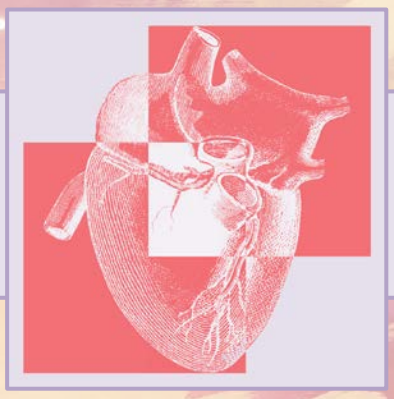
ANZSCTS Cardiac Surgery Database Program

National Annual Report



2016

The Australian and New Zealand Society of Cardiac and Thoracic Surgeons Cardiac Surgery Database Program

National Annual Report

2016

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Table of Contents

List of Figures

National Annual Report 2016

List of Tables

National Annual Report 2016

Foreword

This is the tenth National Annual Report of the Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) Database Program. It describes the data from surgery performed in 30 National public and private hospital cardiac surgical units.

Data presented in this report includes unit comparisons for procedures performed in the 2016 calendar year with procedural outcomes collected up to the end of January 2017. Data is also presented as pooled data (four or five year), and annual data (five years).

The report includes detailed analyses and summaries showing unit comparisons for key performance indicators. Heads of units are notified of outlying status in accordance with the ANZSCTS Database's outlier management procedure (Appendix A).

Units and surgeons are de-identified by random coding. Heads of unit are additionally notified of all surgeon identifiers pertaining to their unit.

The report demonstrates unit performance compared to other contributing units, and the group average.

Overall, in the five-year period, although there is variation in practice, most participating Australian cardiac surgical units and surgeons, had satisfactory outcomes for key performance indicators (mortality and complications), as defined by being within 95% confidence interval of the national average.

The Society will continue its mission to ensure that high quality and safety standards are maintained in all units undertaking cardiac surgical procedures in Australia.

Mr Gil Shardey

Chairman
ANZSCTS Database Program
Steering Committee

Abbreviations

ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AVR	Aortic valve replacement
BITA	Bilateral internal thoracic artery
CABG	Coronary artery bypass graft
CI	Confidence interval
CPB	Cardiopulmonary bypass
CVA	Cerebrovascular accident
DNRI	Derived new renal insufficiency
DSWI	Deep sternal wound infection
eGFR	Estimated glomerular filtration rate
ICU	Intensive care unit
ITA	Internal thoracic artery
KPIs	Key performance indicators
LITA	Left internal thoracic artery
LOS	Length of stay
LVF	Left ventricular function
MI	Myocardial infarction
MRLVF	Mildly reduced left ventricular function
ModLVF	Moderately reduced left ventricular function
MV	Mitral valve
MVR	Mitral valve replacement
NCA	New cardiac arrhythmia
NLVF	Normal left ventricular function
NRBC	Non-red blood cells
NSTEMI	Non-ST-segment elevation myocardial infarction
OM	Observed mortality
PLOS	Procedural length of stay
Post-PLOS	Post-procedural length of stay
Pre-PLOS	Pre-procedural length of stay
RA	Radial artery
RAMR	Risk-adjusted mortality rate
RBC	Red blood cells
Re-op	Re-operation
RITA	Right internal thoracic artery
SRLVF	Severely reduced left ventricular function
STEMI	ST elevation myocardial infarction
SVG	Saphenous vein graft
TAVR	Transcatheter aortic valve replacements
T/P	Tricuspid/pulmonary
VENT	Ventilation

Introduction

Data preparation and presentation

Data includes operative details and outcomes of cardiac surgery performed in 30 participating units in 2016, and from 2012-2015 (section 2) or 2012-2016 (section 3) for pooled analyses.

Final data related to this report was received by the ANZSCTS Database Program Data Management Team in the Centre of Cardiovascular Research and Education in Therapeutics (CCRET) of the Department of Epidemiology and Preventive Medicine, Monash University, on April 5, 2017. Submitted data was checked for completeness and Data Managers in each unit were given opportunities to amend any errors. Any changes to the data after April 5, 2017 are not reflected in this report.

Comparative data are presented in tables and in various graphical forms, interpretation of which are described within Appendix B.

Variable definitions

All definitions are based on ANZSCTS Database Data Definitions Manual version 3.0 and version 4.0 for patients with admission dates on and after September 1st 2016.

Variables presented in this report that are open to interpretation, are defined below.

- Clinical Status

Elective
The procedure could be deferred without risk of compromised cardiac outcome.

Urgent

a. Within 72 hours of angiography if initial operation was performed in the same admission as angiography ('same admission' includes where angiography was performed in another unit prior to direct transfer to unit where initial operation is performed); or

b. Within 72 hours of an unplanned admission (patient who had a previous angiogram and was scheduled for surgery but was admitted acutely); and

c. Procedure required during same hospitalisation in a clinically compromised patient in order to minimise chance of further clinical deterioration. ^

^Additional criteria in version 4.0

Emergency*
Unscheduled surgery required in the next available theatre on the same day (as admission) due to refractory angina or haemodynamic compromise.

Salvage*

The patient underwent cardiopulmonary resuscitation *en route* to, or in the operating room, prior to surgical incision.

** Due to low number of cases, emergency and salvage patients are combined within the report, and labelled as emergency.*

- Derived New Renal Insufficiency (DNRI)

Acute post-operative renal insufficiency is characterised by one of the following:

a. Increased serum creatinine to >0.2mmol/L (>200µmol/L) AND a doubling or greater increase in creatinine over the baseline pre-operative value AND the patient did not require pre-operative dialysis/haemofiltration, or
b. A new post-operative requirement for dialysis/haemofiltration (when the patient did not require this pre-operatively).

- Mortality

***Observed*[#]**

All deaths in hospital prior to discharge, and all deaths post discharge but within 30 days of the surgical date, reported by the unit.

Risk-adjusted

Derived based on the ANZSCTS Database Program's risk model (Appendix C), and used to account for the degree of risk associated with surgery and patient profile.

[#] *shown for variables included in the risk-adjustment model (Appendix C).*

- Readmission ≤ 30 day from surgery

Patient readmitted as an in-patient within 30 days from the date of surgery for ANY reason to general hospital not emergency, short-stay wards or planned transfer to rehabilitation facility. Date of surgery counts as day zero.

- Redo operation

Operation performed on a patient who has undergone a prior cardiac surgery.

- Return to theatre for bleeding

Patient returned to theatre for bleeding or tamponade.

National Annual Report 2016

The report presents patient characteristics, patient complications, mortality based on surgical procedure type, unit performance against key performance indicators (KPIs), and surgeon performance. These are subdivided, based on procedure type as follows:

- Section 1: Isolated Coronary Artery Bypass Graft (CABG)
- Section 2: Valve surgery
- Section 3: Aortic Valve Replacement (AVR) with CABG
- Section 4: Other cardiac
    - Tabulated case numbers only, as these comprise a wide range of procedures, most of which are uncommonly performed.

Contributing units

In 2001, the ANZSCTS with the support of the Victorian Department of Health and Human Services, developed a Program to collect and report data on cardiac surgery performed in Victorian hospitals. The Program expanded to National capture, producing Annual Reports to inform its participants, since 2002 for Victorian units, and since 2007 for National units.

The 2016 report provides a detailed analysis of data, providing an overview of annual trends and outcome measures based on KPIs. The data includes reported cardiac procedures performed in the 2016 calendar year, with follow up data to 31st January 2017, in 30 public and private cardiac units. Averaged annual data over five years, or pooled four-year unit data, is also presented to show trends in outcomes. Where the number of cases in the current year is low (section 2 and 3), pooled data includes the current year.

The following cardiac units contributed data to this report. Some units joined the program more recently, therefore have not provided data over the full five years.

VICTORIA
Alfred
Austin
Cabrini Medical Centre
Epworth Private
Geelong
Jessie McPherson
Monash Medical Centre
Peninsula Private
Royal Melbourne
St Vincent's Public

NEW SOUTH WALES
Canberra (ACT)
John Hunter
Lake Macquarie Private
Liverpool
Prince of Wales
Royal Prince Alfred
St George
St Vincent's Public
Westmead

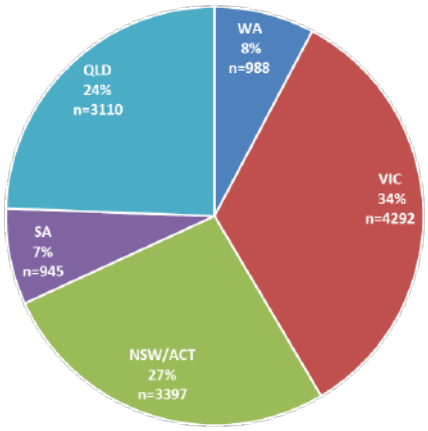
SOUTH AUSTRALIA
Flinders Medical Centre
Royal Adelaide

QUEENSLAND
Gold Coast University
Holy Spirit Northside
Mater Health Services
Prince Charles
Princess Alexandra
Townsville

WESTERN AUSTRALIA
Fiona Stanley
Sir Charles Gairdner
St John of God, Subiaco

The proportion of total cardiac surgery procedures performed in participating Australian units, is reported by jurisdiction (Figure 1).

a. 2016



b. 2012-2015

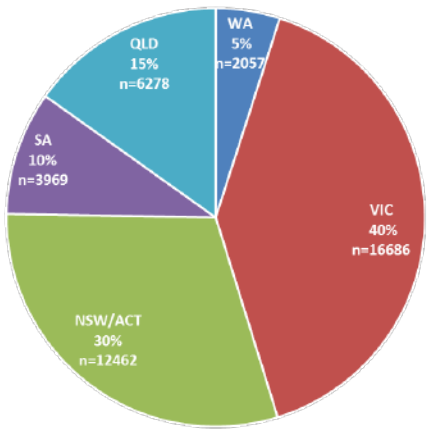
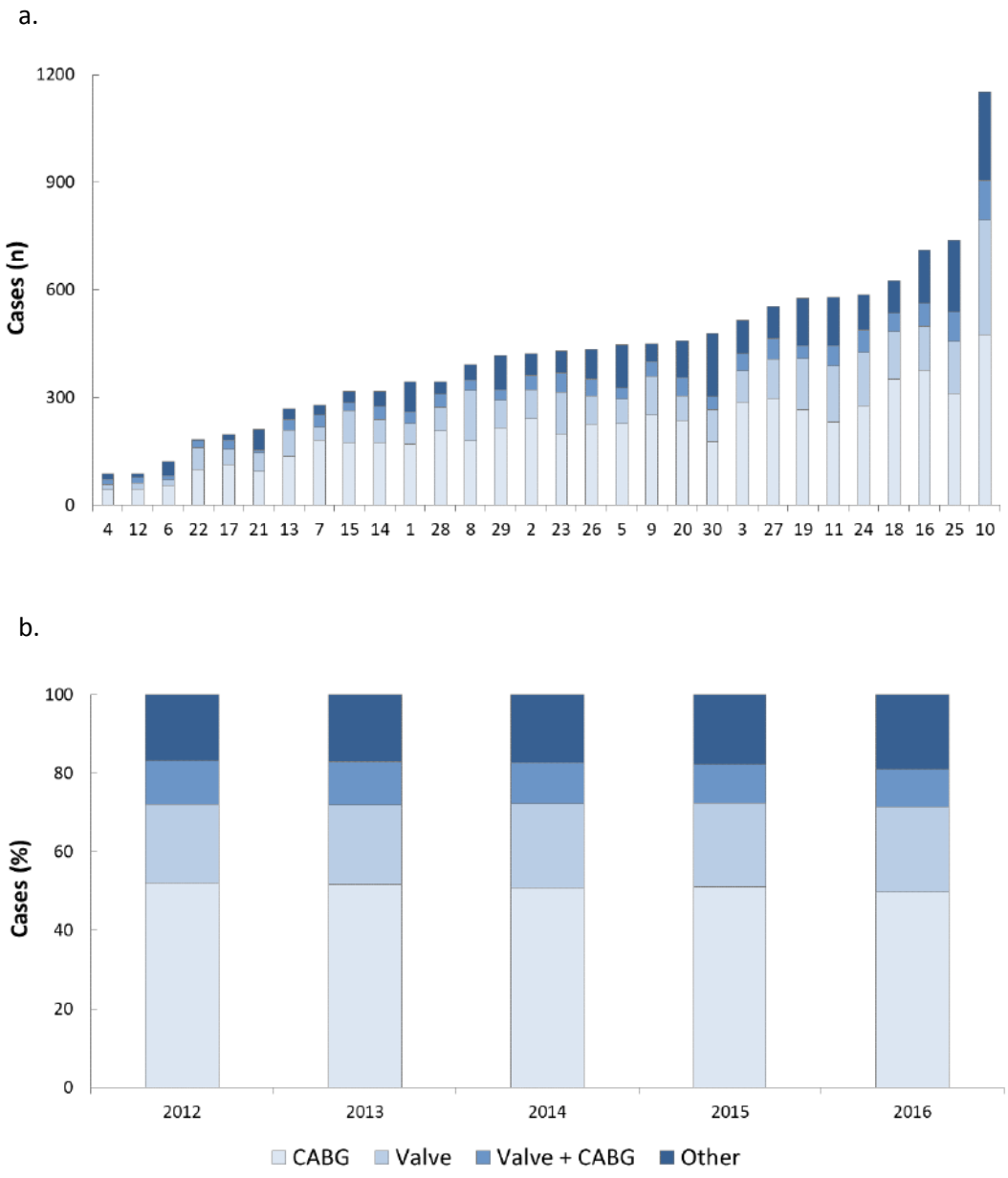


Figure 1. Proportion of cardiac procedures performed in each jurisdiction

Overview of procedure types

Isolated CABG is the most common of the major cardiac procedures performed in 2016, and annually since 2012 (Figure 2).

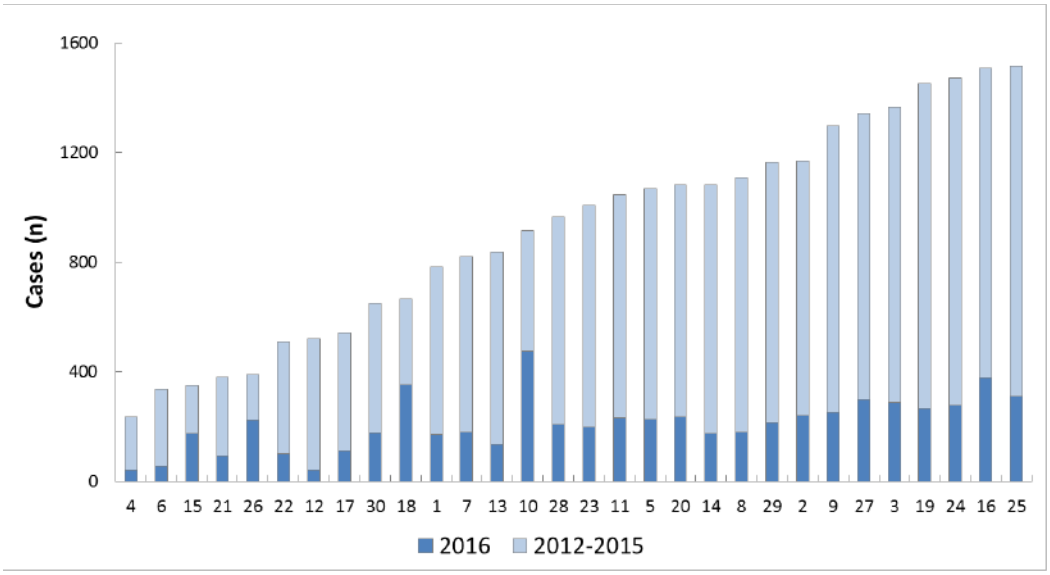


Left vertical axis = Coloured columns (a. number or b. % of cases)

Figure 2. Cardiac procedures performed by a. unit and b. year

1. Isolated CABG

In 2016, unit 4 performed the fewest isolated CABG procedures (n=43) and unit 10 the most (n=475; Figure 3). Not all units contributed for all of the preceding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 3. Isolated CABG procedures performed by unit, 2012 -2016

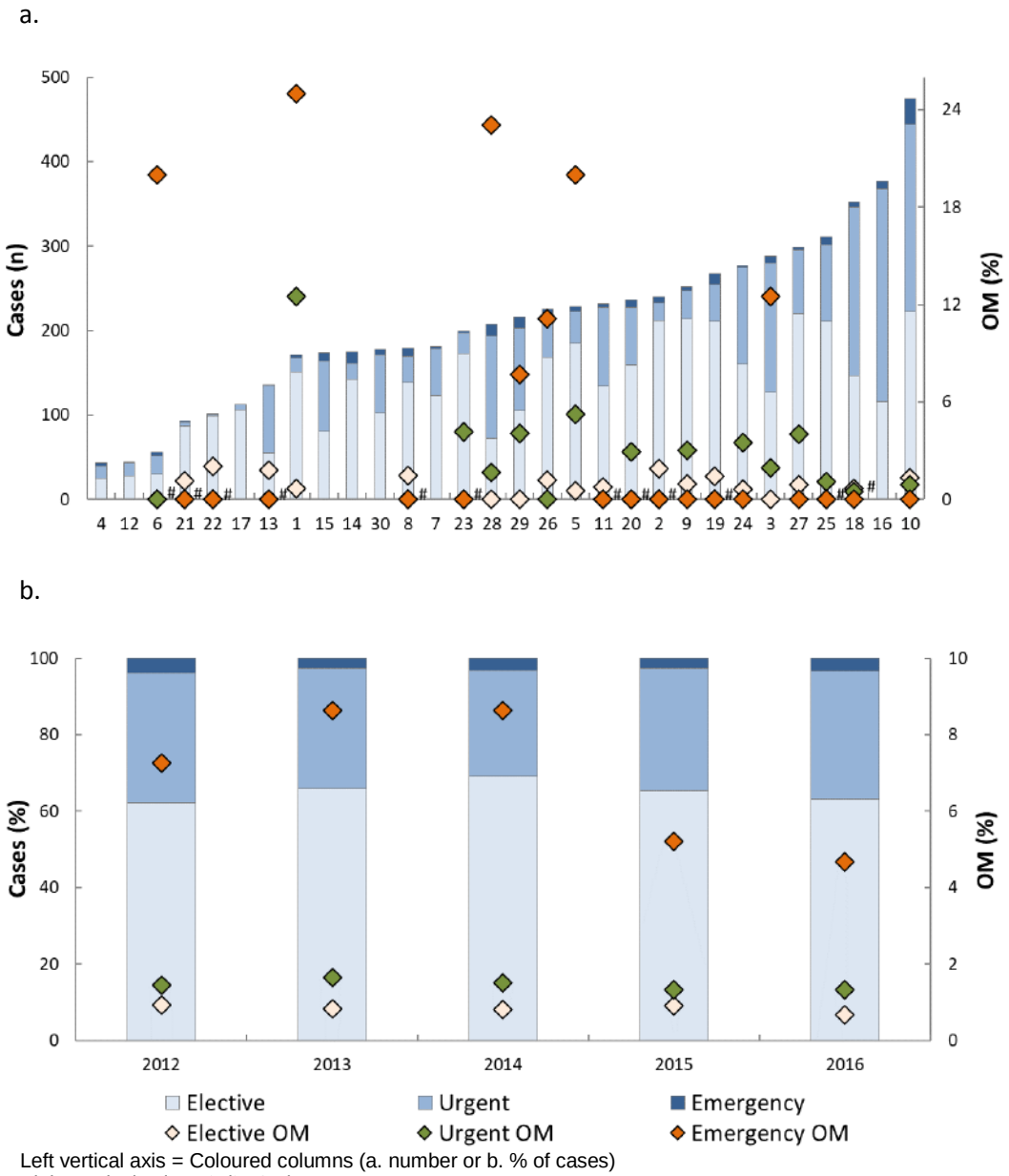
1.1 Patient characteristics

Key patient characteristics influencing outcomes of surgery are clinical status, gender, age and co-morbidities. Only mortality is risk-adjusted to account for these confounders. Observed mortality (OM) is shown for variables that are included in the risk adjustment model (Appendix C), and risk-adjusted mortality rate (RAMR) for all others.

