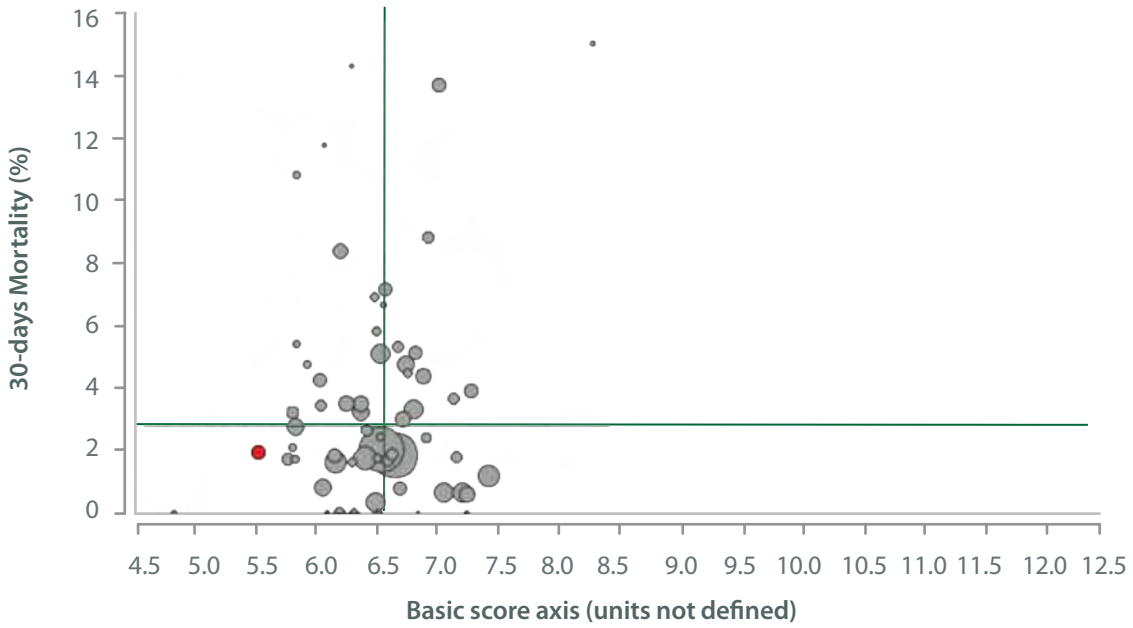
5 most frequent primary diagnosis in infants

		Data	
		Count	Proportion
Diagnosis	VSD, Type 2 (Perimembranous) (Paramembranous)	54	34.6%
	Patent ductus arteriosus	42	26.9%
	Coarctation of aorta	9	5.7%
	TOF, Pulmonary stenosis	7	4.4%
	AVC (AVSD), Complete (CAVSD)	5	3.2%

5 most frequent primary procedures in infants

		Data		
		Count	Proportion	ABC score
Procedures	VSD repair, Patch	69	35.7%	6
	PDA closure, Surgical	42	21.7%	3
	Mediastinal exploration	8	4.1%	-
	Valvuloplasty, Mitral	8	4.1%	8
	Modified Blalock-Taussig Shunt (MBTS)	5	2.5%	6.3

Mortality and complexity benchmarking in infants



Children (1-18 years)

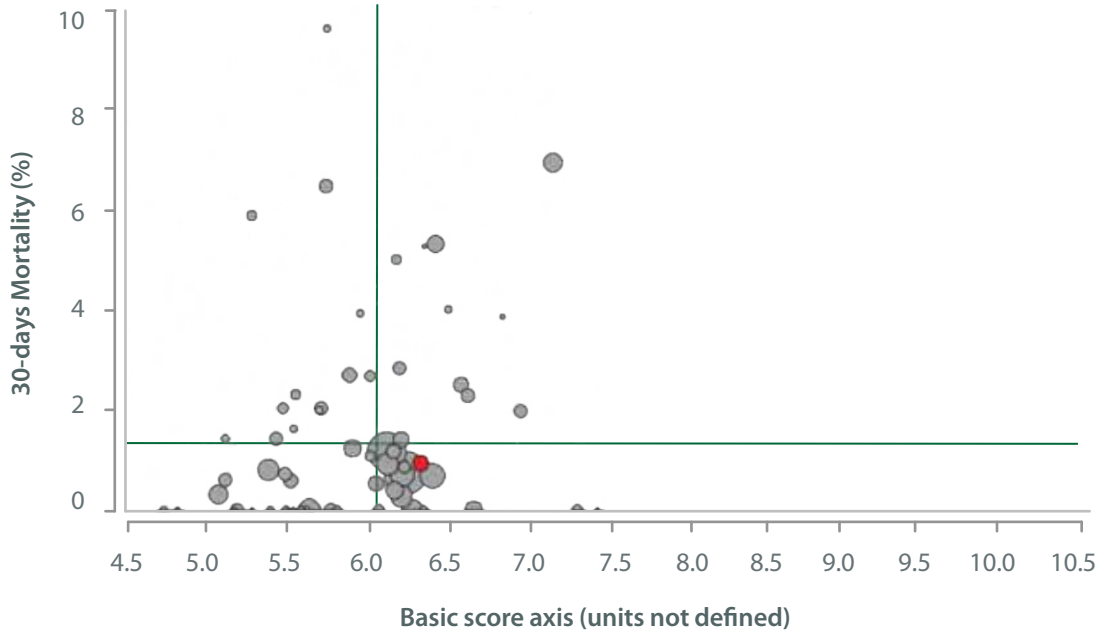
5 most frequent primary diagnosis in children

		Data	
		Count	Proportion
Diagnosis	ASD, Secundum	35	13.6%
	VSD, Type 1 (Subarterial) (Supracristal) (Conal septal defect) (Infundibular)	22	9.7%
	VSD, Type 2 (Perimembranous) (Paramembranous) (Conoventricular)	21	9.2%
	TOF, Pulmonary stenosis	18	7.0%
	Pulmonary atresia, VSD (Including TOF, PA)	8	3.5%

5 most frequent primary procedures in children

		Data		
		Count	Proportion	ABC score
Procedure	VSD repair, Patch	39	15.2%	6.0
	ASD repair, Patch	26	10.1%	3.0
	Fontan, TCPC, External conduit, Fenestrated	18	7.0%	9.0
	TOF repair, Ventriculotomy, Transanular patch	12	4.6%	8.0
	PA, reconstruction (plasty), Branch, Peripheral	10	3.9%	8.8

Mortality and complexity benchmarking in children



Adults (18 years or above)