1.1.1 Clinical status

In 2016, OM was reported by fifteen units (0.5-2%) for elective cases; for urgent by thirteen units (0.5-12.5%); and emergency by seven units (7.7-25.0%; Figure 4a). The number of OM relative to number of cases, is tabulated in Appendix D-I.

Pooled unit data shows annually since 2012, the majority of patients are elective (>62%), and less than 4% are emergency. Averaged annual OM for elective, urgent, and emergency patients is 0.8%, 1.4%, and 6.7%, respectively (Figure 4b).



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

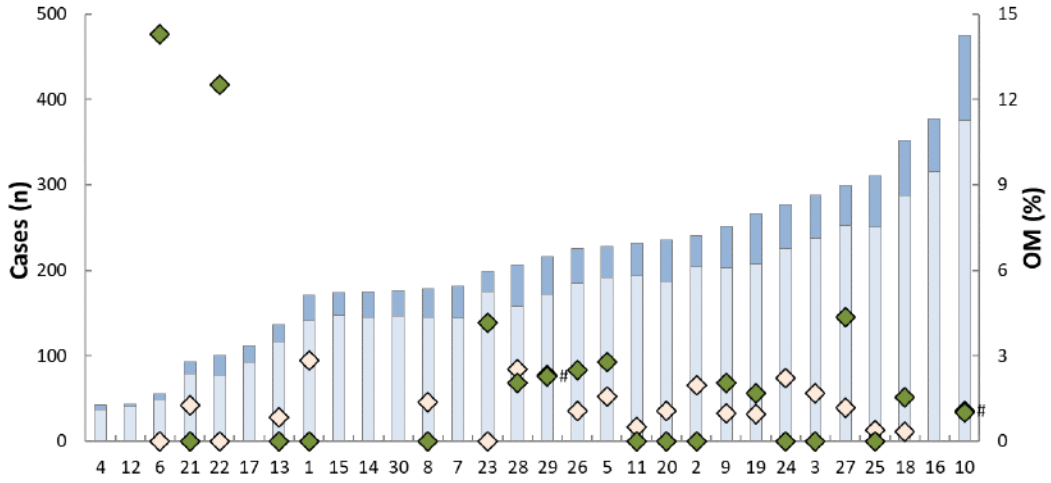
Figure 4. OM following CABG procedures based on clinical status by a. unit and b. year

1.1.2 Gender and age

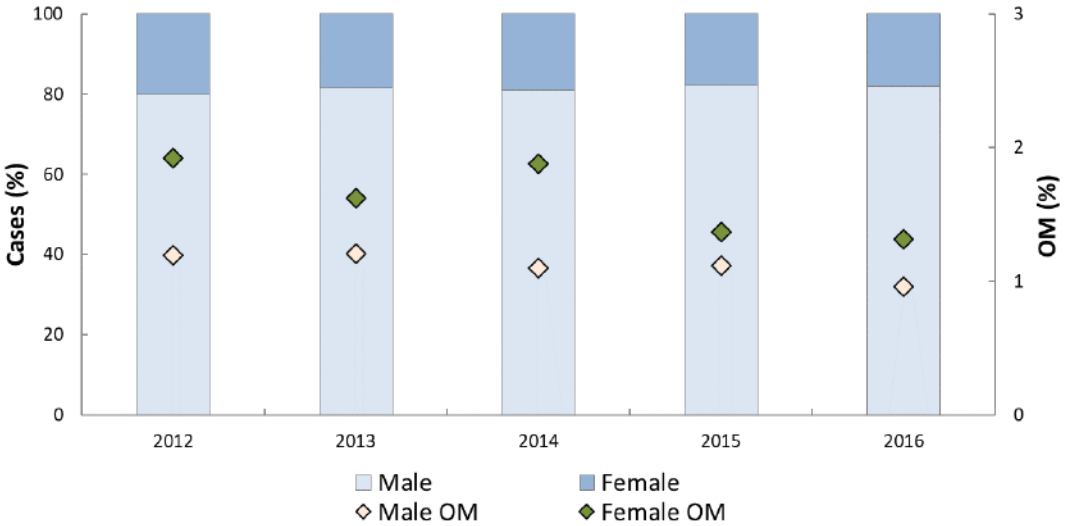
In each unit, the majority of patients who had a CABG were male (Figure 5a). Nineteen units reported OM for male patients (0.3-2.5%), and twelve units for females (1.0-14.3%).

Pooled unit data shows that annually, over 80% of patients who had a CABG procedure are male. Averaged annual OM is 1.1% for males, and 1.6% for females (Figure 5b).

a.



b.

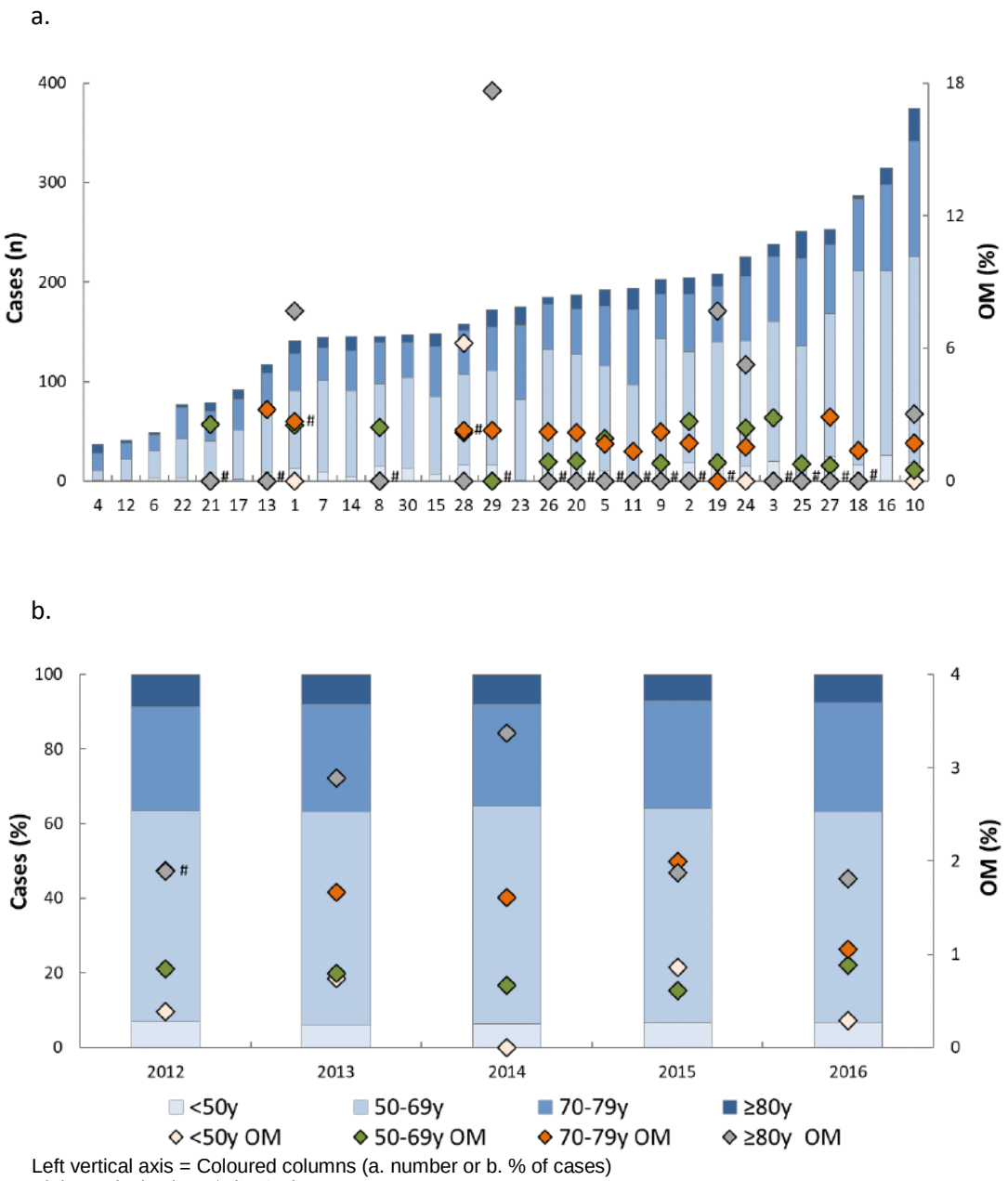


Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 5. OM following CABG procedures based on gender by a. unit and b. year

In 2016, the highest proportion of male patients who had a CABG were aged 50-69 years (Figure 6a). For men aged below 50 years, OM was only reported by unit 28 (6.3%). For men aged 50-69 years, fifteen units reported OM (0.5-2.9%); aged 70-79 years, fourteen units (1.4-3.2%), and aged 80 years and over, five units (3.0-17.6%). The number of OM relative to number of cases, is tabulated in Appendix D-II.

Pooled unit data shows that annually, the majority of male patients who had a CABG are aged 50-69 years (Figure 6b). Averaged OM for males aged below 50 years is 0.5%; aged 50-69 years, 0.8%; 70-79 years, 1.6%; and for males aged 80 years and above, 2.3%.

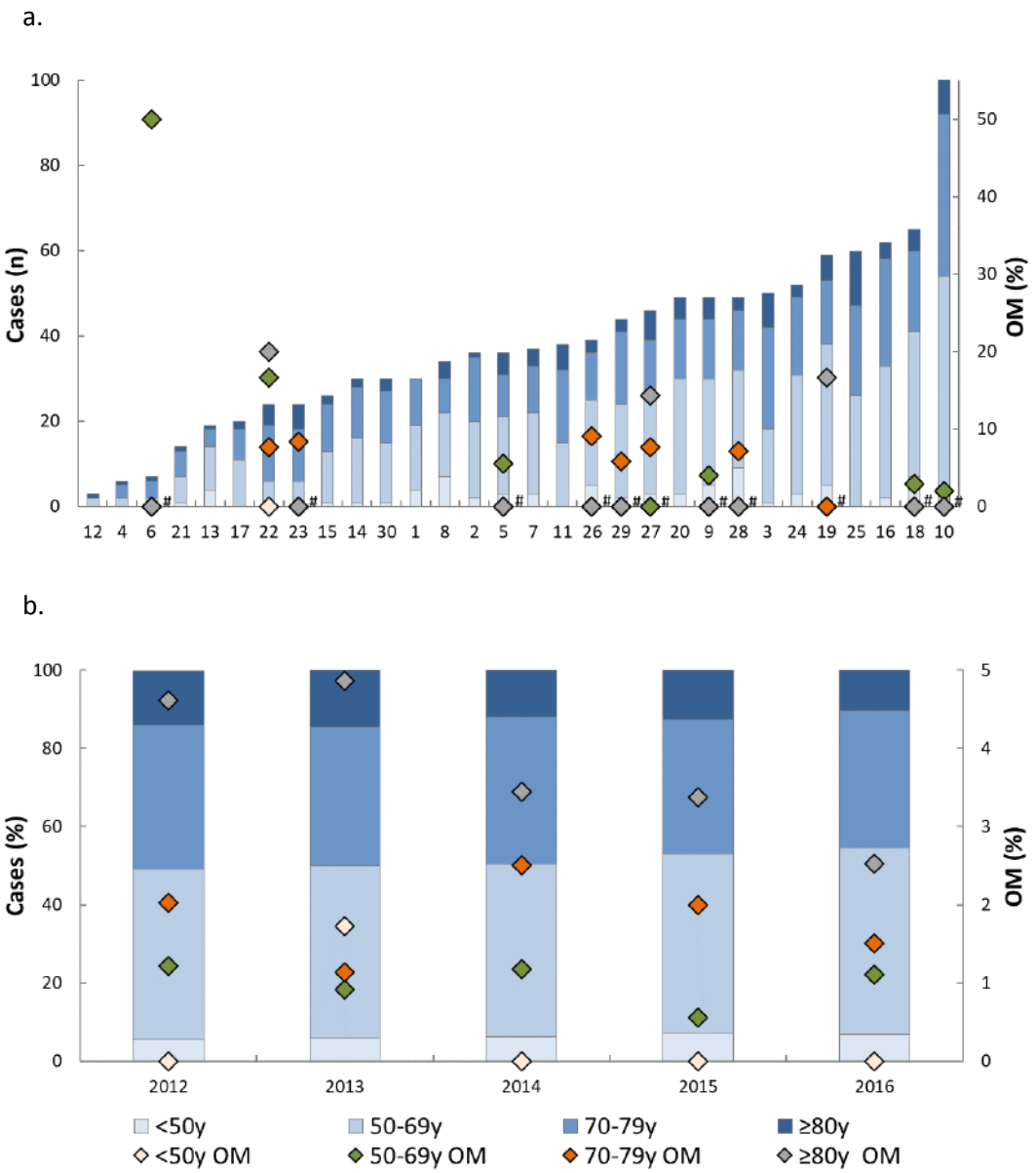


Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 6. OM of male patients following CABG procedures based on age by a. unit and b. year

In 2016, the largest proportion female patients who had a CABG procedure, were also aged 50-69 years (Figure 7a). No OM was reported for females aged below 50 years. Six units reported OM for females aged 50-69 years (2.0-50.0%) and for those aged 70-79 years (5.9-9.1%). Three units reported OM for patients aged 80 years and above (14-20%). The number of OM relative to number of cases, is tabulated in Appendix D-III.

Pooled unit data shows that annually, the majority of female patients who had CABG procedures are aged 50-69 years (Figure 7b). Averaged OM for females aged below 50 years is 0.3%; aged 50-69 years, 1.0%; 70-79 years, 1.8%; and for females aged 80 years and above, 3.8%.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

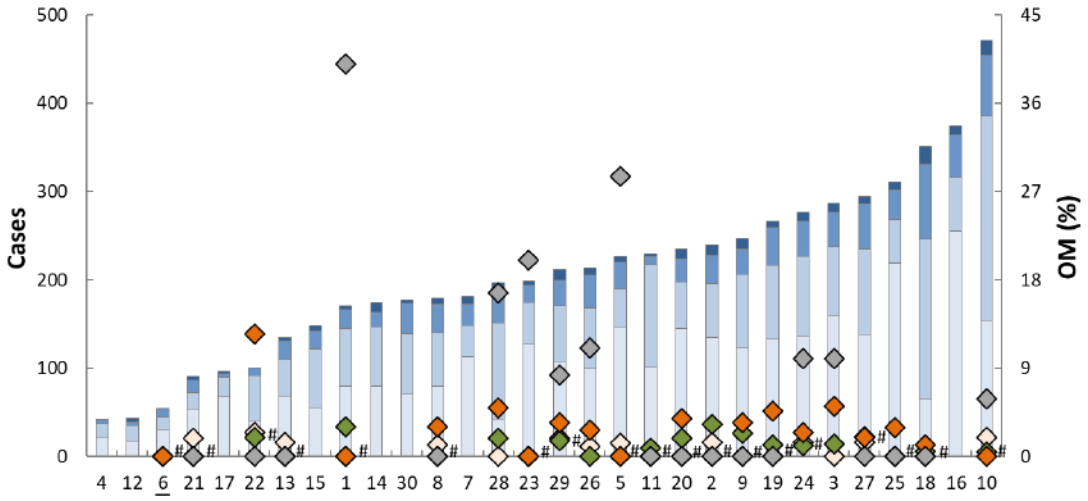
Figure 7. OM of female patients following CABG procedures based on age by a. unit and b. year

1.1.3 Left ventricular function

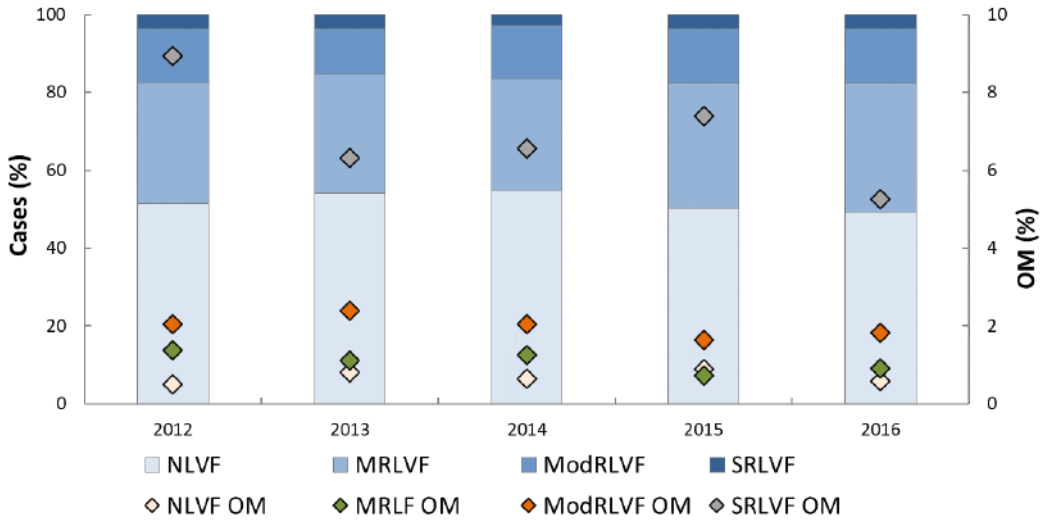
The majority of patients having CABG in 2016 had normal LVF (NLVF; Figure 8a). For patients with NLVF, eleven units reported OM (1.0-2.4%); mildly reduced LVF (MRLVF), fourteen units (0.4-3.3%); moderately reduced LVF (ModRLVF), thirteen units (1.2-12.5%); and severely reduced LVF (SRLVF), ten units (5.9-100%). The number of OM relative to number of cases, is tabulated in Appendix D-IV.

Pooled unit data shows that annually since 2012, most patients have NLVF (>49%), and less than 4% have SRLVF (Figure 8b). Averaged OM is 0.7% for NLVF patients; 1.0% for MRLVF, 2.0% for ModRLVF; and 6.8% for SLVF.

a.



b.



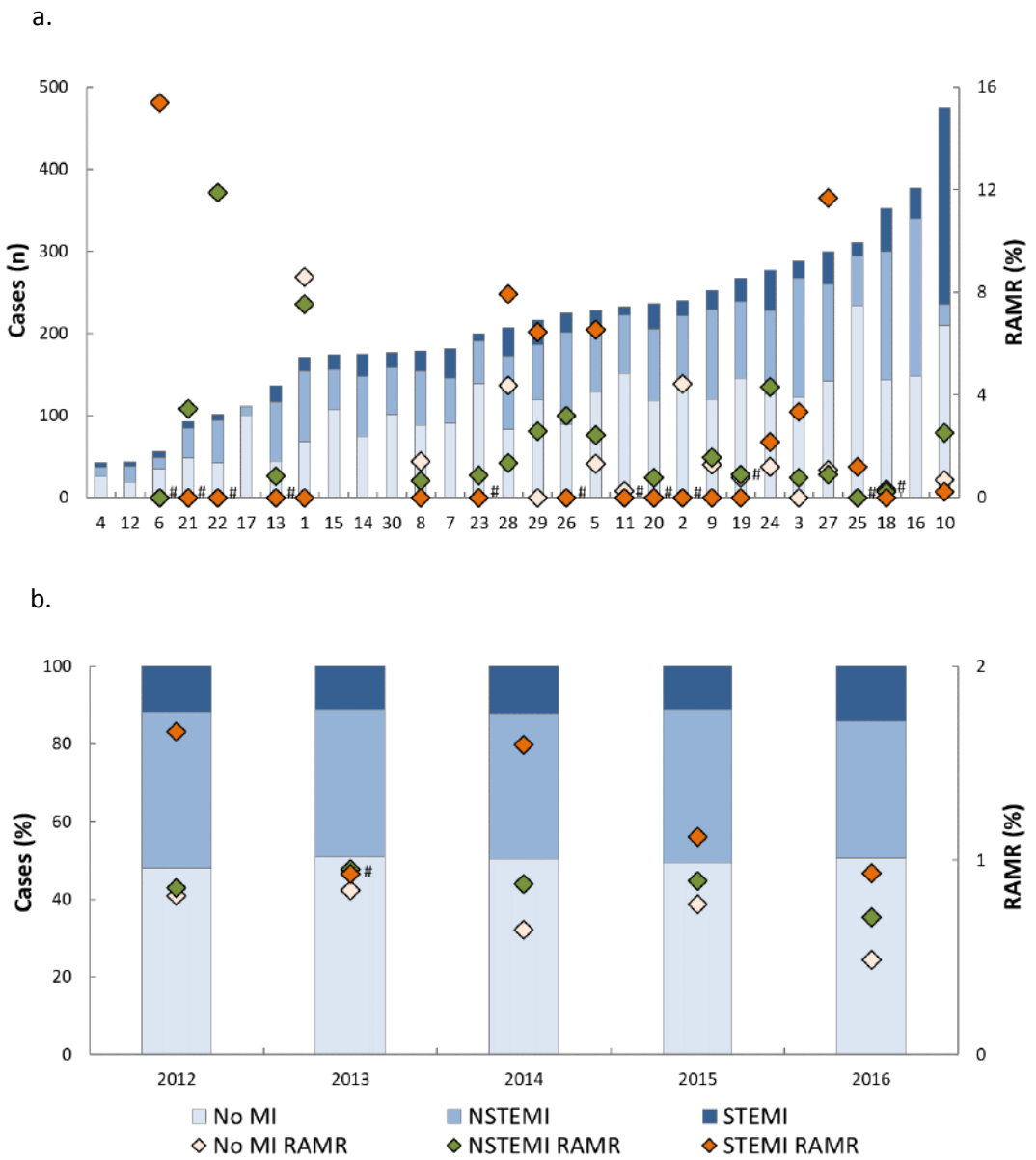
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined unit reported 100% OM for SRVLF group

Figure 8. OM following CABG procedures based on pre-procedure LVF by a. unit and b. year

1.1.4 Previous myocardial infarction

In 2016, eight units reported no OM in patients with no previous myocardial infarction (MI) prior to CABG (Figure 9a). For patients with no previous MI, RAMR was reported by twelve units (0.7-2.9%); for patients with ST Elevation MI (STEMI), by nine units (0.8-12.5%); and for patients with non-STEMI (NSTEMI) by eighteen units (0.6-5.9%).