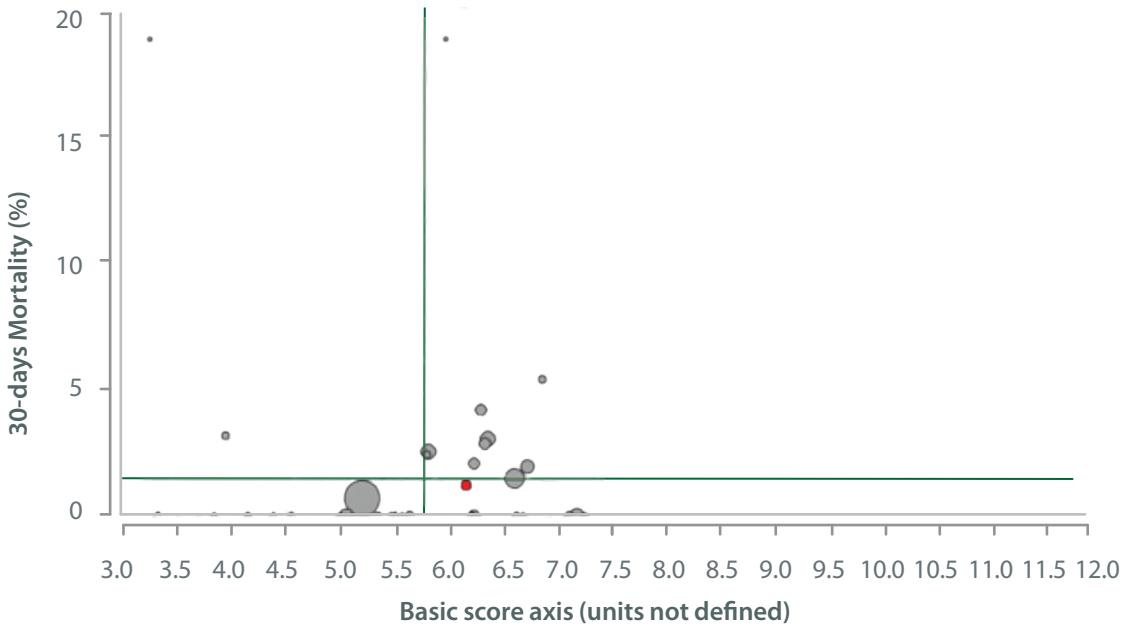
5 most frequent primary diagnosis in adults

		Data	
		Count	Proportion
Diagnosis	Pulmonary insufficiency	15	17.6%
	ASD, Secundum	14	16.4%
	VSD, Type 1 (Subarterial) (Supracristal) (Conal septal defect)	7	8.2%
	AVC (AVSD), Partial (incomplete) (PAVSD) (ASD, primum)	5	5.8%
	VSD, Type 2 (Perimembranous) (Paramembranous)	4	4.7%

5 most frequent primary procedures in adults

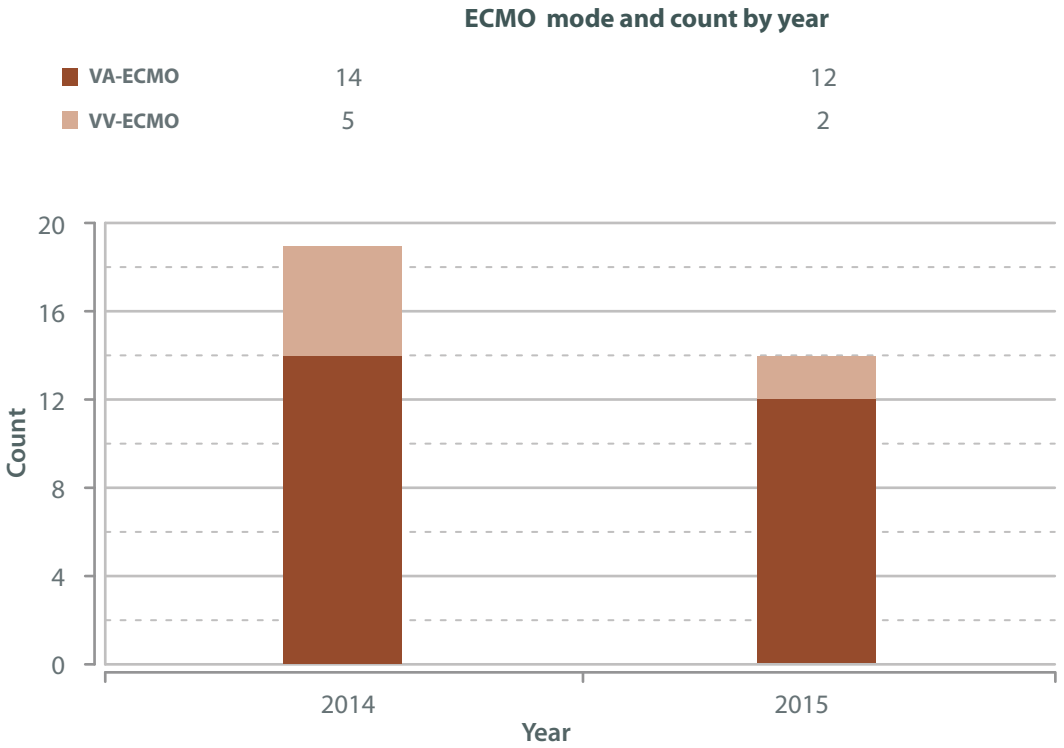
		Data		
		Count	Proportion	ABC score
Procedure	Valve replacement, Pulmonic (PVR)	14	12.6%	6.5
	Mediastinal exploration	8	7.2%	-
	ASD repair, Patch	7	6.3%	3
	Valve replacement, Aortic (AVR), Mechanical	7	6.3%	7
	VSD repair, Patch	6	5.4%	6

Mortality and complexity benchmarking in adults



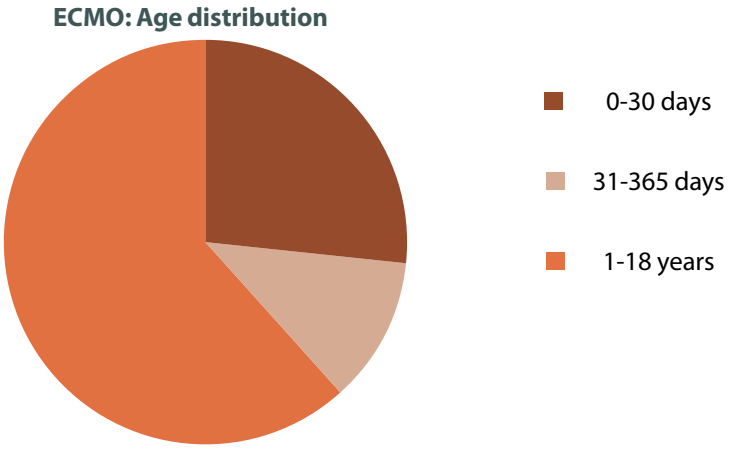
Paediatric Extracorporeal Membrane Oxygenation Program in QMH

- ECMO has been developed for use in patients with respiratory or cardiac failure.
- ECMO program started with treating post-cardiotomy, low cardiac output patients in 2000 at Grantham Hospital.
- In line with provision of ECMO becoming standard for centres performing paediatric cardiac surgery, use of ECMO in this cardiac surgical population has increased in QMH.
- Paediatric ECMO program includes patients <=18 yrs of age supported with extracorporeal membrane oxygenation.
- During 2014-2015, 33 ECMO runs were provided to 26 children. Seven children (28 %) had >1 ECMO runs.
- ECMO was provided with a goal of bridging these children to recovery or to other implantable device or heart transplantation.
- Severe cardiorespiratory failure associated with a diagnosis of myocarditis, sepsis, post-cardiotomy or cardiac medical conditions with hemodynamic instability were supported with venoarterial ECMO (VA-ECMO)(26/33).
- Severe respiratory failure due to respiratory infection were supported with venovenous ECMO (VV-ECMO)(7/33) except for one case of pneumonia with cardiac arrest which was supported with VA-ECMO and was later changed to VV-ECMO.