Annual pooled unit data shows that since 2012, 50% of all patients had no MI prior to CABG, 38% had NSTEMI and 12% STEMI. Averaged RAMR for patients without previous MI is 0.7%, and for patients with previous NSTEMI and STEMI, 0.9% and 1.2%, respectively (Figure 9b).



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

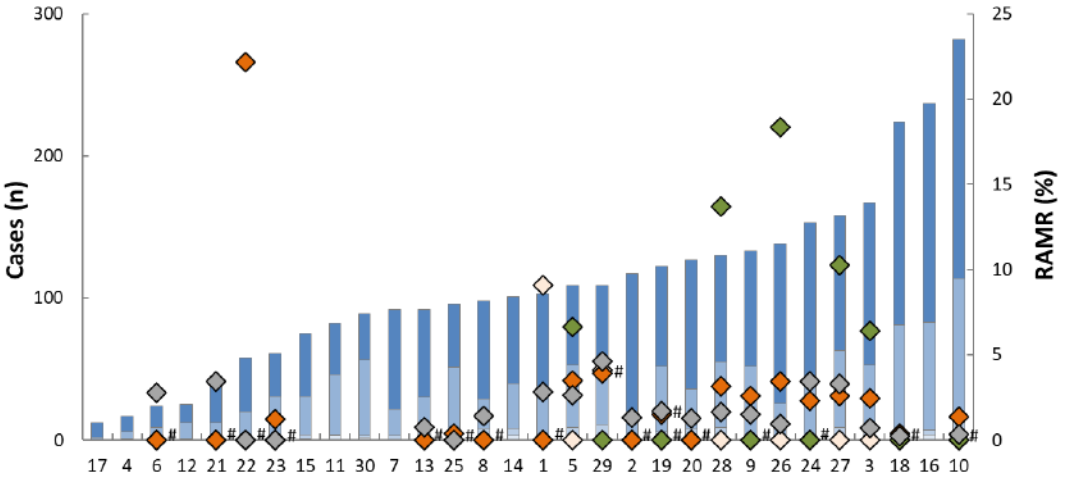
Figure 9. RAMR following CABG procedures based on prior MI by a. unit and b. year

1.1.5 Timing of prior myocardial infarction

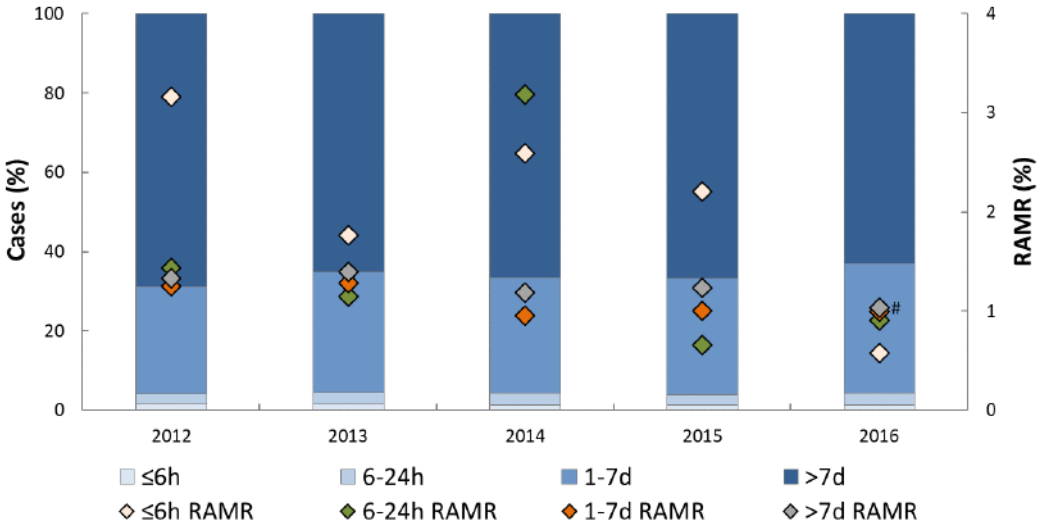
In all units, the majority of patients with prior MI, reported the incident occurring more than 7 days prior to CABG surgery (Figure 10a). For patients with MI occurring 6 hours or less prior, units 1 and 29 had a RAMR of 9.1% and 4.1%, respectively. For patients with MI occurring 6-24 hours prior, RAMR was 6.4-18.4% in five units; for MI occurring 1-7 days, RAMR was 0.4-22.2% in thirteen units; for MI occurring more than 7 days prior, RAMR was 0.3-4.6% in seventeen units. The number of OM relative to number of cases, is tabulated in Appendix D-V.

Pooled unit data shows annually since 2012, the majority (>63%) of prior MI occur more than 7 days prior to CABG (Figure 10b). Averaged RAMR for patients with prior MI occurring 6 hour or less is 2.0%; 6-24 hour prior, 1.3%; 1-7 days prior, 1.1%; and more than 7 days prior, 1.2%.

a.



b.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% RAMR)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 10. RAMR following CABG procedures based on timing of pre-procedure MI by a. unit and b. year

1.2 Complications based on risk factors

Post-operative complications considered in this report include derived new renal impairment (DNRI), any cerebrovascular accident (CVA), deep sternal wound infection (DSWI), new cardiac arrhythmia (NCA), and re-operation (re-op) for bleeding or tamponade.

1.2.1 Pre-existing diabetes or renal impairment

Renal impairment is defined as either a pre-operative creatinine level of ≥200µmol/L or pre-operative estimated glomerular filtration rate (eGFR) ≤60mL/min/1.73m^2.

Generally, patients with diabetes or prior renal impairment have a higher incidence of post-operative complications (Table 1).

Table 1. Complications (%) based on diabetes and renal function status

		Diabetes*		Pre-op creatinine		Pre-op eGFR	
Post-operative complication		No	Yes	<200 µmol/L	≥200 µmol/L	>60mL /min/1.73m2	≤60mL /min/1.73m2
n	2016	3858	2479	6137	208	5021	1324
	2012-2015	13599	8065	20978	705	16484	5199
Any CVA	2016	1.3	1.3	1.2	2.9	1.1	2.0
	2012-2015	1.0	1.4	1.1	2.1	0.8	2.1
DNRI	2016	1.8	3.4	2.2	9.6	1.8	4.6
	2012-2015	2.6	4.2	3.1	6.4	2.5	5.2
DSWI	2016	1.4	1.8	1.6	1.9	1.6	1.6
	2012-2015	0.7	1.6	1.0	2.0	0.9	1.2
NCA	2016	27.2	26.0	26.7	29.8	26.0	29.6
	2012-2015	26.0	25.0	25.5	30.3	24.1	30.4
Re-op for bleeding	2016	2.2	1.7	1.9	3.4	1.7	2.9
	2012-2015	2.2	2.1	2.1	4.0	1.9	3.2

* Eight and 19 missing cases in 2016 and 2012-2015, respectively.

1.2.2 Age

Advancing age is usually associated with higher incidence of post-operative complications (Table 2).

Table 2. Complications (%) based on patient age

		Age			
Post-operative complication		<50 y	50-69 y	70-79 y	>80 y
n	2016	421	3493	1924	506
	2012-2015	1390	11939	6447	1901
Any CVA	2016	0.5	1.1	1.7	1.4
	2012-2015	0.7	0.8	1.5	2.1
DNRI	2016	1.9	1.9	3.1	3.2
	2012-2015	2.2	2.6	3.4	6.3
DSWI	2016	0.2	1.7	1.6	1.6
	2012-2015	1.2	0.9	1.1	0.9
NCA	2016	10.7	23.9	32.9	36.8
	2012-2015	9.9	22.1	32.1	37.1
Re-op for bleeding	2016	2.6	1.6	2.4	2.0
	2012-2015	2.4	2.0	2.4	2.7

1.2.3 Surgical history or use of cardiopulmonary bypass

Redo CABG and on-pump procedures are generally associated with higher incidence of post-operative complications than initial CABG and those performed off pump (Table 3). However, the off-pump CABG group are generally a highly selected group. Only three units perform a significant proportion of off-pump CABG operations (Figure 12a).

Table 3. Complications (%) based on surgical history or use of cardiopulmonary bypass (CPB)

		Surgery		CPB*	
Post-operative complication		Initial	Redo	On-pump	Off-pump
n	2016	6232	113	5931	413
	2012-2015	21150	533	19971	1707
Any CVA	2016	1.3	0.9	1.3	0.2
	2012-2015	1.1	2.3	1.2	0.9
DNRI	2016	2.3	6.2	2.5	1.7
	2012-2015	3.2	3.8	3.3	2.2
DSWI	2016	1.5	3.5	1.6	0.7
	2012-2015	1.0	1.1	1.0	0.8
NCA	2016	26.9	21.2	26.9	25.2
	2012-2015	25.6	27.0	25.7	24.8
Re-op for bleeding	2016	1.9	3.5	1.9	2.4
	2012-2015	2.2	2.3	2.2	2.2

* One and five missing cases in 2016 and 2012-2015, respectively

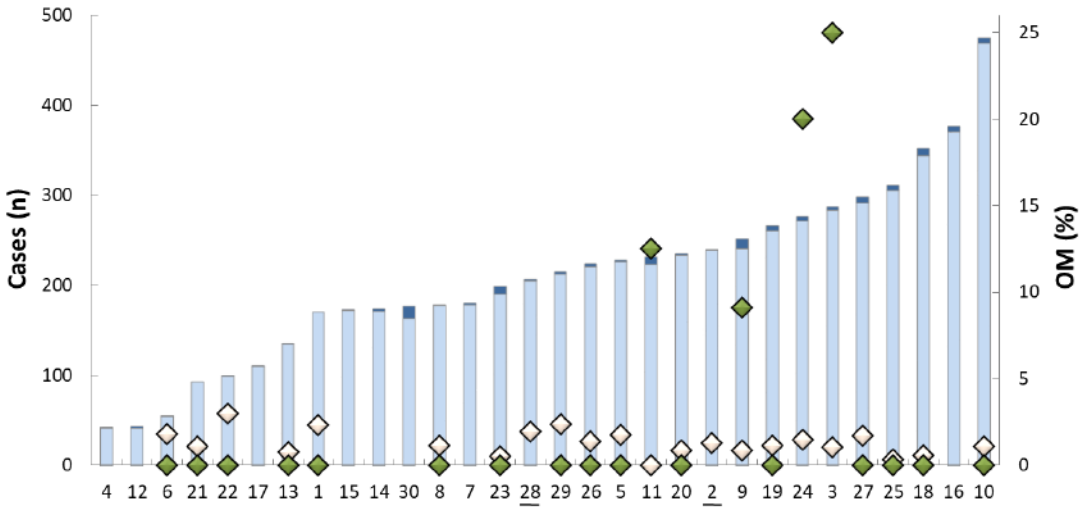
1.3 Mortality based on previous surgery or use of cardiopulmonary bypass

1.3.1 Initial versus redo procedure

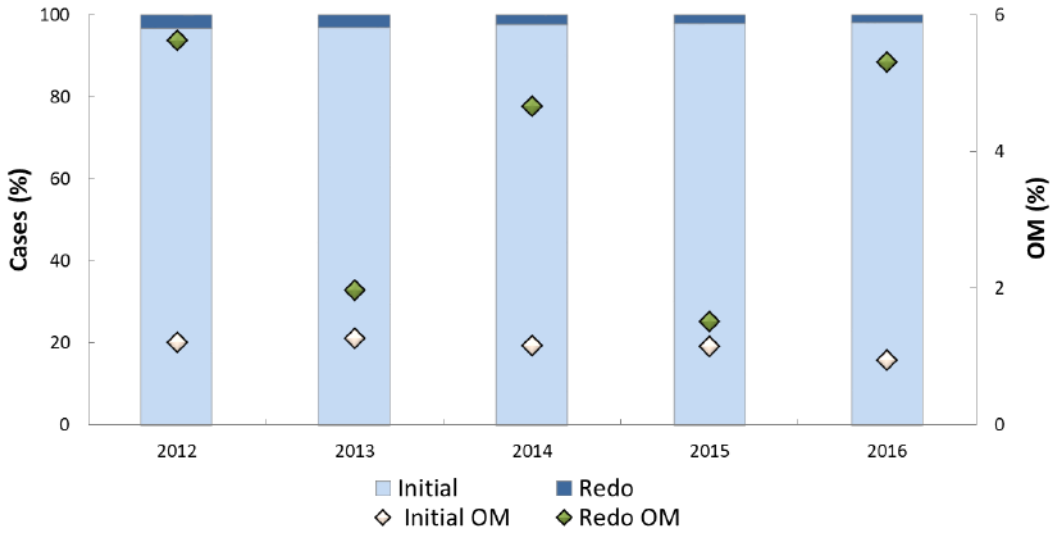
In 2016, four units reported OM for redo procedures; unit 2 (100%; OM=1), unit 3 (25%), unit 24 (20%) and unit 28 (100%; OM=1). Twenty-one units reported OM for initial procedures (0.3-3.0%; Figure 11a).

Pooled unit data shows annually, less than 3% procedures are redo (Figure 11b). Averaged OM for initial CABG is 1.1%, and for redo CABG 3.7%.

a.



b.



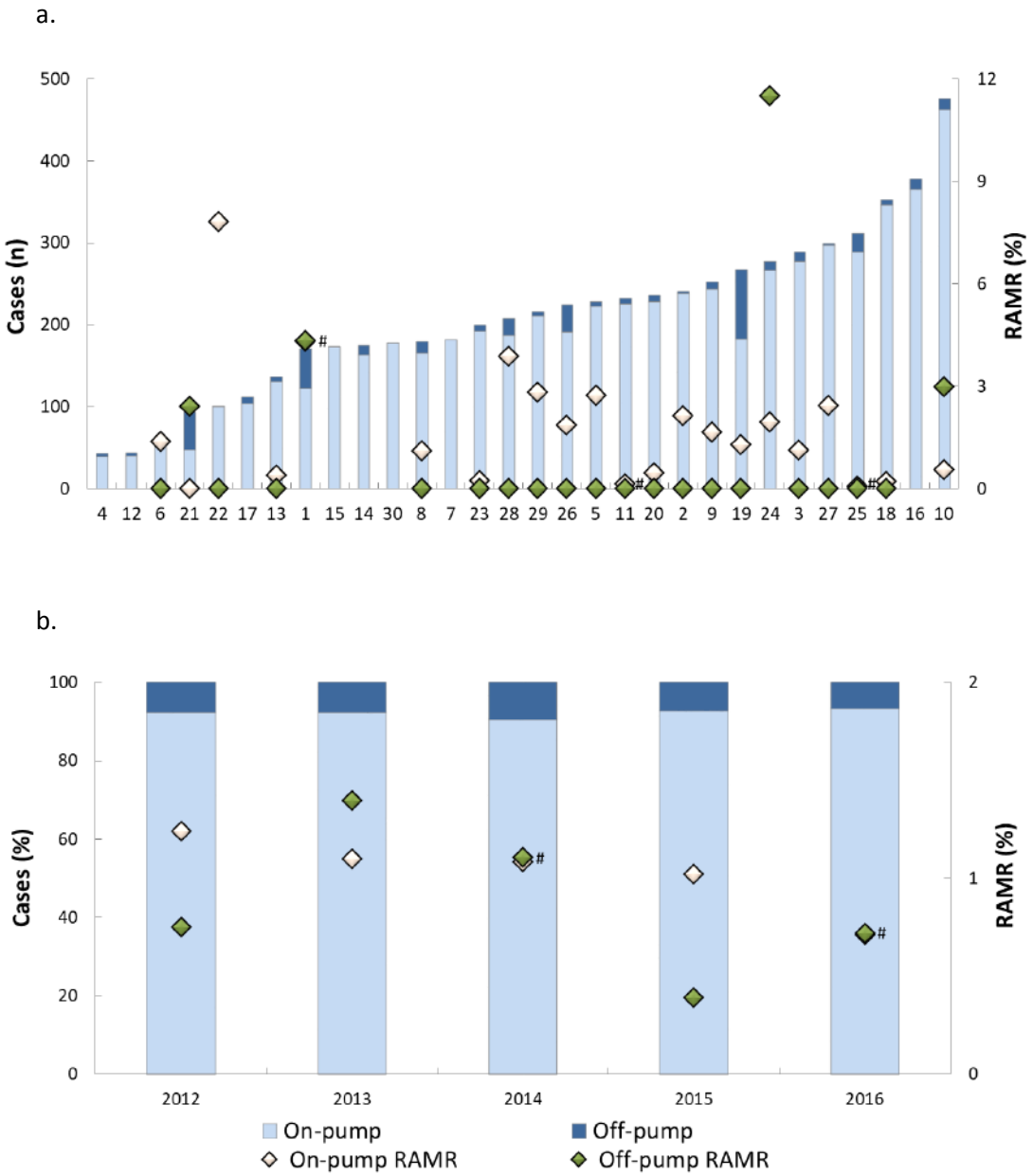
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined units reported 100% OM for Redo group

Figure 11. OM following initial versus redo CABG by a. unit and b. year

1.3.2 On-pump versus off-pump

In 2016, four units reported off-pump OM (RAMR 2.4-11.5%), and twenty-one units on-pump (RAMR 0.1-7.8%; Figure 12a).

Pooled unit data shows that annually since 2012, less than 10% of procedures are off-pump (Figure 12b). Averaged RAMR for on-pump and off-pump CABG is 1.0%, and 0.9%, respectively.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% RAMR)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 12. OM following on-pump and off-pump CABG by a. unit and b. year

1.4 Conduits used and distal anastomoses performed

Compared to on-pump, off-pump CABG procedures in 2016 involved fewer mean number of total grafts, comprised of predominantly of all-arterial grafts, therefore, relatively few arterial with saphenous vein graft (SVG; Table 4a). For pooled unit data, the mean number of all grafts in the preceding four years, was also higher for on-pump CABG.

In the preceding four years, compared to on-pump, off-pump procedures have a higher proportion of bilateral (B) internal thoracic artery (ITA) and T and Y grafts and consequently a lower proportion of left (L) and right (R) ITA, gastroepiploic artery (GEPA) and radial artery (RA; Table 4b) conduits.