Age distribution

- 61.5% (16/26) of the paediatric cases supported with ECMO were between 1-18 years. Acute myocarditis, severe respiratory failure due to pneumonia and cardiac condition resulting in hemodynamic instability were the main etiologies for ECMO support. 13 received VA-ECMO and 3 VV-ECMO.
- 26.9% (7/26) were neonates and all received VA-ECMO support for post cardiotomy hemodynamic instability or for failure to wean off Cardiopulmonary Bypass (CPB).
- 11.5% (3/26) were infants . 2 were post cardiotomy with hemodynamic instability supported with VA-ECMO and 1 was respiratory failure due to pneumonia provided with VV-ECMO.



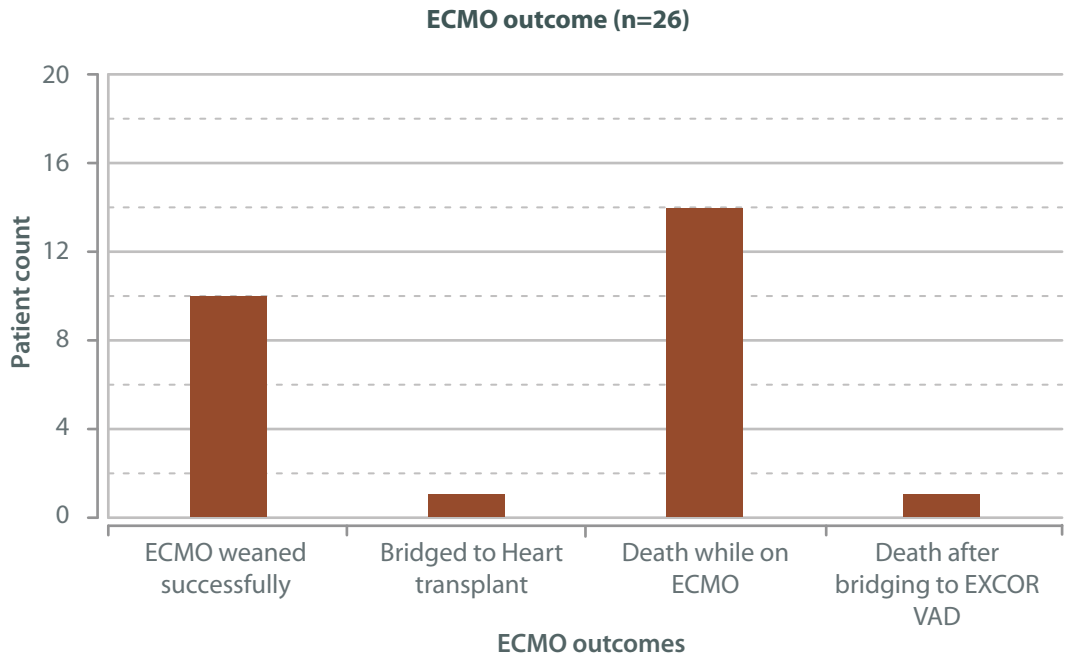
Indication for ECMO support

- In QMH cardiogenic shock of all etiologies for which stable hemodynamics could not be maintained by conventional therapy and severe respiratory failure for which arterial oxygen saturation could not be maintained by mechanical ventilatory support were the main indications for ECMO support.
- ECMO was used for children in QMH for wide spectrum of different etiologies.

Indication for ECMO		Data		
		Count	Proportion	Mortality
Indication	Post-cardiotomy	14	48%	71.4%
	Hemodynamic instability	12		
	Failure weaning from cardiopulmonary bypass	2		
	Acute myocarditis	3	16%	0%
	Respiratory failure due to infection	5	20%	40%
	Cardiac medical condition with hemodynamic collapse	2	8%	50%
	Septic shock	1	4%	100%
	Congenital Diaphragmatic Hernia	1	4%	0%

ECMO outcomes

- Overall 10 (38.4%) were successfully weaned off ECMO.
- One (3.8%) was successfully bridged to heart transplant.
- One (3.8%) was unsuccessfully bridged to Berlin Heart EXCOR®, Pediatric Ventricular Assist Device.
- Fourteen patients died (53.8%) (13 died while on ECMO and 1 died after successful weaning off ECMO).
- No mortality was seen for patients with acute fulminant myocarditis requiring ECMO.
- Viral pneumonia associated respiratory failure requiring ECMO showed a mortality of 7.6% (2/26).
- For postcardiotomy cardiogenic shock patients supported with ECMO mortality rate was 38.4% (10/26).
- Cardiac medical condition with hemodynamic collapse had a mortality rate of 3.8% (1/26, Dysplastic mitral valve with mitral regurgitation resulting in heart failure).
- Overall survival rate for Paediatric ECMO was 46.1% (12/26).




5 C翼
Wing C5
A5，B5翼
Wings A5 & B5
C5心肺外科病房
C5 Cardiothoracic Surgical Ward
D5心肺外科病房
D5 Cardiothoracic Surgical Ward
E5心肺外科深切治療部
E5 Cardiothoracic Surgical Intensive Care Unit
F5手術大樓
Wing F5 Operating Theatres
降機

Appendices

Appendices

Appendix 1

Adult cardiac database- Database form

Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 1; Version 1.1

Patient identification and demographics

Hospital number		**Date of birth**	dd / mm / yyyy
Given name		**Date / time of operation**	dd / mm / yyyy hh:mm
Family name		**Gender**	○ 1. Male ○ 2. Female

Admission details & cardiac history

Date of referral	dd / mm / yyyy	**Outpatient clinic**	select from list
Date of admission	dd / mm / yyyy		

Admission category
- ○ 1. Health Authority
- ○ 2. Private

Mode of admission
- ○ 1. Elective
- ○ 2. Planned inpatient transfer
- ○ 3. Emergency

Angina status pre-surgery
- ○ 0. No angina
- ○ 1. No limitation of physical activity
- ○ 2. Slight limitation of ordinary activity
- ○ 3. Marked limitation of ordinary physical activity
- ○ 4. Symptoms at rest or minimal activity

Dyspnoea status pre-surgery
- ○ 1. No limitation of physical activity
- ○ 2. Slight limitation of ordinary activity
- ○ 3. Marked limitation of ordinary physical activity
- ○ 4. Symptoms at rest or minimal activity

Congestive cardiac failure
- ○ 0. Never
- ○ 1. In the past
- ○ 2. Now

Symptom status
- ○ 1. Stable
- ○ 2. Unstable / recent deterioration

Number of previous MIs
- ○ 0. None
- ○ 1. One
- ○ 2. Two or more
- ○ 9. Unknown

Interval between surgery and last MI
- ○ 0. No previous MI
- ○ 1. MI < 6 hours
- ○ 2. MI 6-24 hours
- ○ 3. MI 25-48 hours
- ○ 4. MI 2-30 days
- ○ 5. MI 31-90 days
- ○ 6. MI > 90 days

Previous interventions

Previous PCI
- ○ 0. No previous PCI
- ○ 1. PCI < 24 hours before surgery
- ○ 2. PCI > 24 hours before surgery; same admission
- ○ 3. PCI > 24 hours before surgery; previous admission

Date of last PCI dd / mm / yyyy

Previous cardiac surgery
- ○ 0. No previous cardiac surgery
- ☐ 1. CABG
- ☐ 2. Valve
- ☐ 3. Congenital cardiac
- ☐ 4. Other cardiac
- ☐ 5. Aortic - ascending / arch
- ☐ 6. Aortic - descending / abdominal
- ☐ 7. Other thoracic
- ☐ 8. Carotid endarterectomy
- ☐ 9. Other peripheral vascular

Date of last cardiac operation dd / mm / yyyy

This form is designed so that questions requiring a single response-option are identified with round radio-buttons next to the options, whereas questions where more than one response option may be selected are identified by square tick boxes next to the options

Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 2; Version 1.1

Hospital number _____ **Date of surgery** dd / mm / yyyy

Previous interventions

Previous PCI
- ○ 0. No previous PCI
- ○ 1. PCI < 24 hours before surgery
- ○ 2. PCI > 24 hours before surgery; same admission
- ○ 3. PCI > 24 hours before surgery; previous admission

Date of last PCI dd / mm / yyyy

Previous cardiac surgery
- ○ 0. No previous cardiac surgery
- ☐ 1. CABG
- ☐ 2. Valve
- ☐ 3. Congenital cardiac
- ☐ 4. Other cardiac
- ☐ 5. Aortic - ascending / arch
- ☐ 6. Aortic - descending / abdominal
- ☐ 7. Other thoracic
- ☐ 8. Carotid endarterectomy
- ☐ 9. Other peripheral vascular

Date of last cardiac operation dd / mm / yyyy

Risk factors for acquisition of coronary disease

Diabetes
- ○ 0. Not diabetic
- ○ 1. Diet
- ○ 2. Oral therapy
- ○ 3. Insulin

Cigarette smoking history
- ○ 0. Never smoked
- ○ 1. Ex smoker
- ○ 2. Current smoker

Hypercholesterolaemia
- ○ 0. No
- ○ 1. Yes

History of hypertension
- ○ 0. No hypertension
- ○ 1. Treated or BP>140 / 90 on >1 occasion prior to admission
- ○ 9. Unknown

Family history of IHD
- ○ 0. No
- ○ 1. Yes

Renal function / dialysis
- ○ 0. None
- ☐ 1. Functioning transplant
- ☐ 2. Creatinine >200 µmol ℓ^{-1}
- ☐ 3. Dialysis for acute renal failure; onset within 6 weeks of cardiac surgery
- ☐ 4. Dialysis for chronic renal failure; onset more than 6 weeks prior to cardiac surgery
- ☐ 5. Unknown

Hyperthyroidism
- ○ 0. No
- ○ 1. Yes

History of pulmonary disease
- ○ 0. No pulmonary disease
- ☐ 1. COAD / ephysema
- ☐ 2. Asthma
- ☐ 3. Neoplasm
- ☐ 4. Infective lung disease
- ☐ 9. Other

Neurological dysfunction
- ○ 0. No
- ○ 1. Yes

Extra-cardiac arteriopathy
- ○ 0. No
- ○ 1. Yes

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 3; Version 1.1

Hospital number _____ Date of surgery dd / mm / yyyy

Additional medical history and risk factors

History of gastrointestinal disease
- ○ 0. None
- ☐ 1. Peptic ulcer disease
- ☐ 2. Malignancy
- ☐ 3. Inflammatory bowel disease
- ☐ 4. Major abdominal surgery
- ☐ 5. Other

Major abdominal surgery
- ○ 0. No
- ○ 1. Yes

Pre-operative heart rhythm
- ○ 0. Sinus rhythm
- ○ 1. Atrial fibrillation / flutter
- ○ 2. Complete heart block / pacing
- ○ 3. VF / VT
- ○ 4. Other abnormal rhythm

Saphenous vein
- ○ 0. Normal
- ☐ 1. Minor varicosites
- ☐ 2. Major varicosites
- ☐ 3. Previous varicose vein surgery
- ☐ 4. Previous DVT

Capillary refill (non-dominant hand)
- ○ 0. <5 seconds
- ○ 1. 5-10 seconds
- ○ 2. >10 seconds

Pre-operative haemoglobin _____ g $d\ell^{-1}$

Pre-operative creatinine _____ µmol ℓ^{-1}

Cardiac investigations

Left- or right-heart catheterisation
- ○ 0. Normal
- ☐ 1. Minor varicosites
- ☐ 3. Previous varicose vein surgery

Date of last catheterisation _____ dd / mm / yyyy

Extent of coronary vessel disease
- ○ 0. No vessel with >50% diameter stenosis
- ○ 1. One vessel with >50% diameter stenosis
- ○ 2. Two vessels with >50% diameter stenosis
- ○ 3. Three vessels with >50% diameter stenosis
- ○ 9. Not investigated

Left main stem disease
- ○ 0. No LMS disease or LMS disease <= 50% diameter stenosis
- ○ 1. LMS >50% diameter stenosis
- ○ 9. Not investigated

Left ventricular function _____ %

Ejection fraction category
- ○ 1. Good (LVEF > 50%)
- ○ 2. Fair (LVEF 30-50%)
- ○ 3. Poor (LVEF < 30%)
- ○ 9. Not measured

Ejection fraction estimate based upon
- ☐ 1. Left ventriculogram
- ☐ 2. Echocardiogram
- ☐ 3. MR scan
- ☐ 3. Other investigation

PA systolic _____ mm Hg

AV gradient _____ mm Hg

LVEDP _____ mm Hg

Mean PAWP LA _____ mm Hg

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 4; Version 1.1

Hospital number | Date of surgery dd / mm / yyyy

Pre-operative status and support

IV nitrates or any heparin	○ 0. Never smoked ○ 1. Until operation	○ 2. Within one week of surgery
Pre-operative aspirin [1]	○ 0. No	○ 1. Yes
Pre-operative clopidogrel [1]	○ 0. No	○ 1. Yes
Other anticoagulant	○ 0. No	○ 1. Yes
IV inotropes prior to anaesthesia	○ 0. No	○ 1. Yes
Ventilated	○ 0. No	○ 1. Yes
Cardiogenic shock	○ 0. No	○ 1. Yes