Table 4a. Summary of anastomoses and conduits for on-pump and off-pump CABG

		On-pump	Off-pump
No. of patients	2016	5931	413
	2012-2015	19971	1707
Mean no. grafts	2016	3.2	2.4
	2012-2015	3.2	2.4
Only arterial grafts* (%)	2016	21.9	61.3
	2012-2015	21.5	68.2
Arterial with SVG grafts* (%)	2016	77.8	38.5
	2012-2015	78.4	31.5

*Proportion of procedures in which at least one graft was used

Table 4b. Arterial conduits used for on-pump and off-pump CABG (% of patients)

		On-pump	Off-pump
BITA	2016	8.3	20.3
	2012-2015	8.3	26.5
GEPA	2016	0.2	0.2
	2012-2015	0.4	0.3
LITA or RITA	2016	85.4	77.7
	2012-2015	85.8	71.2
RA (x1 or x2)	2016	35.3	26.9
	2012-2015	37.6	29.4
T or Y grafts*	2016	9.3	16.5
	2012-2015	8.5	27.4

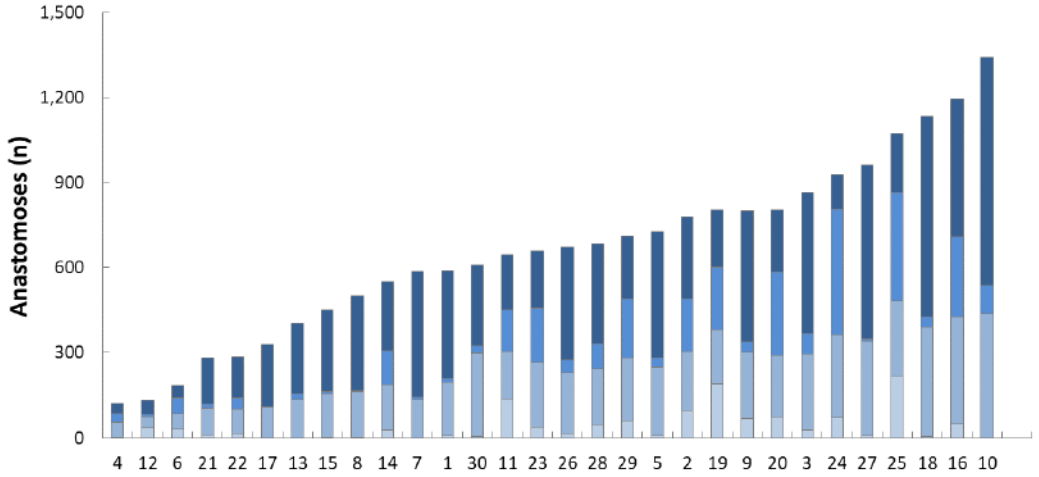
* Arterial only

1.5 Arterial and venous conduit usage

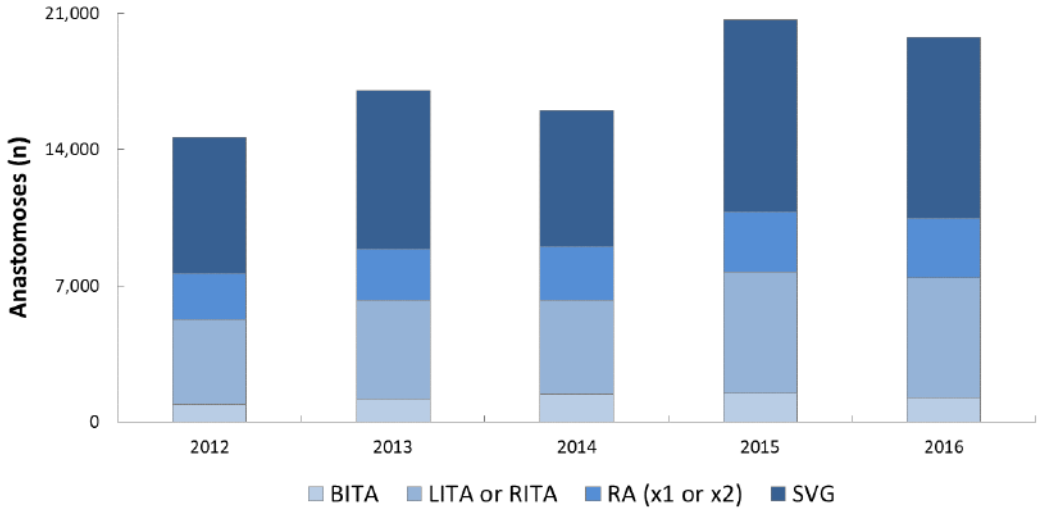
In 2016, the number of anastomoses performed per unit with bilateral ITA's was 110 (unit 19) or fewer, with unilateral ITA's 28 (unit 12) to 415 (unit 10), with RA 246 (unit 24) or fewer and for SVG from 22 (unit 4) to 404 (unit 10; Figure 13a).

Pooled unit data shows annually since 2012, the greatest number of anastomoses were performed using ITA conduits (>41%; Figure 13b). GEPA represented less than 40 anastomoses annually from 2012-2016 (data not shown).

a.



b.



Left vertical axis = Coloured columns (number of anastomoses)

Figure 13. Number of arterial and venous anastomoses by a. unit and b. year

1.6 Unit Outcomes – mortality, complications and resource utilisation

Unit outcomes for mortality, complications, and resource utilisation are represented by funnel plots (Appendix B-II). The solid line in each plot represents the average value. Units above the upper 95% confidence interval (CI) are notified and managed as outlined in Appendix A.

Complications reported are any CVA, DNRI, DSWI, NCA, readmission, and re-op for bleeding.

Resource utilisation variables reported are intensive care unit (ICU) and ventilation (VENT) times, pre- and post- procedural length of stay (-PLOS), red blood cell (RBC) and non-RBC transfusion (NRBC).

1.6.1 Mortality

In 2016, the average OM was 1.0%, and for the preceding four years, 1.2% (Figure 14a, b).

The 2016 average RAMR is 0.8%, and for the preceding four years 1.1% (Figure 14c, d).

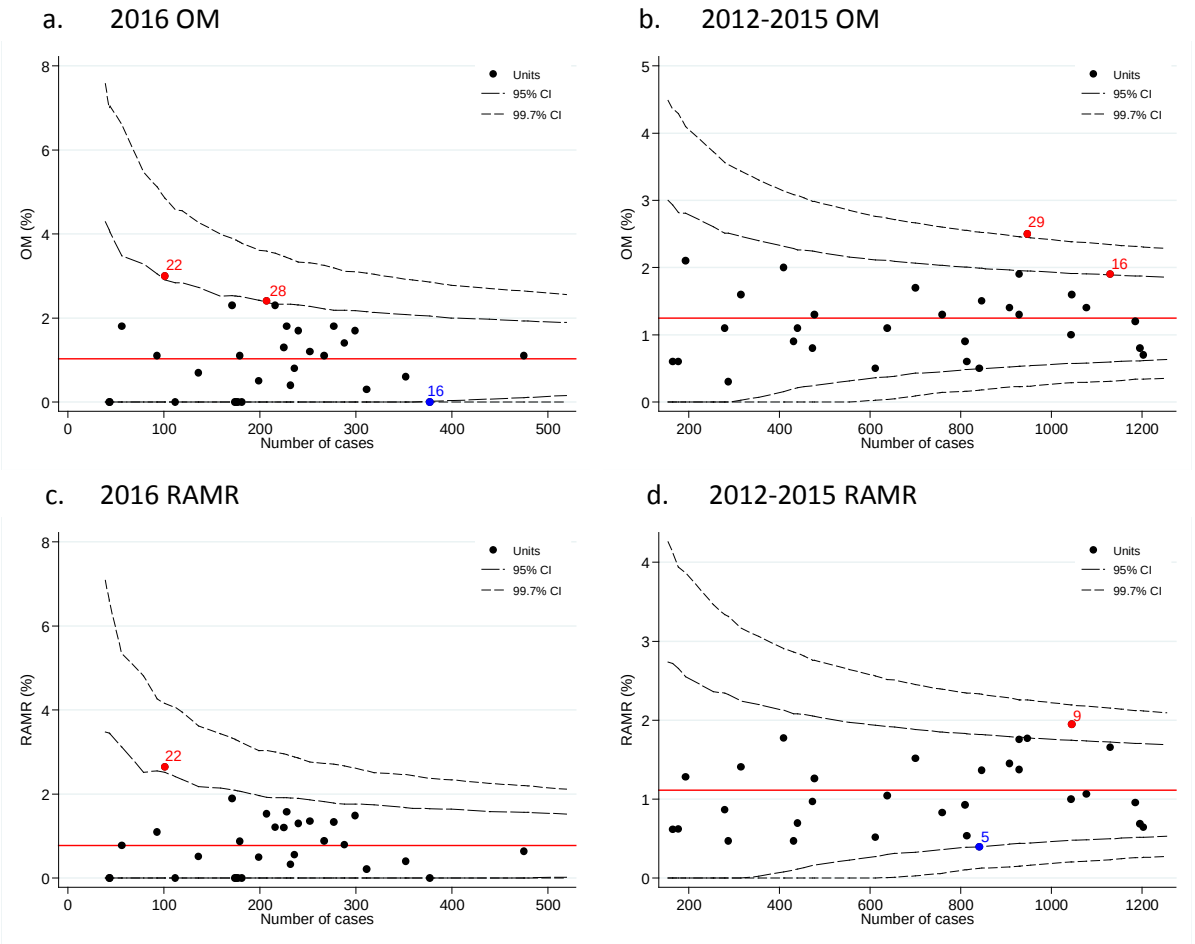


Figure 14. Mortality following CABG

1.6.2 Complications 2016

For 2016 (Figure 15), average complication rates were: CVA 1.3%; DNRI 2.4%; DSWI 1.6%; NCA 27%; re-op for bleeding 1.9%; and readmission 9.4%. All units were within upper 95% CI for DSWI.

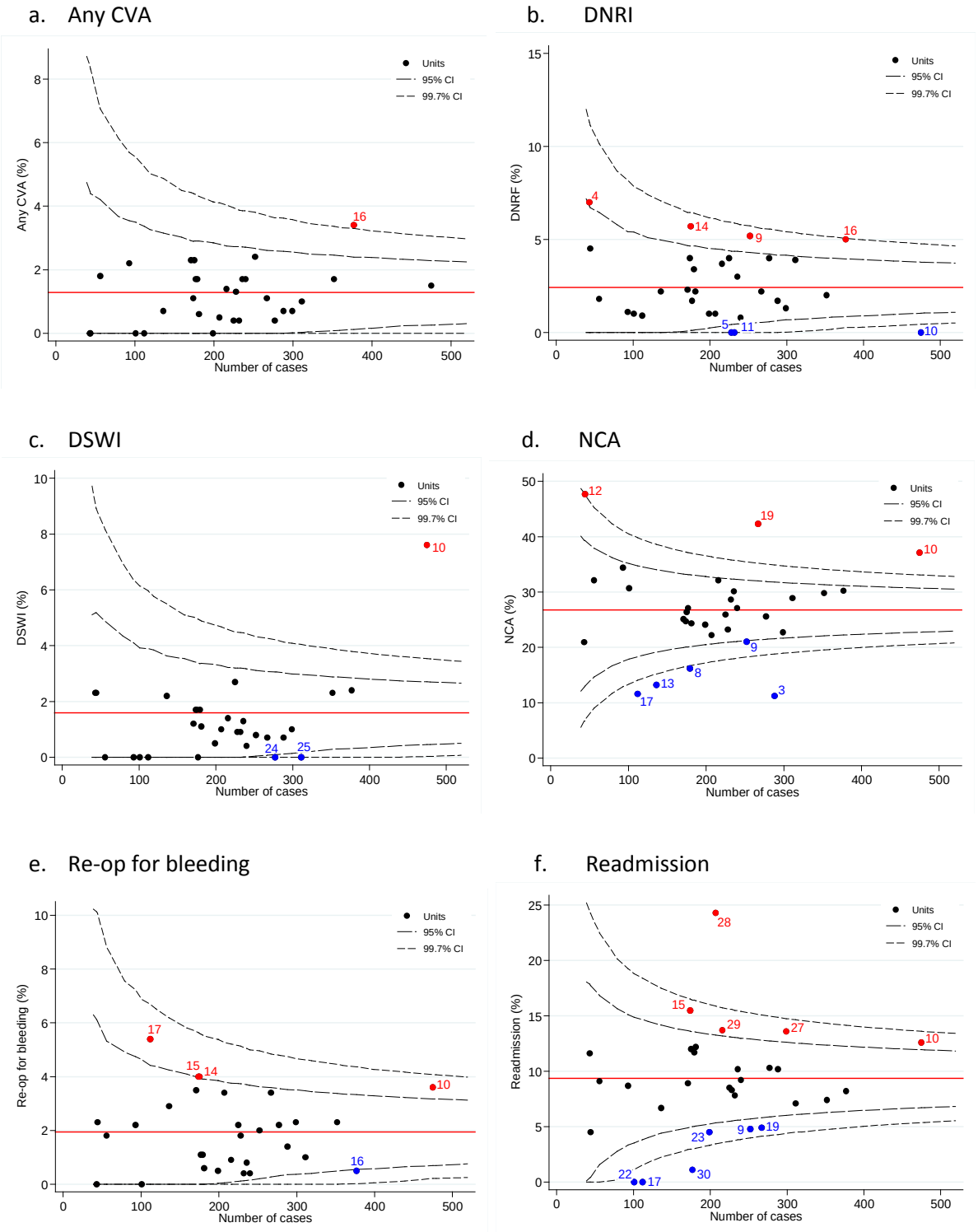


Figure 15. 2016 complication outcomes following CABG

1.6.3 Complications 2012-2015

For preceding four years combined (Figure 16), average complication incidences were: CVA 1.1%; DNRI 3.2%; DSWI 1.0%; NCA 26%; re-op for bleeding 2.2%; and readmission 8.7%.

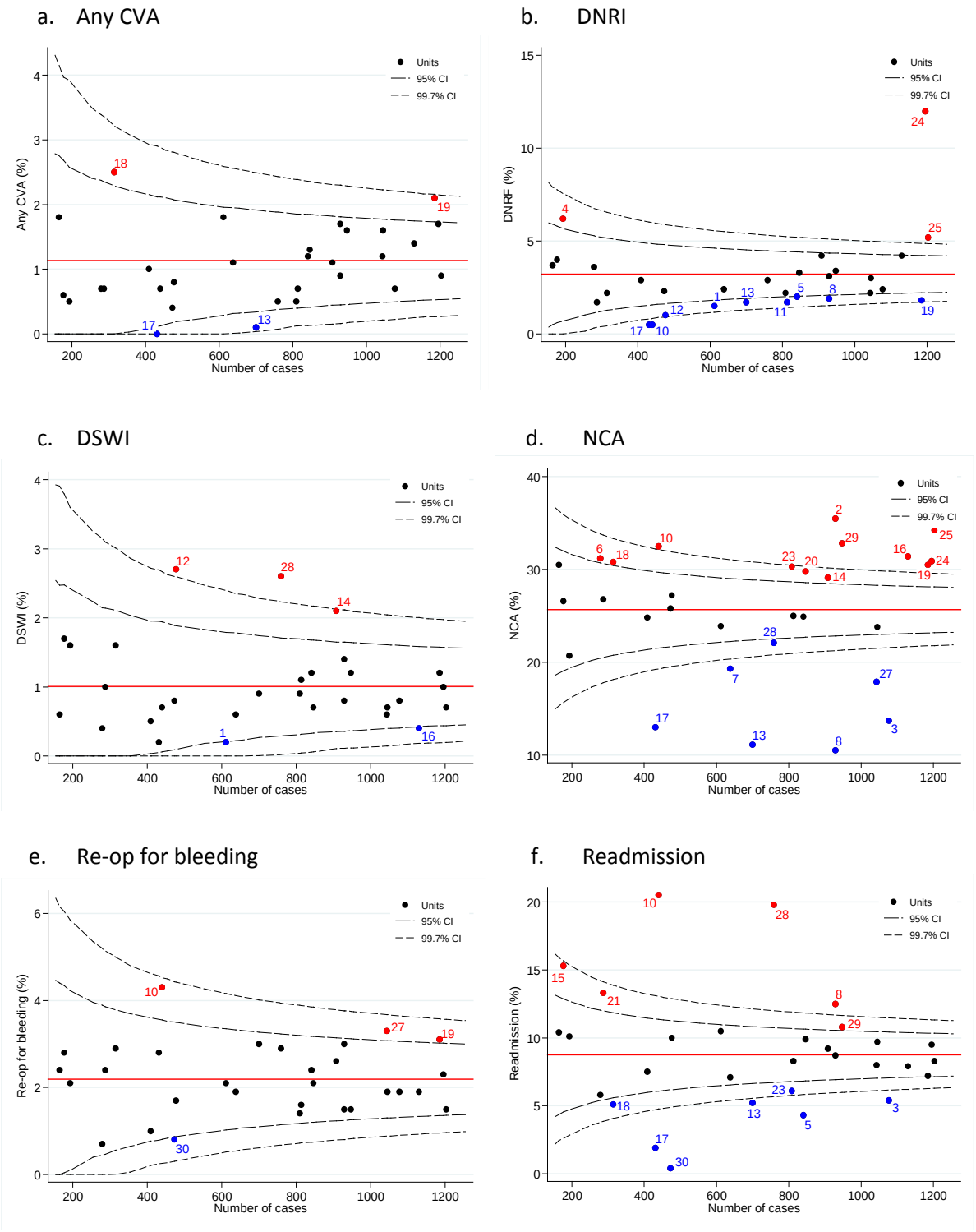


Figure 16. Four year pooled complication outcomes following isolated CABG

1.6.4 Resource utilisation 2016

For 2016 (Figure 17), averaged median resource utilisation times were: ICU 43 hours; VENT 9.2 hours; Pre-PLOS 1.6 days; and Post-PLOS 6.9 days. The average percentages of patients transfused with blood products were: RBC 28%; and NRBC 16%. All units were within 95% CI for Post-PLOS.

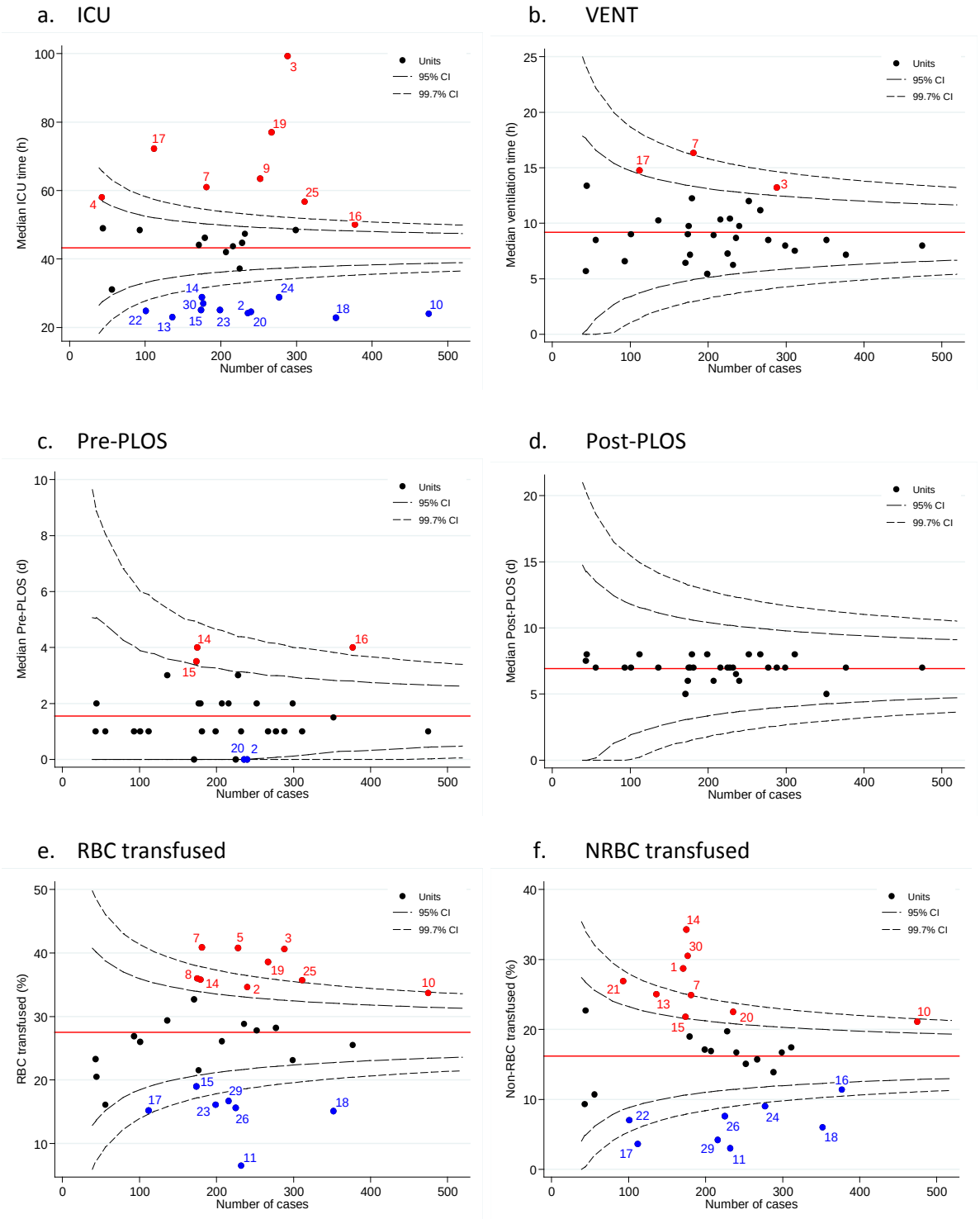


Figure 17. 2016 resource utilisation following CABG

1.6.5 Resource utilisation 2012-2015

For the preceding four years combined (Figure 18), averaged median resource utilisation times were: ICU 42 hours; VENT 10 hours; Pre-PLOS 1.4 days; and Post-PLOS 6.9 days. The average percentages of patients transfused with blood products were: RBC 32% and NRBC 20%. All units were within 95% CI for Post-PLOS.

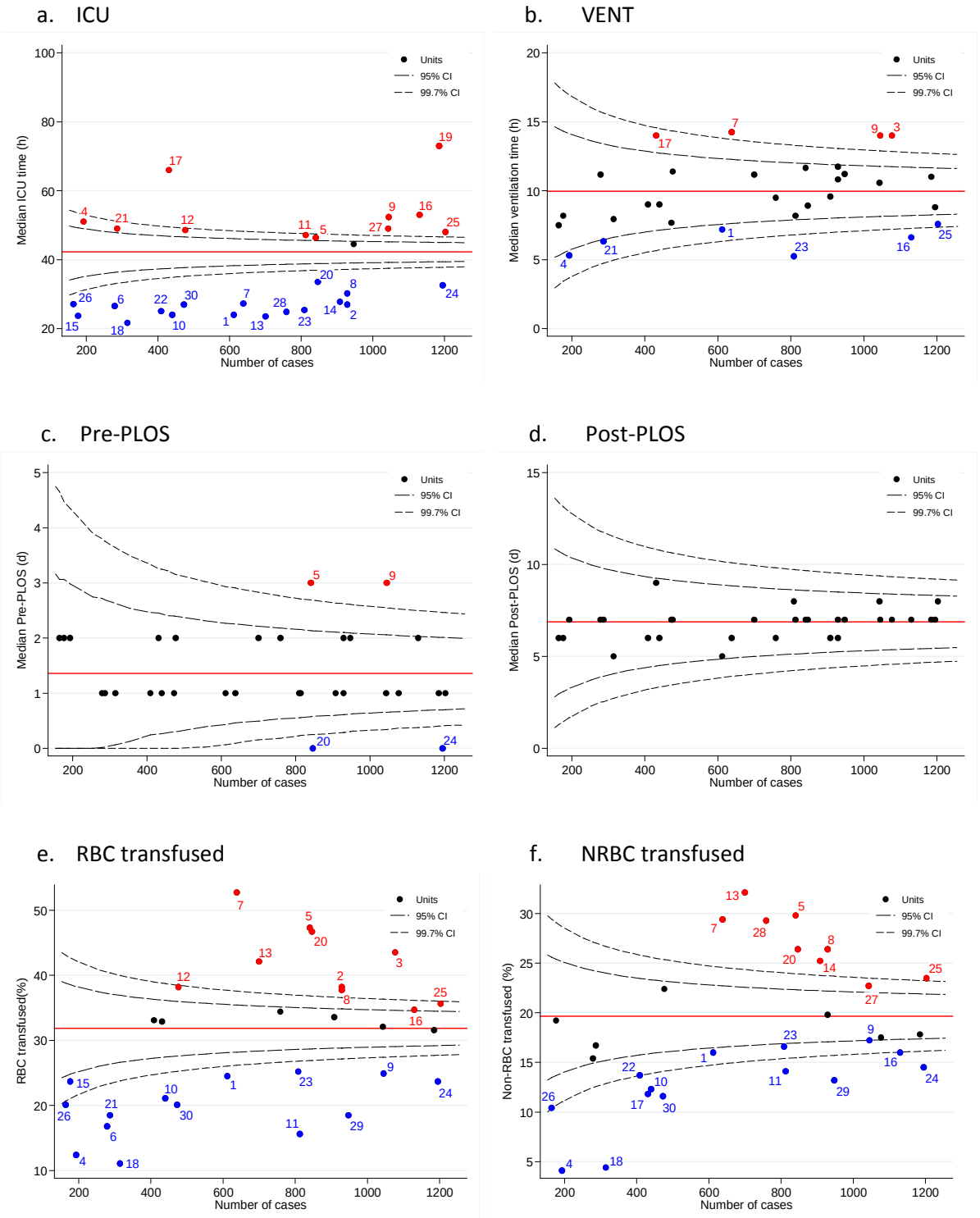


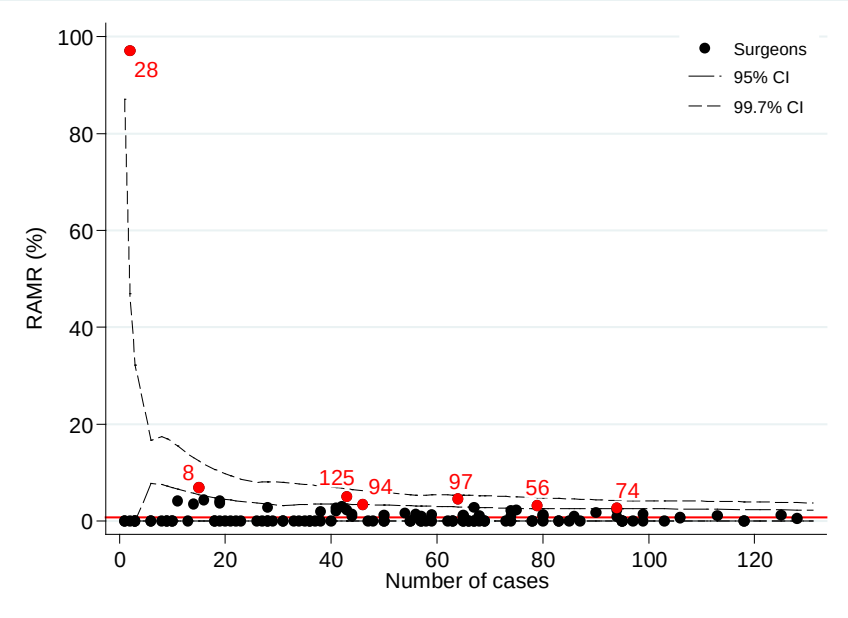
Figure 18. Four year pooled resource utilisation following CABG

1.7 Surgeons' outcomes – mortality

Surgeons' outcomes for mortality are represented by funnel plots (Appendix B-II). The solid line in each plot represents the average value. When a surgeon's RAMR is above the upper 95% CI, the surgeon and Head of Unit where the surgeon practices, are notified and managed as outlined in Appendix A.

The 2016 average RAMR is 0.8%, and for the preceding four years, 1.1% (Figure 19). The number of OM relative to number of cases, is tabulated in Appendix D (Tables VII-VIII).

a. 2016 RAMR



b. 2012-2015 RAMR

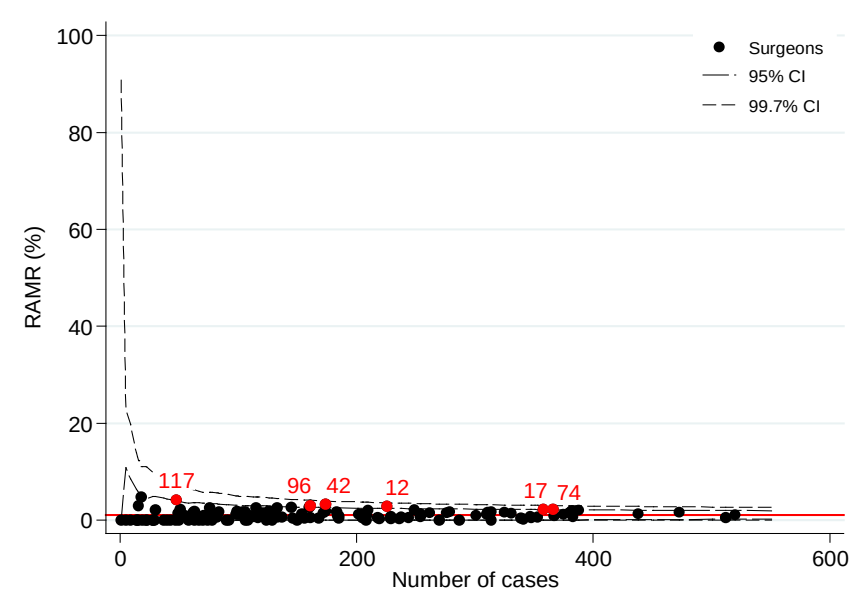


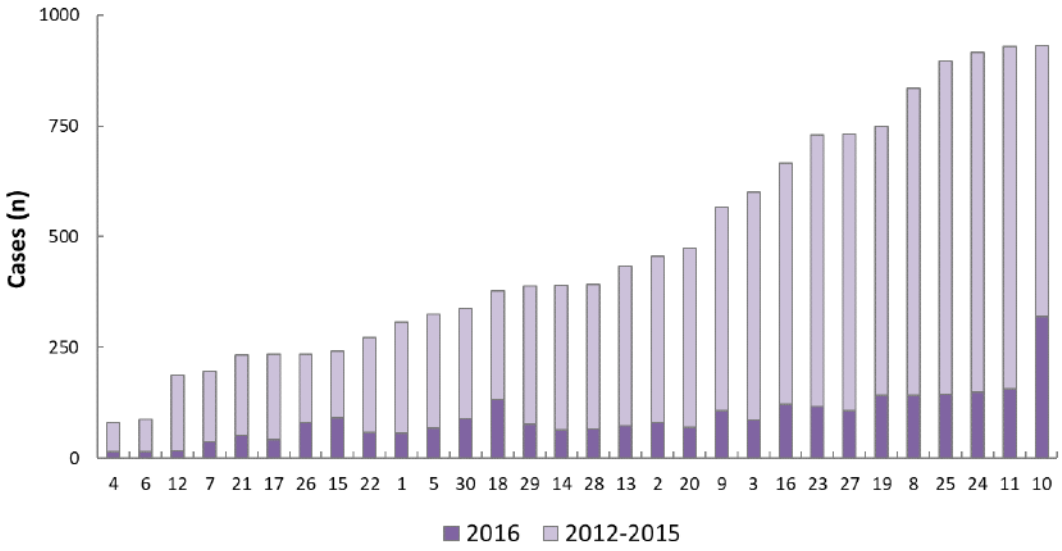
Figure 19. Mortality following CABG, for individual surgeons

1.8 Key Messages

- *Generally, OM increases with clinical urgency, most markedly for emergency patients.*
- *Overall, OM increases with age and is generally higher for women than in men.*
- *Impaired LVF is associated with a higher risk of OM.*
- *Previous AMI is associated with higher OM.*
- *Patients with diabetes or prior renal impairment, have higher RAMR and generally higher incidence of post-operative complications.*
- *Advancing age is usually associated with a higher incidence of post-operative complications.*
- *Redo CABG and on-pump procedures are generally associated with higher incidences of post-operative complications than initial CABG and those performed off pump.*
- *Relatively few anastomoses are performed using bilateral ITA's.*
- *Most units used unilateral ITA conduit to perform at least half and arterial conduit of various types for two-thirds of anastomoses. Therefore, only about a third of anastomoses are performed using SVGs.*
- *Complication rates for 2016 were similar to the proceeding four years, with a slightly lower incidence of DNRI and re-op for bleeding, and higher DSWI.*

2. Valve Surgery

In 2016, units 4 and 6 performed the fewest number of isolated valve procedures (n=15) and unit 10 the most (n=319; Figure 20). Not all units contributed for all of the proceeding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 20. Isolated valve procedures performed by unit, 2012-2016

2.1 Overview of all valve procedures

Single and multi-valve procedures are detailed in Table 5a. A full list of valve procedures is detailed in the Data Definitions Manual. Aortic root reconstructions and transcatheter aortic valve replacements (TAVR) are reported in Table 5b.

The most common isolated valve procedures performed in 2016 and for the preceding four years, were single aortic, followed by single mitral (Table 5a). For both procedures, OM was below 2% for each time period. For valve procedures combined with CABG, OM is generally higher.

Of other valve procedures (Table 5b), the most common performed in 2016 were TAVR and aortic root replacement with valve conduit. In 2016, OM was reported for the latter (5.3%) and for David procedures (3.9%). For preceding four-year data, the highest OM is associated with aortic root replacement with valve conduit procedures (3.6%).

The majority of valve procedures combined with CABG are aortic valve replacement (AVR); these are analysed and presented in detail in section 3.0.

Table 5a. Valve procedures performed in 2016 and in preceding four years

Valve Procedure	Year	Without CABG		With CABG	
		n	OM (%)	n	OM (%)
Single Aortic#	2016	1421	1.9	854	2.7
	2012-2015	4793	1.9	3106	3.4
AVR	2016	1361	1.8	841	2.7
	2012-2015	4594	1.9	3063	3.4
Other Aortic	2016	60	5.0	13	0.0
	2012-2015	199	1.5	43	7.0
Single Mitral†	2016	695	1.2	250	5.2
	2012-2015	2331	1.7	942	5.6
Replacement	2016	307	2.3	117	6.0
	2012-2015	1008	3.5	379	9.0
Repair	2016	387	0.3	133	4.5
	2012-2015	1307	0.4	555	3.2
Single Tricuspid	2016	41	7.3	9	11.1
	2012-2015	138	7.2	23	4.3
Single Pulmonary	2016	39	1.8	-	-
	2012-2015	95	0.0	4	25.0
Aortic and Mitral	2016	154	3.2	47	14.9
	2012-2015	502	6.4	176	6.3
Aortic and Tricuspid	2016	17	0.0	7	0.0
	2012-2015	45	2.2	22	9.1
Mitral and Tricuspid	2016	137	5.8	28	17.9
	2012-2015	393	4.8	110	10.9
Other Double	2016	15	6.7	1	0.0
	2012-2015	22	0.0	3	33.3
Triple	2016	44	9.1	8	0.0
	2012-2015	119	11.8	33	24.2
Quadruple	2016	-	-	-	-
	2012-2015	2	0.0	-	-
Total valve procedures^	**2016**	**2563**	**2.2**	**1204**	**4.1**
	2012-2015	**11005**	**2.4**	**5623**	**4.4**

^ 10 procedures were not included as they were miscoded
# Aortic valve procedures exclude TAVR
† Mitral valve procedures exclude TMVR

Table 5b. Other valve procedures performed in 2016 and in preceding four years

Valve Procedure	Year	WITHOUT CABG		WITH CABG	
		n	OM %	n	OM %
Aortic root replacement with valve conduit	2016	187	5.3	48	6.3
	2012-2015	698	3.6	161	13.0
Pulmonary autograft aortic root replacement (Ross)	2016	22	0.0	-	-
	2012-2015	73	0.0	1	0.0
Root reconstruction with valve sparing (David)	2016	51	3.9	12	0.0
	2012-2015	125	1.6	17	0.0
TAVR	2016	205	0.0	7	0.0
	2012-2015	327	3.1	1	0.0
Transapical#	2016	7	-	-	-
Transfemoral#	2016	37	-	-	-
Total other valve procedures	**2016**	**465**	**2.6**	**67**	**4.5**
	2012-2015	**1688**	**2.9**	**247**	**9.7**

^ TAVRs captured by the ANZSCTS Database are those in which a cardiothoracic surgeon participates.
# New variables introduced in v4, thus the denominators do not equal the total number of TAVR procedure

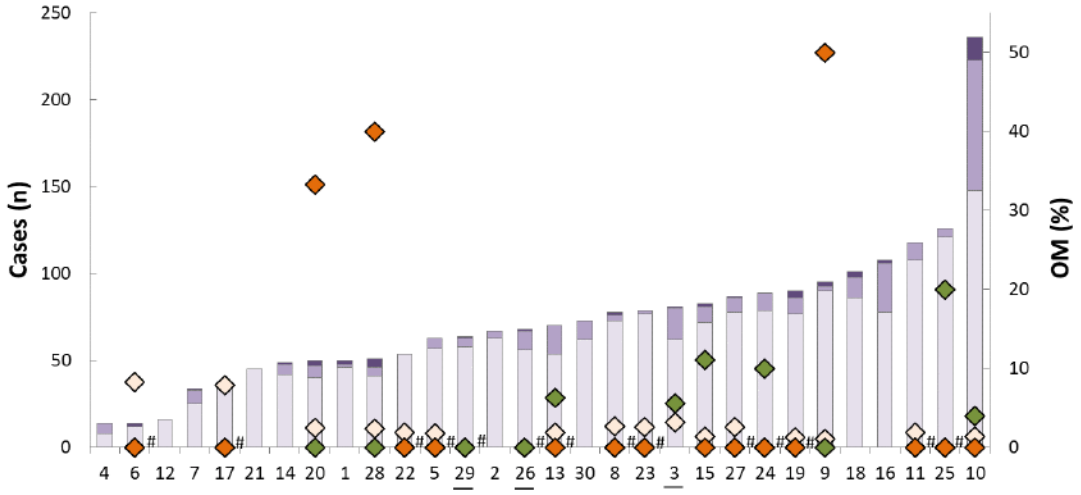
2.2 Patient characteristics for single valve surgery

2.2.1 Clinical Status

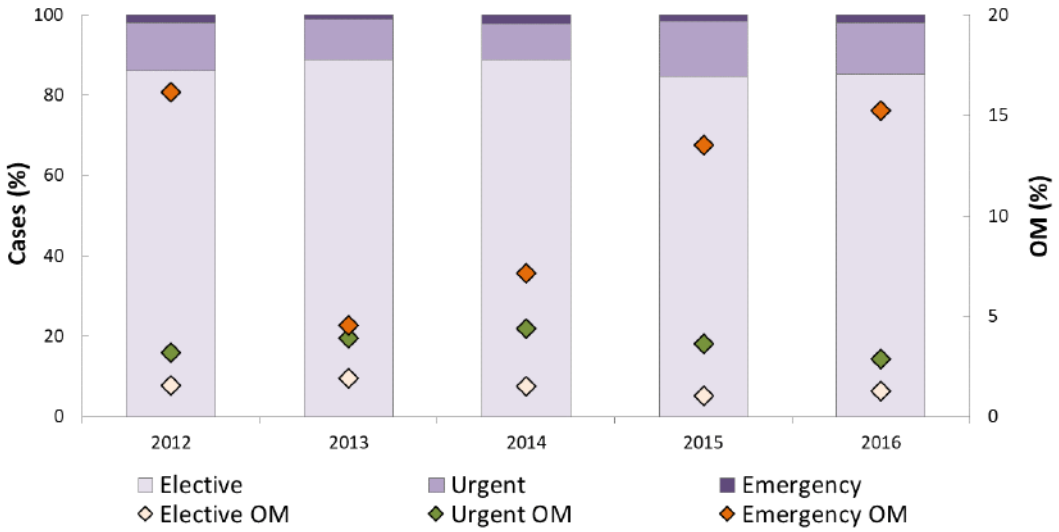
Isolated valve surgery is predominantly elective. Emergency valve surgery is rare. Unit 10 had the highest proportion of emergency and urgent valve operations in its case-mix (Figure 21a). Nine units reported no OM; sixteen units reported OM for elective cases (1.1-8.3%), and five units for urgent cases (4.0-20.0%). For emergency cases, six units reported OM: units 3, 26 and 29 (100%; OM=1); units 9 (50%; OM=2), 20 (33.3%; OM=3), and 28 (40.0%; OM=5). The number of deaths relative to cases, is tabulated in Appendix E-I.