Operation data

Operative urgency	○ 1. Elective ○ 2. Urgent	○ 3. Emergency ○ 4. Salvage
Number of previous heart operations		
Responsible consultant anaesthetist	select from list	
First operator	select from list	
First operator: grade	○ 1. Consultant ○ 2. Professor ○ 3. Associate professor ○ 4. Specialist	○ 5. Associate consultant ○ 6. HST ○ 9. Other
First operator: year of HST	○ 1. Year 1 ○ 2. Year 2 ○ 3. Year 3	○ 4. Year 4 ○ 5. Year 5 ○ 6. Year 6 ○ 8. Not applicable
First assistant	select from list	
First assistant: grade	○ 1. Consultant ○ 2. Professor ○ 3. Associate professor ○ 4. Specialist	○ 5. Associate consultant ○ 6. HST ○ 9. Other
First assistant: year of HST	○ 1. Year 1 ○ 2. Year 2 ○ 3. Year 3	○ 4. Year 4 ○ 5. Year 5 ○ 6. Year 6 ○ 8. Not applicable

1. Within the last 7 days

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 5; Version 1.1

Hospital number | Date of surgery: dd / mm / yyyy

Operation data continued …

Chest opened by	select from list
IMA harvested by	select from list
Vein harvested by	select from list
Radial artery harvest by	select from list
Cannulation by	select from list
Chest closed by	select from list

Endoscopic vein harvest
- ○ 0. No
- ○ 1. Yes
- ○ 2. Converted

Endoscopic radial artery harvest
- ○ 0. No
- ○ 1. Yes
- ○ 2. Converted

Arterial cannulation
- ○ 0. Not applicable
- ☐ 1. Ascending aorta
- ☐ 2. Arch
- ☐ 3. Axillary / subclavian
- ☐ 4. Femoral
- ☐ 5. Other

Venous cannulation
- ○ 0. Not applicable
- ☐ 1. Right atrial
- ☐ 2. RA / IVC 2-stage
- ☐ 3. Bicaval
- ☐ 4. Femoral
- ☐ 5. Other

Procedures classified by group

Cardiac procedures
- ○ 1. CABG alone
- ○ 2. CABG & valve
- ○ 3. CABG, valve & other
- ○ 4. CABG & other
- ○ 5. Valve alone
- ○ 6. Valve & other
- ○ 7. Other

Other cardiac procedures
- ○ 0. None
- ☐ 1. LV aneurysmectomy
- ☐ 2. Acquired VSD
- ☐ 3. Atrial myxoma
- ☐ 4. Pulmonary embolectomy
- ☐ 5. Cardiac transplant
- ☐ 6. Pulmonary transplant
- ☐ 7. Cardiac trauma (not iatrogenic)
- ☐ 8. Epicardial pacemaker
- ☐ 9. Pericardiectomy
- ☐ 10. ASD closure
- ☐ 11. Other (for congenital condition)
- ☐ 12. Atrial ablation
- ☐ 19. Other procedure not listed above

Other thoracic & vascular procedures
- ○ 0. None
- ☐ 1. Aortic
- ☐ 2. Peripheral vascular
- ☐ 3. Carotid endarterectomy
- ☐ 4. Other thoracic

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 6; Version 1.1

Hospital number | Date of surgery: dd / mm / yyyy

Coronary artery surgery

Number of DCAs [1]

	Graft 1	Graft 2	Graft 3	Graft 4	Graft 5	Graft 6	
Graft site	code	code	code	code	code	code	see below
Coronary quality [3]	code	code	code	code	code	code	see below
Coronary lumen at anastomosis	code	code	code	code	code	code	see below
Graft conduit	code	code	code	code	code	code	see below
Conduit quality	code	code	code	code	code	code	see below
Graft anastomosis	code	code	code	code	code	code	see below

CABG: Graft sites

1 → 1. Prox RCA
2 → 2. Mid RCA
3 → 3. Distal RCA
4 → 4. RCA-PDA
5 → 5. RCA-LV
6 → 6. LMS
7 → 7. Prox LAD
8 → 8. Mid LAD
9 → 9. Distal LAD
10 → 10. Diag 1
11 → 11. Diag 2
12 → 12. Prox Cx
13 → 13. Int
14 → 14. OM1
15 → 15. OM2
16 → 16. Distal Cx
15 → 17. Cx-PDA

CABG: Coronary quality

1 → 1. Good
2 → 2. Moderate / patchy disease
3 → 3. Severe / diffuse disease
4 → 4. Endarterectomy required

CABG: Coronary lumen

1 → 1. <1.5 mm
2 → 2. 1.5-2.0 mm
3 → 3. >2.0 mm

CABG: Graft conduits

1 → 1. Pedicle LIMA
2 → 2. Pedicle RIMA
4 → 4. Free LIMA
5 → 5. Free RIMA
7 → 7. Radial artery
8 → 8. Long SV
9 → 9. Short SV
11 → 11. Other artery
12 → 12. Other vein

CABG: Conduit quality

1 → 1. Good
2 → 2. Moderate
3 → 3. Poor

CABG: Graft anastomosis

2 → 2. End-to-side
3 → 3. Side-to-side

2. Distal coronary anastomoses
3. At and beyond the anastomosis

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 7; Version 1.1

Hospital number | Date of surgery dd / mm / yyyy

Valve surgery

Number replaced / repaired

	Aortic	Mitral	Tricuspid	Pulmonary
Haemodynamic pathology	○ 1. Stenosis ○ 2. Regurgitation ○ 3. Mixed	○ 1. Stenosis ○ 2. Regurgitation ○ 3. Mixed	○ 1. Stenosis ○ 2. Regurgitation ○ 3. Mixed	○ 1. Stenosis ○ 2. Regurgitation ○ 3. Mixed
Native valve pathology	code	code	code	code
Other native valve pathology	text	text	text	text
Explant valve type	○ 1. Native valve ○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Ring	○ 1. Native valve ○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Ring	○ 1. Native valve ○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Ring	○ 1. Native valve ○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Ring
Reason for repeat valve operation	☐ 1. Thrombosis ☐ 2. Dehiscence ☐ 3. Embolism ☐ 4. Infection ☐ 5. Intrinsic failure ☐ 6. Haemolysis ☐ 19. Other reason	☐ 1. Thrombosis ☐ 2. Dehiscence ☐ 3. Embolism ☐ 4. Infection ☐ 5. Intrinsic failure ☐ 6. Haemolysis ☐ 19. Other reason	☐ 1. Thrombosis ☐ 2. Dehiscence ☐ 3. Embolism ☐ 4. Infection ☐ 5. Intrinsic failure ☐ 6. Haemolysis ☐ 19. Other reason	☐ 1. Thrombosis ☐ 2. Dehiscence ☐ 3. Embolism ☐ 4. Infection ☐ 5. Intrinsic failure ☐ 6. Haemolysis ☐ 19. Other reason
Other reason for repeat	text	text	text	text
Valve procedure	○ 1. Replacement ○ 2. Repair	○ 1. Replacement ○ 2. Repair	○ 1. Replacement ○ 2. Repair	○ 1. Replacement ○ 2. Repair
Valve repair procedures	codes	codes	codes	codes
Valve implant type	○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Annulopl. ring	○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Annulopl. ring	○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Annulopl. ring	○ 2. Mechanical ○ 3. Biological ○ 4. Homograft ○ 5. Autograft ○ 6. Annulopl. ring
implant prosthesis name				
implant prosthesis model				
Implant prosthesis serial number				
implant prosthesis size	mm	mm	mm	mm