Pooled data shows that the majority of patients are elective (>87%) and less than 2% are emergency (Figure 21b). Averaged OM for elective patients is 1.4%; for urgent, 3.5%; and for emergency, 11.8%.

a.



b.



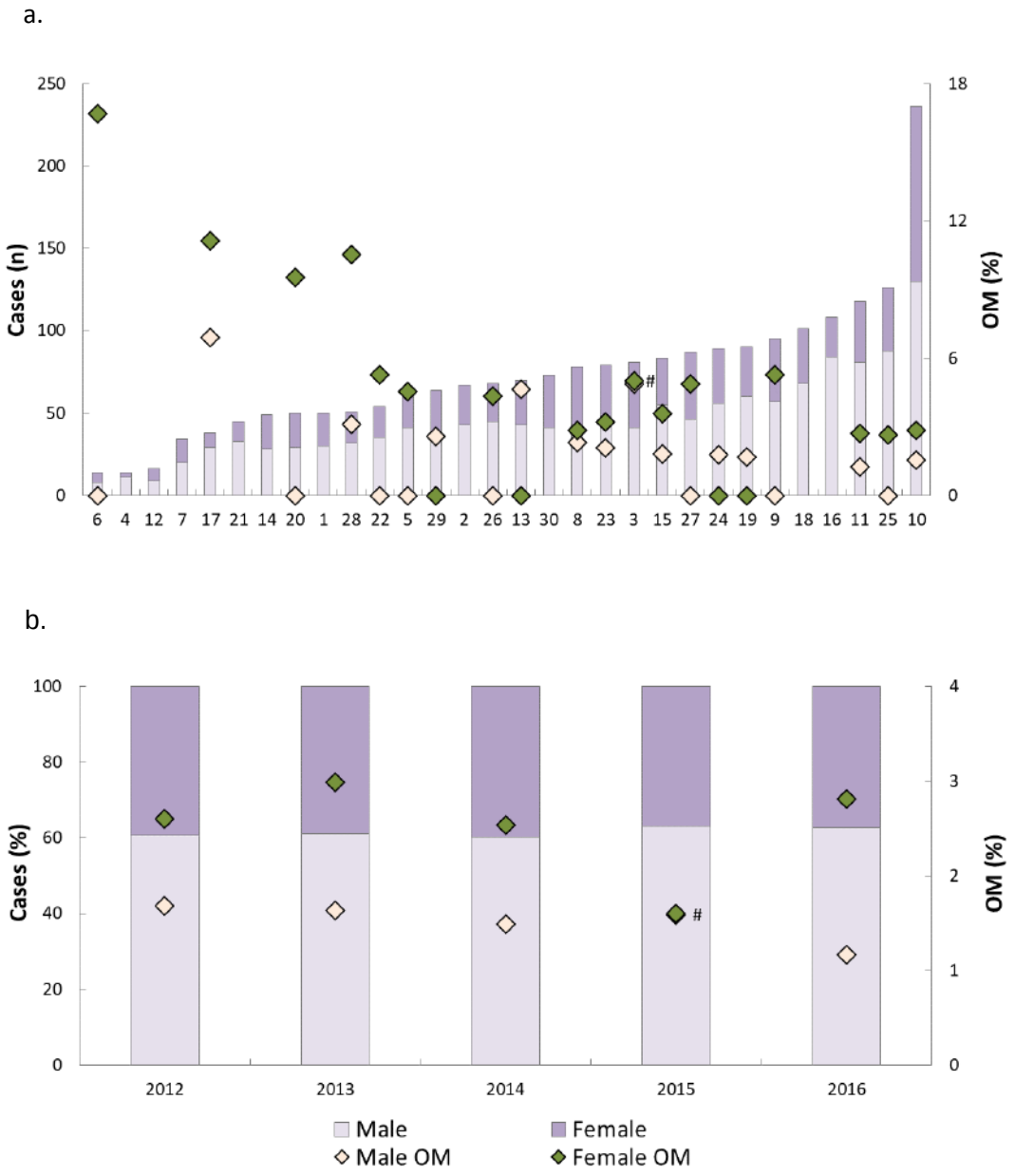
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined units reported 100% OM for Emergency cases

Figure 21. OM following single valve procedures based on clinical status by a. unit and b. year

2.2.2 Gender and age

In each unit, half or more of the patients who had valve surgery were male (Figure 22a). Twelve units reported OM for male patients (1.2-6.9%), and sixteen units for females (2.7-16.7%). The number of deaths relative to cases, is tabulated in Appendix E-II.

Pooled unit data shows that over 60% of patients who had a single valve procedure are male. Averaged OM is 1.5% for males, and 2.5% for females (Figure 22b).

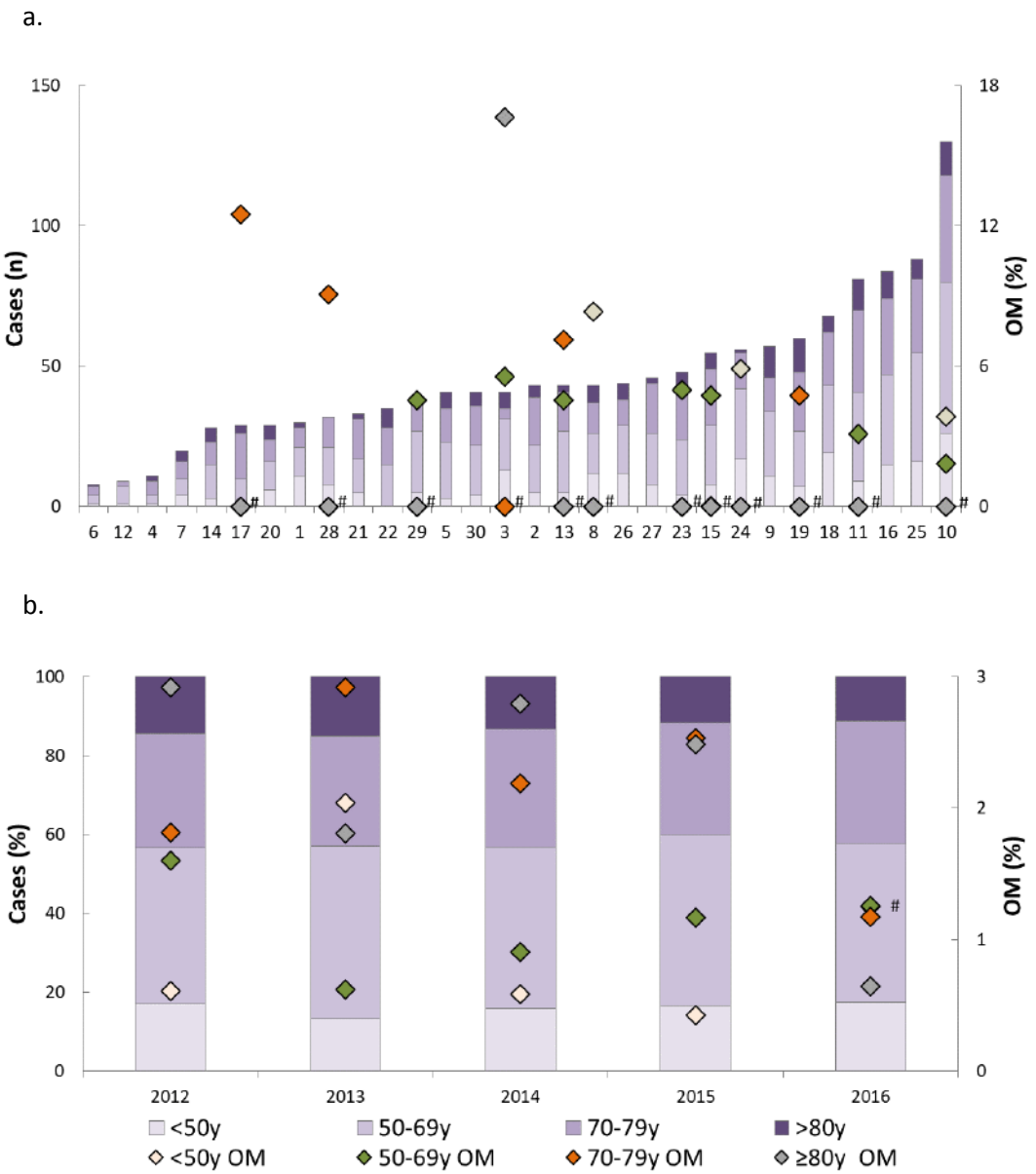


Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 22. OM following single valve surgery based on gender by a. unit and b. year

The largest group of male patients who had a single valve procedure in 2016 were aged 50-69 years (Figure 23a). Eighteen units reported no OM. For males aged less than 50 years, three units reported OM (3.8-8.3%); aged 50-69 years, seven units (1.9-5.6%); aged 70-79 years, four units (4.8-12.5%); and unit 3 for patients aged 80 years and older (16.7%). The number of deaths relative to number of cases, is tabulated in Appendix E-III.

Pooled unit data also shows the largest group of male patients having single valve procedures are aged 50-69 years (Figure 23b). Averaged OM for male patients aged under 50 years is 0.9%; for patients aged 50-69 years, 1.1%; and 2.1% for patients aged 70 -79 years and 80 years and older.

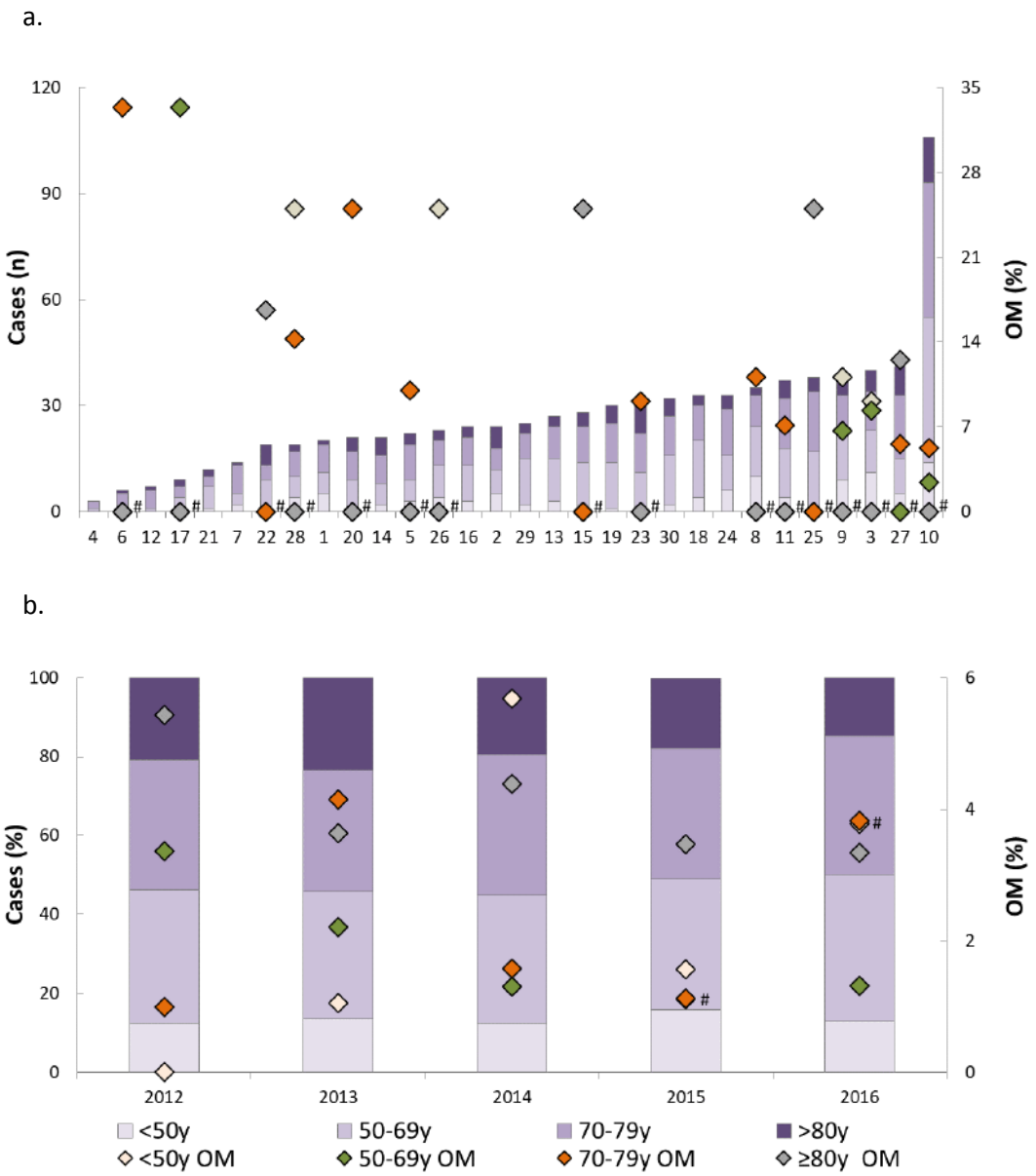


Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 23. OM for male patients following single valve procedures based on age by a. unit and b. year

In 2016, the highest number of female patients who had valve procedures were also aged 50-69 years (Figure 24a). Thirteen units reported no OM. For female patients aged less than 50 years, four units reported OM (9.1-25.0%); aged 50-69 years, four units (2.4-33.3%); aged 70-79 years, nine units (5.3-33.3%); and aged 80 years or older, four units (12.5-25.0%). The number of deaths relative to number of cases, is tabulated in Appendix E-IV.

For pooled data, approximately equal proportions of patients were aged 50-59 and 60 to 69 years (Figure 24b). Averaged OM for female patients aged under 50 years is 2.4%; aged 50-69 years, 1.8%; aged 70-79 years, 2.4%; and 4.0% for patients aged 80 years and older.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 24. OM for female patients following single valve procedures based on age by a. unit and b. year

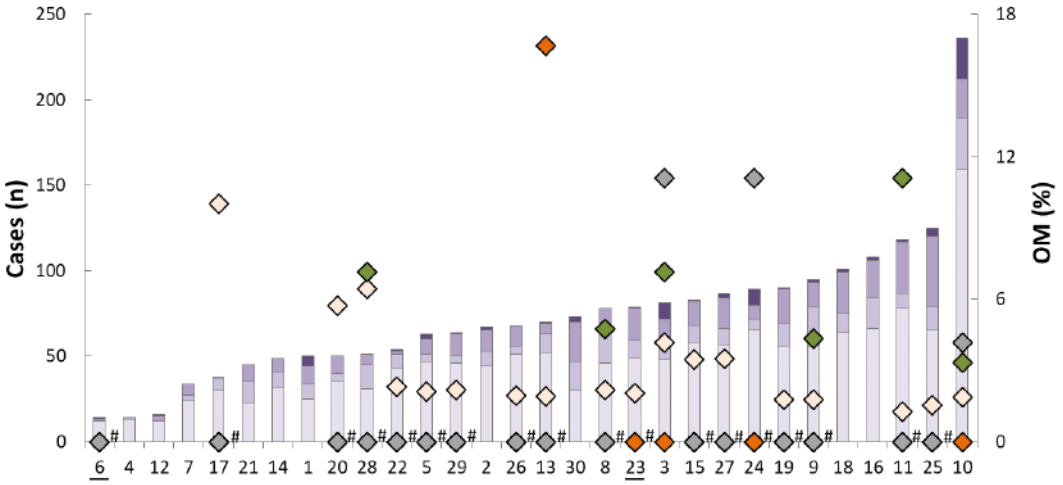
2.3 Mortality based on procedure type

2.3.1 Single valve procedures

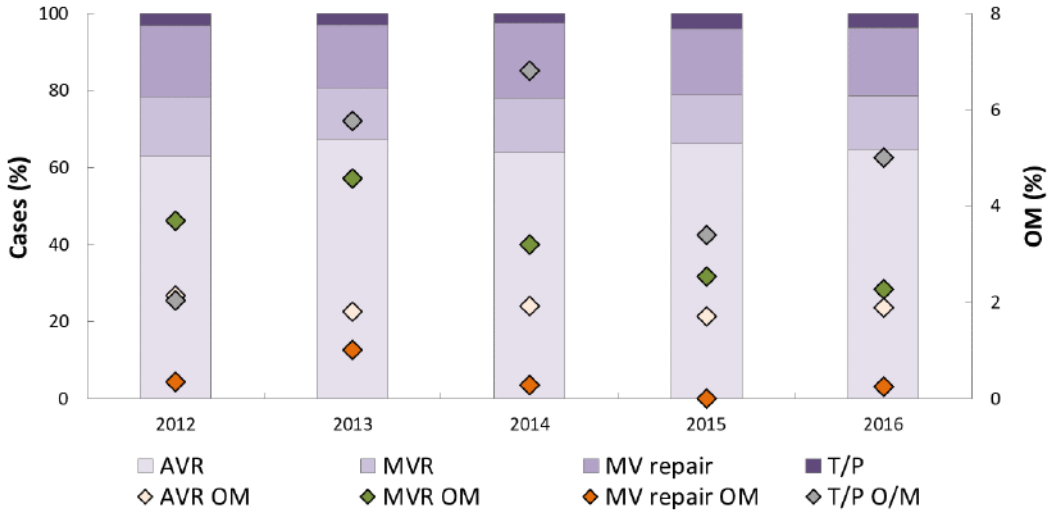
In 2016, ten units reported no OM (Figure 25a). Eighteen units reported OM for aortic valve procedures (1.3-10.0%); seven units for mitral valve replacement (MVR; 3.3-11.1%); only unit 13 for MV repair (16.7%); and three units for tricuspid/pulmonary (T/P; 4.2-11.1%) procedures. Units 6 and 23 reported 100% OM (OM=1) for MVR and T/P procedures, respectively. The number of deaths relative to number of cases, is tabulated in Appendix E-V.