Valve surgery: native valve pathology

0 → 0. Native valve not present
1 → 1. Congenital
2 → 2. Degenerative
3 → 3. Active infective endocarditis
4 → 4. Previous infective endocarditis
5 → 5. Rheumatic
6 → 6. Annuloaortic ectasia
7 → 7. Calcific degeneration
8 → 8. Ischaemic
9 → 9. Functional regurgitation
19 → 19. Other native valve pathology

Valve surgery: valve repairs

1 → 1. Commissurotomy
2 → 2. Annuloplasty (ring)
3 → 3. Annuloplasty (suture)
4 → 4. Leaflet resection
5 → 5. Leaflet extension
6 → 6. Chordal transfer
7 → 7. Chordal shortening
8 → 8. Artificial chord
9 → 9. Papillary muscle repositioning
10 → 10. Decalcification / debridement
11 → 11. Leaflet patch
12 → 12. Sub-valvar release
13 → 13. Re-suspension
19 → 19. Other

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 8; Version 1.1

Hospital number | Date of surgery: dd / mm / yyyy

Major aortic procedure data

Number of aorta segments

	Root	Ascending	Arch	Descending	Abdominal	
Aortic pathology	code	code	code	code	code	see below
Aortic procedure	code	code	code	code	code	see below

Major aortic: pathology

1 → 1. Aneurysm
2 → 2. Syphilis
3 → 3. Dissection
4 → 4. Transection
5 → 5. Coarctation
6 → 6. Atheromatous
7 → 7. Marfan's
9 → 9. Mycotic
10 → 10. Other connective tissue disorders
11 → 11. Congenital
12 → 12. Infection - native
13 → 12. Infection - graft
99 → 99. Unknown

Major aortic: procedure

1 → 1. Interposition tube graft
2 → 2. Tube graft + separate AVR
3 → 3. Root replacement + composite valve graft & coronary re-implantation
4 → 4. Root replacement + preservation of native valve & coronary re-implantation
5 → 5. Homograft root replacement
6 → 6. Autograft root replacement (Ross procedure)
7 → 7. Aortic patch graft
8 → 8. Sinus of Valsalva repair
9 → 9. Reduction aortoplasty

Status at the end of the procedure

Native rhythm
- ○ 1. Sinus rhythm
- ○ 2. Atrial fibrillation / flutter
- ○ 3. Nodal rhythm
- ○ 4. Heart block
- ○ 5. Other

Pacing
- ○ 0. None
- ○ 1. Atrial
- ○ 2. Ventricular
- ○ 3. Dual chamber

Inotropes
- ○ 0. None
- ○ 1. Low dose (<10 ml hr^{-1})
- ○ 2. High dose (>10 ml hr^{-1})

Closure

Arterial cannulation
- ○ 0. Not applicable
- □ 1. Atrial
- □ 2. Ventricular

Drains
- □ 1. Mediastinal
- □ 2. Pericardial
- □ 3. Left pleural
- □ 4. Right pleural

Sternal closure
- ○ 1. Routine
- ○ 2. Modified

Intra-operative TOE
- ○ 0. No
- ○ 1. Yes

TOE findings

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

Page 9; Version 1.1

Hospital number _____ Date of surgery dd / mm / yyyy

Cardiopulmonary support

Cardiopulmonary bypass	○ 0. No	○ 1. Yes	
Conversion to off pump	○ 0. No	○ 1. Yes	
Predominant method of myocardial protection	○ 0. Non-cardioplegic	○ 1. Cardioplegia	
Cardioplegia: solution	○ 1. Blood	○ 2. Crystalloid	○ 8. Not applicable
Cardioplegia: temperature	☐ 1. Cold	☐ 2. Warm	○ 8. Not applicable
Cardioplegia: infusion mode	☐ 1. Antegrade	☐ 2. Retrograde	○ 8. Not applicable
Cardioplegia: timing	○ 1. Intermittent	○ 2. Continuous	○ 8. Not applicable
Hot shot	○ 0. No	○ 1. Yes	

Non-cardioplegic myocardial protection

- ○ 1. Aortic cross clamping with fibrillation
- ○ 2. Fibrillation with perfusion
- ○ 3. Cross clamp with direct coronary perfusion
- ○ 4. Cross clamp and beating heart
- ○ 5. Beating heart without cross clamp

Chest opened by select from list

Lowest systemic temperature _____ °C

Antegrade highest concentration _____

Intra-aortic balloon pump used

- ○ 0. No
- ☐ 1. Pre-operation
- ☐ 2. Intra-operation
- ☐ 3. Post-operation

Reason for IABP use

- ○ 1. Haemodynamic instability
- ○ 2. Unstable angina
- ○ 3. CPB wean
- ○ 4. Prophylactic

IABP serial number _____

Date IABP removed dd / mm / yyyy

Transamin	○ 0. No	○ 1. Yes
Novo 7	○ 0. No	○ 1. Yes
Filtration	○ 0. No	○ 1. Yes

Volume filtered _____ ml

Height _____ cm

Weight _____ kg

Cumulative bypass time _____ min

Cumulative cross clamp time _____ min

Total circulatory arrest time _____ min

This form is designed so that questions requiring a single response-option are identified with round radio-buttons next to the options, whereas questions where more than one response option may be selected are identified by square tick boxes next to the options

Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

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Hospital number | Date of surgery: dd / mm / yyyy

Cardiopulmonary support continued …

Cerebral perfusion during HCA
- ○ 0. None
- ○ 1. Antegrade
- ○ 2. Retrograde

Cell salvage used
- ○ 0. No
- ○ 1. Yes

Volume heparinized saline ml

Other volume (blower mister etc) ml

Blood from circuit ml

Volume processed ml

Volume re-infused ml

Perfusion notes

Blood products used

Blood units

Platelets units

FFP units

Cryoprecipitate units

Post-operative course (CCU)

PA catheter
- ○ 0. No
- ○ 1. Yes

Inotropes
- ○ 0. None
- ☐ 1. Dopamine
- ☐ 2. Dobutamine
- ☐ 3. Adrenaline
- ☐ 4. Noradrenaline
- ☐ 5. Vasopressin
- ☐ 6. Milrinone
- ☐ 7. Enoxamine

Inotropes >5 ml hour^{-1}
- ○ 0. No
- ○ 1. Yes

Vasoconstrictor >5 ml hour^{-1}
- ○ 0. No
- ○ 1. Yes

Chest drainage (first 24 hours) ml

Date of discharge from CCU dd / mm / yyyy

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Queen Mary Hospital, Hong Kong

Adult Cardiac Surgical Database

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Hospital number | Date of surgery dd / mm / yyyy