Pooled unit data shows, the majority of single valve procedures were aortic (>63%; Figure 25b). Averaged OM for AVR procedures is 1.9%; for MVR 3.2%; for MV repair 0.4%; and for T/P 4.5%.

a.



b.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined units 6 and 23 reported 100% OM for MVR and T/P, respectively

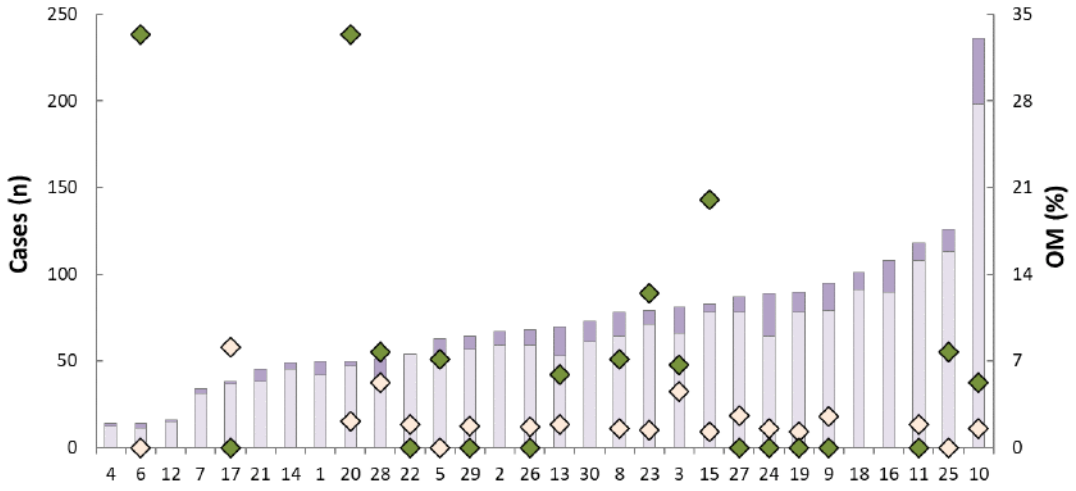
Figure 25. OM following single valve procedures by a. unit and b. year

2.3.2 Initial versus redo single valve procedures

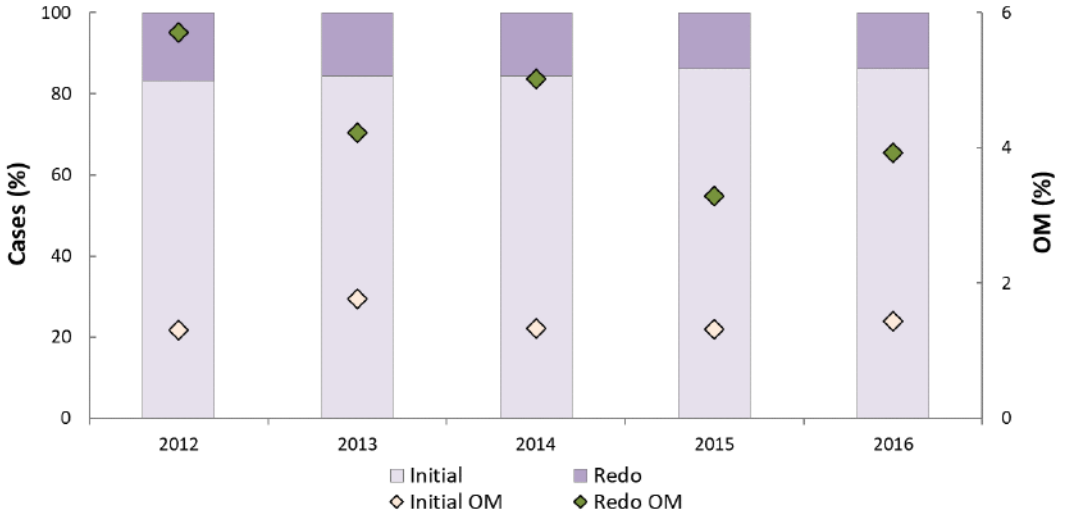
In 2016, seventeen units reported OM for initial procedures (1.3-8.1%), and eleven units for redo (5.3-33.3%; Figure 26a).

Pooled unit data shows that annually, less than 17% of procedures are redo (Figure 26b). Averaged OM for initial single valve procedures is 1.4%, and for redo 4.4%.

a.



b.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
Units with no diamonds reported 0% OM for all groups

Figure 26. OM following initial versus redo single valve procedure by a. unit and b. year

2.4 Unit outcomes – mortality, complications and resource utilisation for single valve procedures

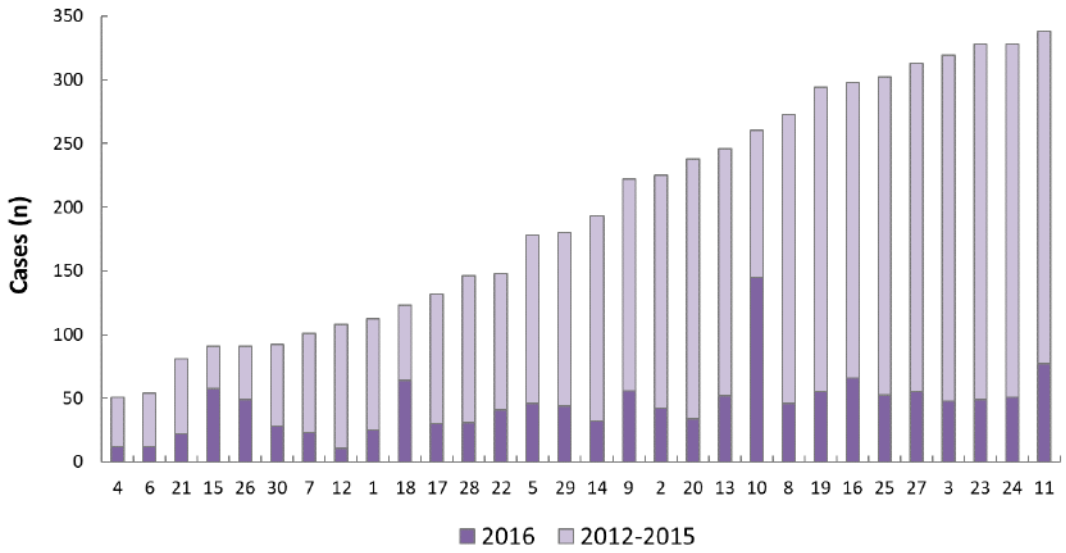
Unit outcomes are analysed for AVR and mitral procedures, given these are the more common valve procedures performed (Table 5). Analysis of AVR with CABG procedures, another large patient group, is shown in section 3.0.

Complications reported are any CVA, DNRI, DSWI, NCA, re-op for bleeding and re-admission. Resource utilisation variables are ICU and VENT times, Post-PLOS, Pre-PLOS, RBC and NRBC transfusion.

Given the low annual number of cases reported in 2016 for AVR (12 to 145 cases per unit), MVR (<50 cases per unit) and MV repair (≤30 cases per unit), only pooled five-year data is shown.

2.4.1 Aortic valve replacement

In 2016, unit 12 performed the fewest AVR (n=11) and unit 10 the most (n=145; Figure 27). Not all units contributed for all of the proceeding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 27. Isolated AVR performed by unit, 2012-2016

2.4.1.1 Mortality

The averaged OM for AVR performed in 2012-2016 is 1.9% (Figure 28).

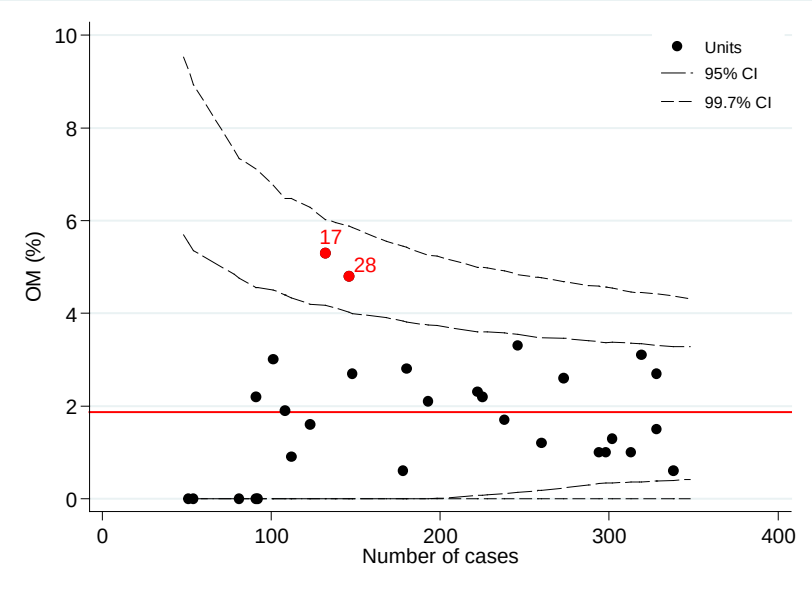


Figure 28. OM following AVR by unit, 2012-2016

2.4.1.2 Complications 2012-2016

For pooled 2012-2016 data (Figure 29), average complication rates were: CVA 1.7%; DNRI 3.8%; DSWI 0.8%; NCA 32.0%; re-op for bleeding 3.2%; readmission 10%.

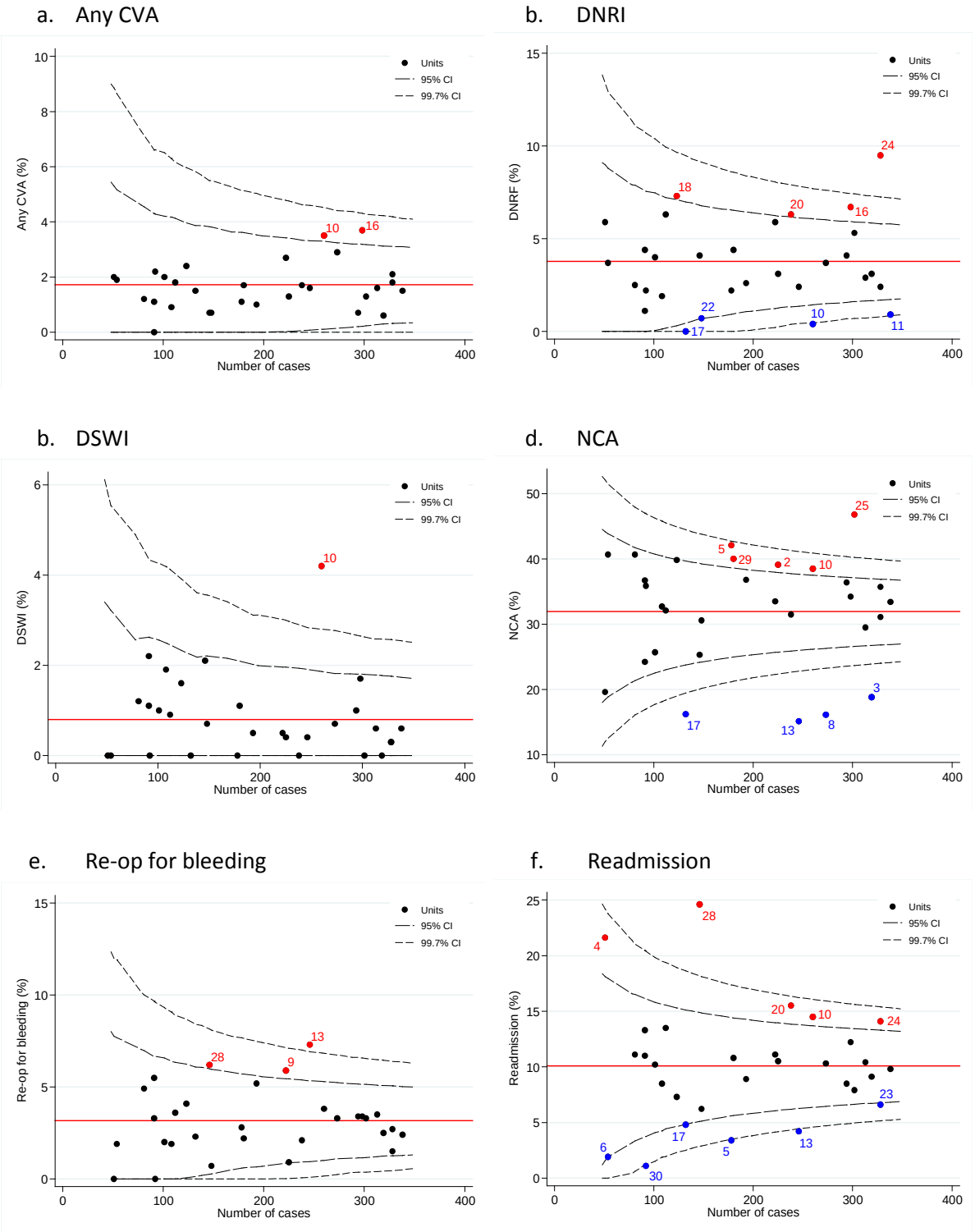


Figure 29. Five year pooled complication outcomes following AVR

2.4.1.3 Resource utilisation 2012-2016

For pooled 2012-2016 data (Figure 30), averaged median resource utilisation was ICU 43 hours; VENT 9.6 hours; Pre-PLOS 0.6 days; and Post-PLOS 7.7 days. The average percentages of patients transfused with blood products were RBC 31% and NRBC 21%. All units were within upper 95% CI for Pre-PLOS and Post-PLOS.

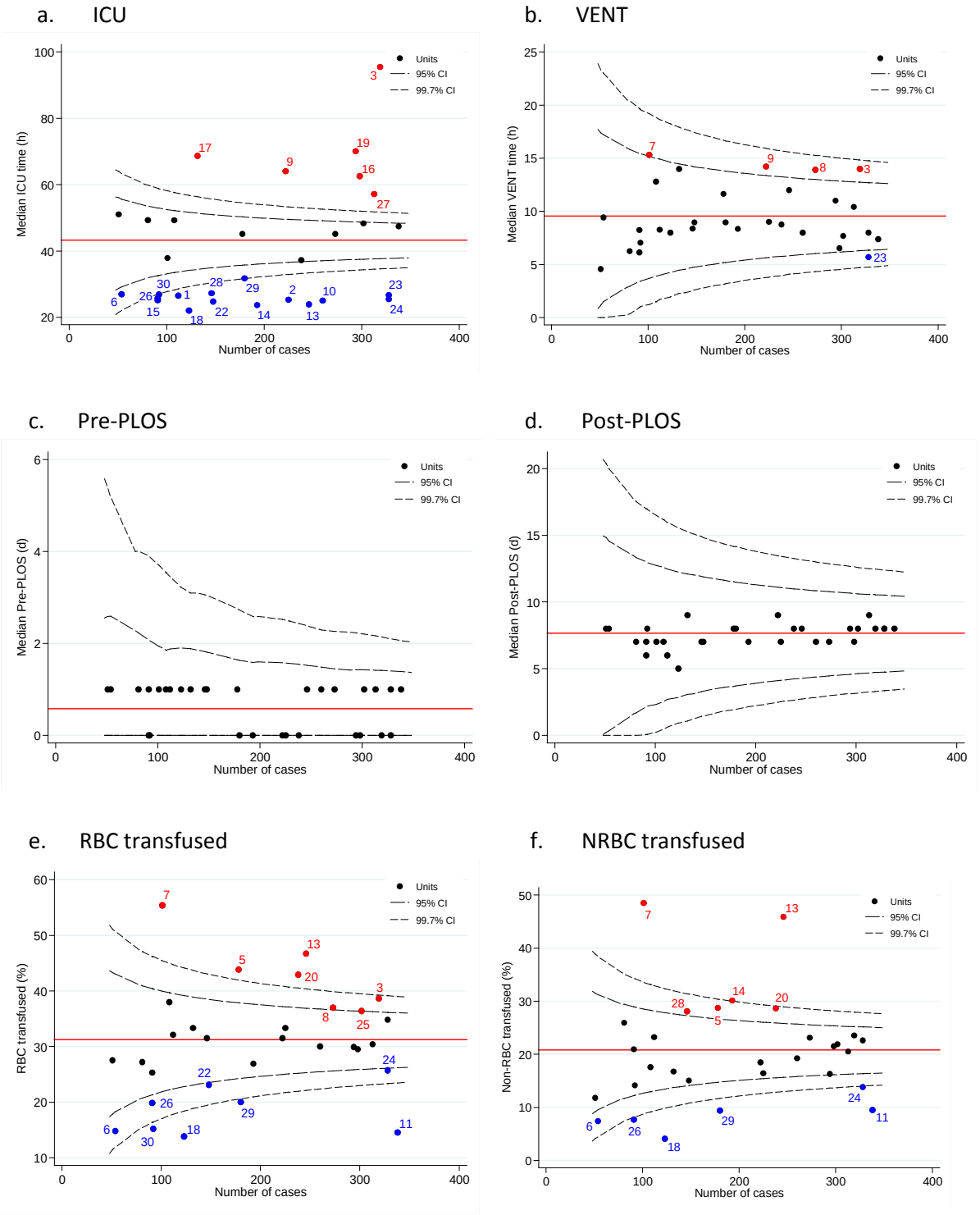
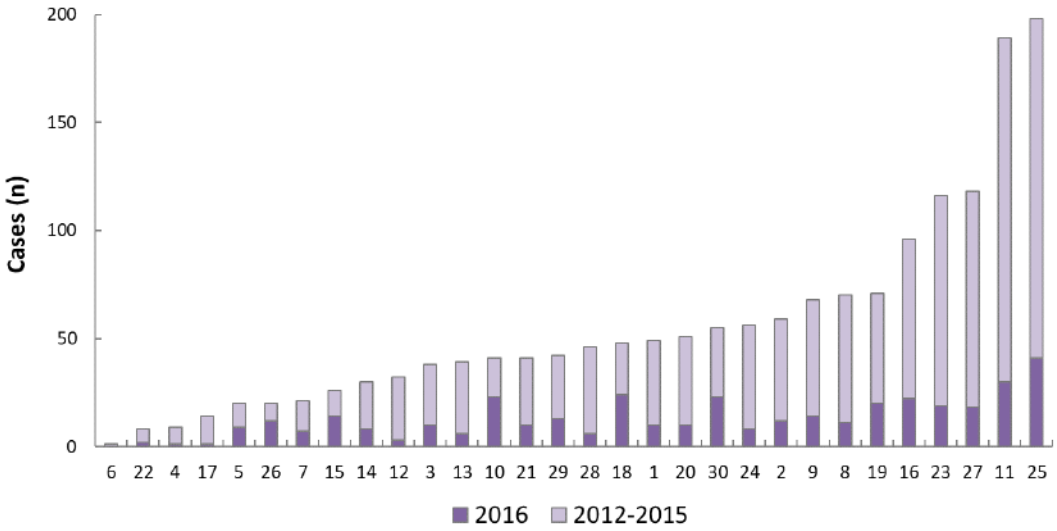


Figure 30. Five year pooled resource utilisation following AVR

2.4.2 Mitral valve repair

In 2016, unit 6 performed no MV repair operations and unit 25 the most (n= 41; Figure 31). Not all units contributed for all of the preceding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 31. Isolated MV repair procedures performed by unit, 2012-2016

2.4.2.1 Mortality

The average OM for MV repair procedures performed in 2012-2016 is 0.4% (Figure 32).

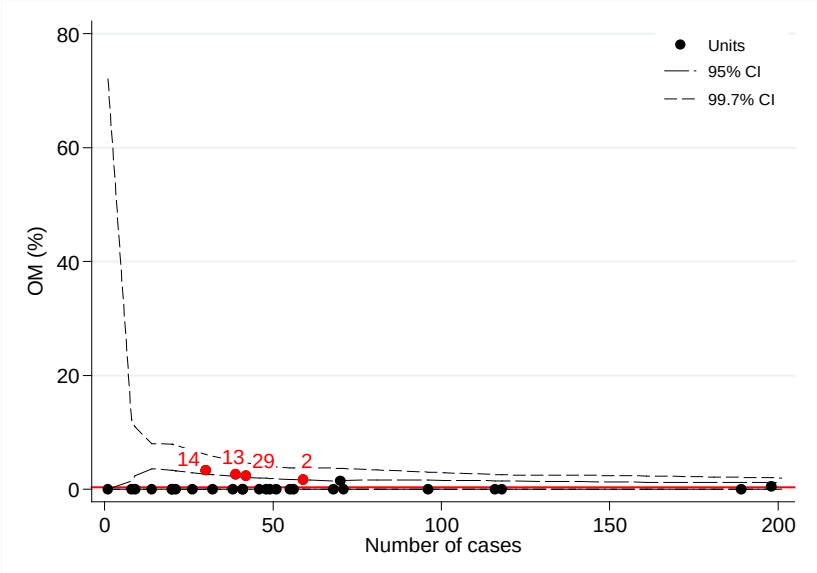


Figure 32. OM following MV repair by unit, 2012-2016

2.4.2.2 Complications 2012-2016

For pooled 2012-2016 data (Figure 33), average complication rates were: CVA 1.3%; DNRI 2.3%; DSWI 0.2%; NCA 28%; re-op for bleeding 2.5%; readmission 10%.