Post-operative course

Post-operative complications
- ○ 0. No
- ○ 1. Yes

Re-admission to CCU
- ○ 0. No
- ○ 1. Yes

Return to theatre
- ○ 0. No re-operation necessary
- ☐ 1. Re-operation for bleeding or tamponade
- ☐ 2. Re-operation for valvular problems
- ☐ 3. Re-operation for graft problems
- ☐ 4. Re-operation for other cardiac problems
- ☐ 5. Sternum resuturing (sterile)
- ☐ 6. Surgery for deep sternal wound infection

Arrhythmias requiring intervention
- ○ 0. None
- ☐ 1. Atrial fibrillation / flutter
- ☐ 2. VT
- ☐ 3. VF
- ☐ 4. Heart block
- ☐ 5. Other

Intervention
- ☐ 1. Pharmocological
- ☐ 2. Electrical cardioversion
- ☐ 3. Permanent pacemaker
- ☐ 4. Other

Secondary airway support
- ○ 0. None
- ☐ 1. Mini-tracheostomy
- ☐ 2. Facial CPAP
- ☐ 3. Re-intubation
- ☐ 4. Tracheostomy

Pulmonary complications requiring intervention
- ○ 0. None
- ☐ 1. Chest infection
- ☐ 2. Pleural effusion
- ☐ 3. Pneumothorax
- ☐ 4. Pulmonary embolus
- ☐ 5. Other

Infective complications
- ○ 0. None
- ☐ 1. Superficial sternal
- ☐ 2. Deep sternal / mediastinal
- ☐ 3. Pulmonary
- ☐ 4. Leg or arm wound
- ☐ 5. Septicaemia
- ☐ 6. Other

Post-operative fever
- ○ 0. No
- ○ 1. Yes

Gastro-intestinal complications
- ○ 0. None
- ☐ 1. GI bleed
- ☐ 2. Perforated peptic ulcer
- ☐ 3. Ischaemic bowel
- ☐ 4. Pancreatitis
- ☐ 5. Ileus requiring intervention
- ☐ 6. Other

Renal impairment
- ○ 0. No
- ○ 1. Yes

New HF / dialysis post-operatively
- ○ 0. No
- ○ 1. Yes

Renal replacement therapy
- ○ 0. No
- ○ 1. Yes

Type of renal replacement therapy
- ☐ 1. Peritoneal dialysis
- ☐ 2. CWH
- ☐ 3. HD

Peak post-operative creatinine _____ µmol ℓ^{-1}

New post-operative stroke
- ○ 0. None
- ○ 1. Yes (prophylatic)
- ○ 2. Yes (clinically indicated)

Post-operative antibiotics
- ○ 0. None
- ○ 1. Transient stoke
- ○ 2. Permanent stroke

Complication notes

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Adult Cardiac Surgical Database

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Hospital number | Date of surgery: dd / mm / yyyy

Discharge

Pre-discharge haemoglobin: g $d\ell^{-1}$

Pre-discharge creatinine: µmol ℓ^{-1}

Aspirin
- ○ 0. Not given
- ○ 1. Given
- ○ 2. Contra-indicated
- ○ 3. Other antiplatelet given
- ○ 4. Unknown

Statin
- ○ 0. Not given
- ○ 1. Given
- ○ 2. Contra-indicated
- ○ 3. Unknown

Warfarin
- ○ 0. No
- ○ 1. Yes

Discharge destination from cardiothoracic ward
- ○ 1. Home
- ○ 2. Convalescence (Non acute Hospital)
- ○ 3. Other hospital
- ○ 4. Not applicable - patient deceased
- ○ 5. Other specialty

Patient status at discharge
- ○ 0. Alive
- ○ 1. Dead
- ○ 2. Dead (theatre)
- ○ 3. Dead (ICU)
- ○ 4. Dead (cardiothoracic ward)
- ○ 5. Dead (other wards / hospital)

Date of discharge from CTS: dd / mm / yyyy

Date of discharge / death: dd / mm / yyyy

This form is designed so that questions requiring a single response-option are identified with round radio-buttons next to the options, whereas questions where more than one response option may be selected are identified by square tick boxes next to the options

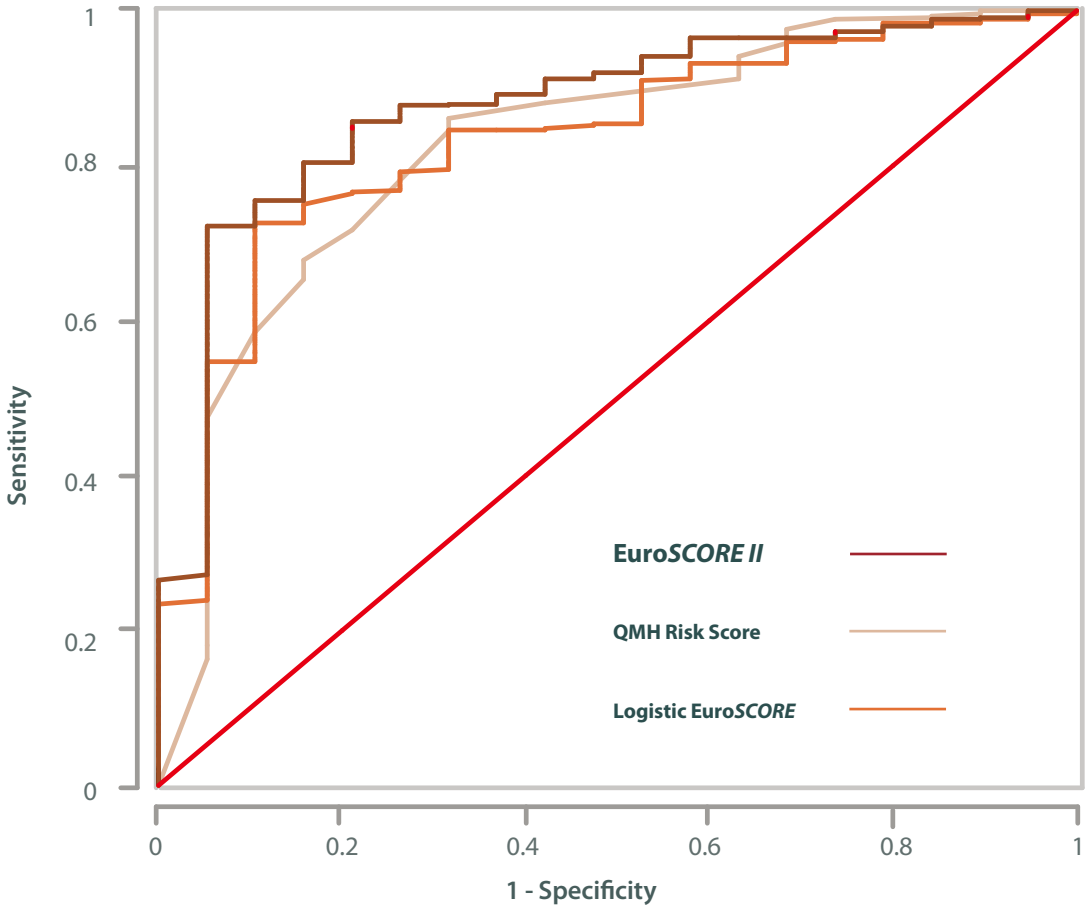
QMH Risk Score for Adult CABG and Valve surgery (since 2010)

- Significant geographic and demographic differences between European and Asian patients.
- QMH Risk Score was developed to predict in-hospital morality for patients undergoing CABG and valve surgery in Hong Kong.
- Between Nov 1999 and May 2006, 3156 adults undergoing CABG and valves surgery cases were prospectively collected.
- Age <18, congenital abnormalities, aortic surgery were excluded.
- Multivariate logistic regression analysis: 11 risk factors identified.
- Area under ROC curve = 0.756.
- Hosmer-Lemeshow goodness-of-fit test = p > 0.05.

QMH risk calculator

		Score
Risk Factors	Age (years)	
	<60	0
	60-64	2
	65-69	2.5
	70-74	3
	≥ 75	4
	Renal failure	4
	EF<30%	3
	Pre-operative Cardiac Conditions	2
	Transmyocardial infarction <48hrs	3.5
	Congestive cardiac failure	1.5
	Endocarditis	2.5
	Pulmonary hypertension	2.5
	Redo operation	2
	Emergency surgery	2
	Valves & CABG	2

Comparing Euro*SCORE II* , QMH Risk Score and Logistic Euro*SCORE* Receiver Operating Curve (ROC) for adult cardiac surgery, 2014-2015



		Area under the curve	Asymptotic 95% Confidence Interval		Hosmer-Lemeshow statistics (P-valve)
			Lower Bound	Upper Bound	
Risk stratification model	Euro*SCORE II*	0.877	0.802	0.952	0.066
	QMH Risk Score	0.828	0.727	0.928	0.834
	Logistic Euro*SCORE*	0.836	0.752	0.919	0.147

Observed mortality 19/566= 3.56%

		Predicted mortality rate % (95%CI)	Observed/predicted ratio
Risk stratification model	EuroSCORE-II	4.18 (2.7-6.3)	0.85
	QMH Risk Score	4.17 (2.6-6.1)	0.85
	Logistic EuroSCORE	9.33 (7.1-12.1)	0.38

Appendix 2

Congenital cardiac database

Nomenclature & Database

The International Congenital Heart Surgery Nomenclature and Database Project was started in 1998. A common nomenclature, along with a common core minimal data set, was adopted by the STS and EACTS and published in 2000. The International Paediatric and Congenital Cardiac Code (IPCCC) was finally presented[1] and published in 2005.

International Paediatric and Congenital Cardiac Code (IPCCC)

- Available *via* the Internet at www.IPCCC.NET
- Assigned to 180 diagnoses, 257 Procedures
- Integrated in both the STS and EACTS Congenital Heart Databases

World's Largest Congenital Heart Databases

- EACTS Congenital Heart Database (since 1992)
- STS Congenital Heart Surgery Database (since 2002)

1. The Fourth World Congress of Pediatric Cardiology and Cardiac Surgery. Buenos Aires, Argentina. September 19, 2005.

Risk Stratification: Aristotle Basic Complexity (ABC) Score and level[1]

Two methods of risk stratification are currently included in the EACTS Congenital Heart Database – The Aristotle Basic Complexity (ABC) Score and The STS-EACTS (STAT) Mortality and Morbidity Score. The former is used for the report in this book. The Aristotle Project was conceived in 1999, with input from members of the EACTS, the STS, the European Congenital Heart Surgeons, and the Congenital Heart Surgeons Society. The ABC Score was created by the International Aristotle Committee using the opinions of a panel of experts, made up of 50 congenital heart surgeons in 23 countries representing multiple societies. It is a concept to evaluate quality of care based on procedure complexity. It contains score values for single procedures. The ABC Score was originally assigned to 145 primary congenital cardiac procedures based upon mortality, morbidity, and technical difficulty. Each component receives a score of between 0.5 and 5 points. The ABC defined as the sum of the three components: overall ABC score = mortality component + morbidity component + technical difficulty component.

Score	Mortality	Morbidity	Difficulty
1 point	<1%	ICU 0-24H	elementary
2 points	1-5%	ICU 1D-3D	simple
3 points	5-10%	ICU 4D-7D	average
4 points	10-20%	ICU1W-2W	important
5 points	> 20%	ICU > 2W	major

The overall ABC ranging from 1.5 to 15 points, 1 to 4 levels, with higher scores / levels indicating greater overall risk. 156 congenital cardiac procedures are assigned to the score currently.

ABC Score	1.5-5.9	6.0-7.9	8.0-9.9	10.0-15.0
Level	1	2	3	4

Since 2003, the EACTS and the STS incorporate the Aristotle Basic Complexity Score into their congenital heart databases. The accuracy of the ABC Score was validated using 3-year-data of 35,862 operations from both the STS and EACTS Databases. The results published in 2007 showed the ABC score generally discriminates between low-risk and high-risk congenital procedures making it a potentially useful covariate for case-mix adjustment in congenital heart surgery outcomes analysis[2].

1. Lacour-Gayet *et al.* The Aristotle Score for congenital heart surgery. Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu 2004;7:185–91

2. O'Brien SM, *et al.* Accuracy of the Aristotle Basic Complexity Score for Classifying the Mortality and Morbidity Potential of Congenital Heart Surgery Operations. Ann Thorac Surg 2007;84:2027–37

Data Management & Reports

Data collection and input

- The data of all the congenital cardiac operations was retrieved prospectively using a standard form by the first-line clinical staffs.
- The surgeons are responsible for the operative data, while paediatricians in charge of the ICU and the general ward are responsible for the pre- and postoperative data.
- The department research staffs are responsible for data collection and input the data into the local computer and submit to the online server of the EACTS Database.

Data validation and verification

- The EACTS Database has intrinsic data validation rules (see next page) to ensure the internal data integrity in the process of data validation. The system reminds the user whenever there is an improper input of the data, which are corrected before final submission.
- Data verification is to compare the data collected in the database with the patient record in the hospital chart and the electronic medical system. This eliminates unintentional and organizational mistakes in the data, and is carried out by the department research staff.

Local database and data analysis

- The complete export from EACTS database writes file in csv format which is imported into relational database, Microsoft Access. Tables are linked using unique identifiers and files are then imported into SPSS for further analysis.
- The local database gets updated automatically as new data is entered. A regular backup of the local database is done by our research staff.

The central database & database online reports

- The central database is located in Warsaw, Poland. It contains the data gathered from the centers. The Software Development Team is working on the EACTS Database Software, maintaining the servers and this wiki website. The members of the database team can be contacted through email or phone.
- The ONLINE REPORT includes primary report and complication report of the whole database, gold standards report, basic score report and benchmark, quality of care benchmark report (bubble charts) and outcome prognosis report based on the primary diagnosis.

醫院管理局
HOSPITAL AUTHORITY

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