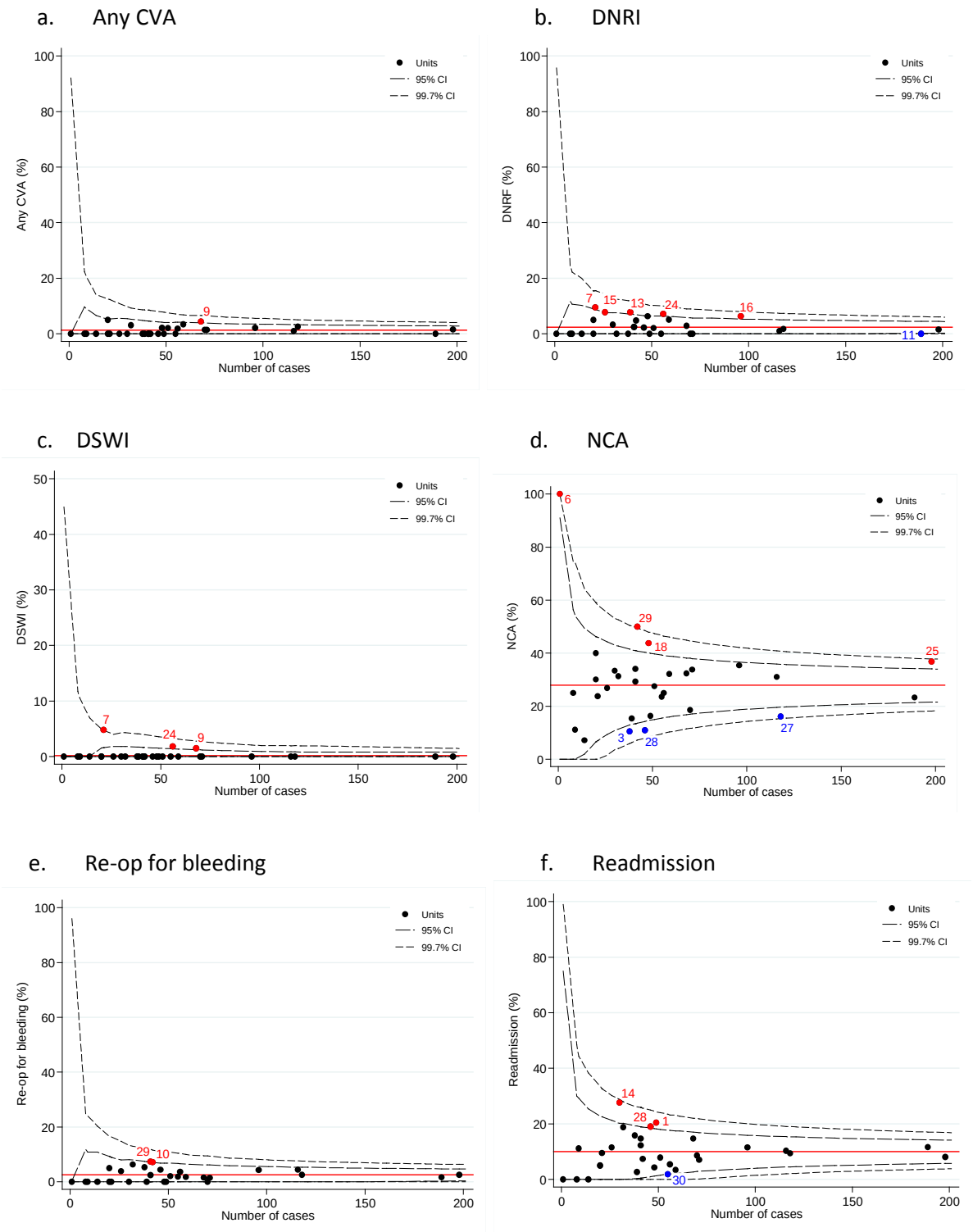


Figure 33. Five year pooled complication outcomes following MV repair

2.4.2.3 Resource utilisation 2012-2016

For pooled 2012-2016 data (Figure 34), averaged median resource utilisation was: ICU 41 hours; VENT 7.7 hours; Pre-PLOS 0.6 days; Post-PLOS 6.9 days. The average percentages of patients transfused with blood products were RBC, 18% and NRBC, 13%. All units were within 95% CI for VENT and Post-PLOS.

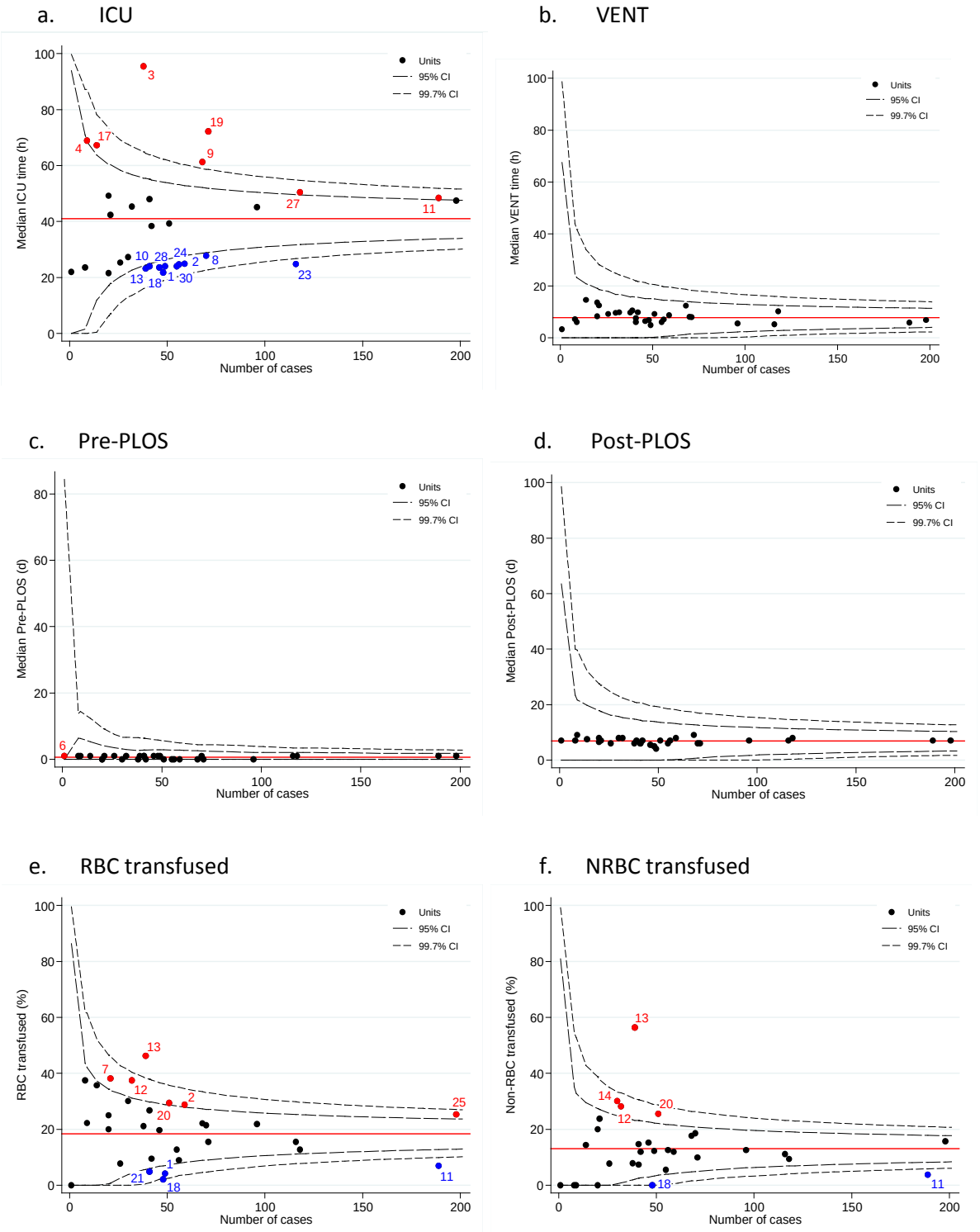
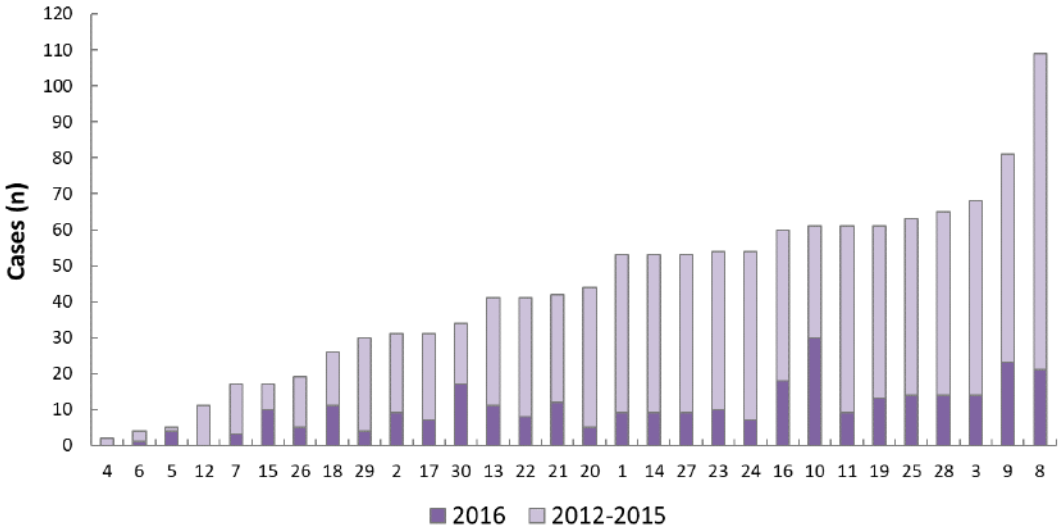


Figure 34. Five year pooled resource utilisation following MV repair

2.4.3 Mitral valve replacement

In 2016, units 4 and 12 performed no MV replacement (MVR) procedures and unit 10 the most (n=30; Figure 35). Not all units contributed for all of the preceding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 35. Isolated MVR procedures performed by unit, 2012-2016

2.4.3.1 Mortality

The average OM for MVR procedures performed in 2012-2016 is 3.2% (Figure 36).

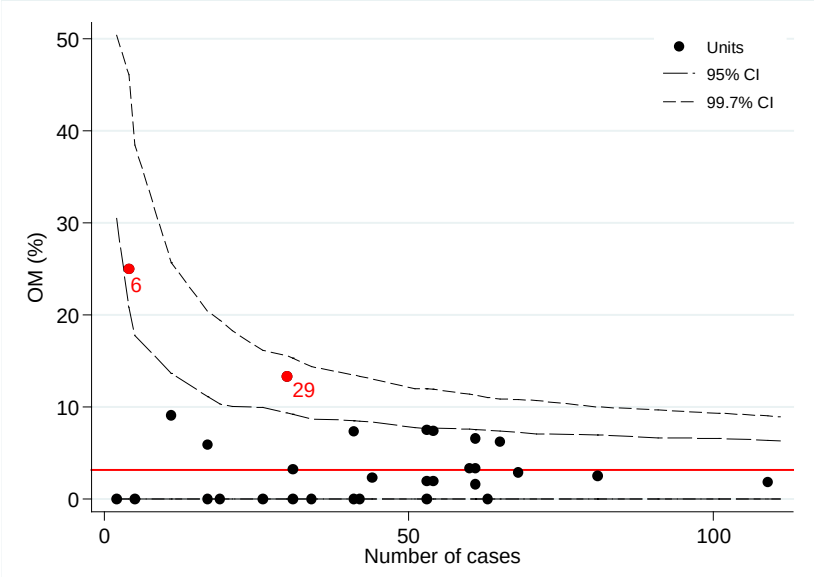


Figure 36. OM following MVR by unit, 2012-2016

2.4.3.2 Complications 2012-2016

For pooled 2012-2016 data (Figure 37), average complication rates were: CVA 3.7%; DNRI 5.0%; DSWI 0.8%; NCA 30%; re-op for bleeding 4.7%; readmission 13%.

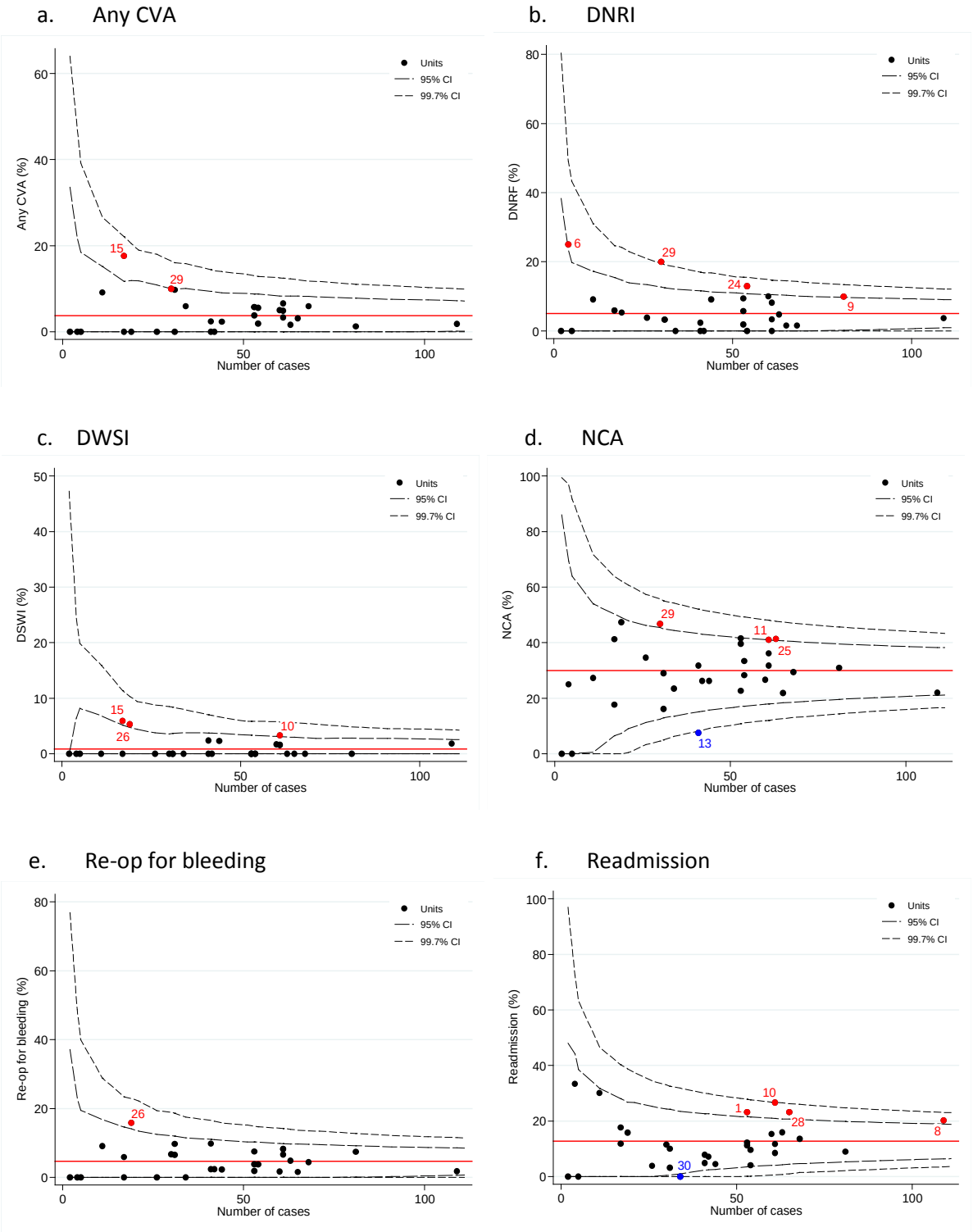


Figure 37. Five-year complication outcomes following MVR

2.4.3.3 Resource utilisation 2012-2016

For pooled 2012-2016 data (Figure 38), averaged median resource utilisation was: ICU 57 hours; VENT 12 hours; Pre-PLOS 1.0 days; Post-PLOS 9.3 days. The average percentages of patients transfused with blood products were RBC 44% and NRBC 34%. All units were within 95% CI for VENT and Post-PLOS.

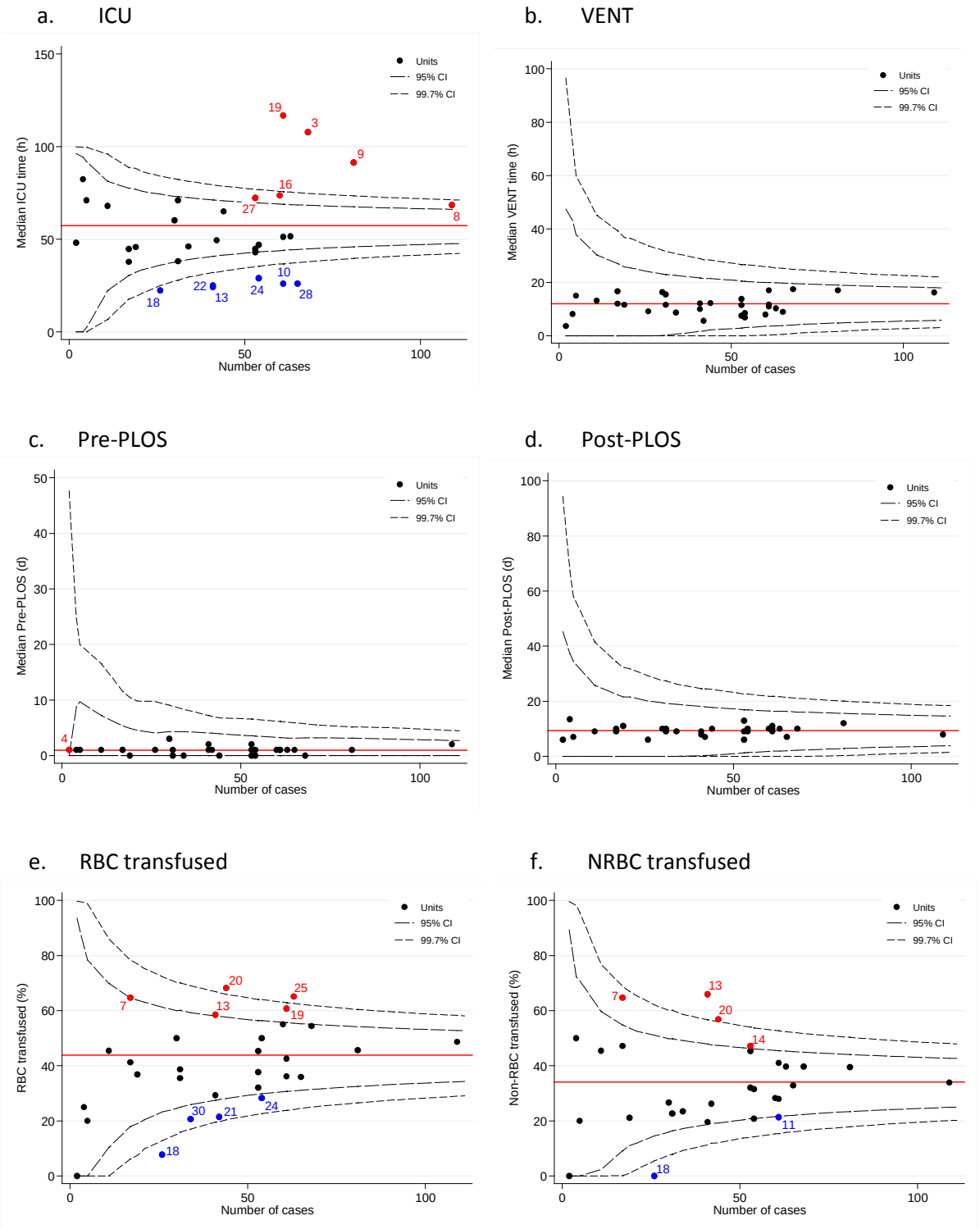


Figure 38. Five-year resource utilisation following MVR

2.5 Surgeons' outcomes – mortality

Surgeons' outcomes for mortality are represented by funnel plots (Appendix B-I). The solid red line in each plot represents the average value. When surgeon RAMR is above the upper 95% CI, the Head of Unit where the surgeon practices, and the individual surgeon, are notified and managed as outlined in Appendix A.

2.5.1 Aortic valve replacement

The average OM for 2012-2016 is 1.9% (Figure 39). The number of OM relative to number of cases, is tabulated in Appendix E-VI.

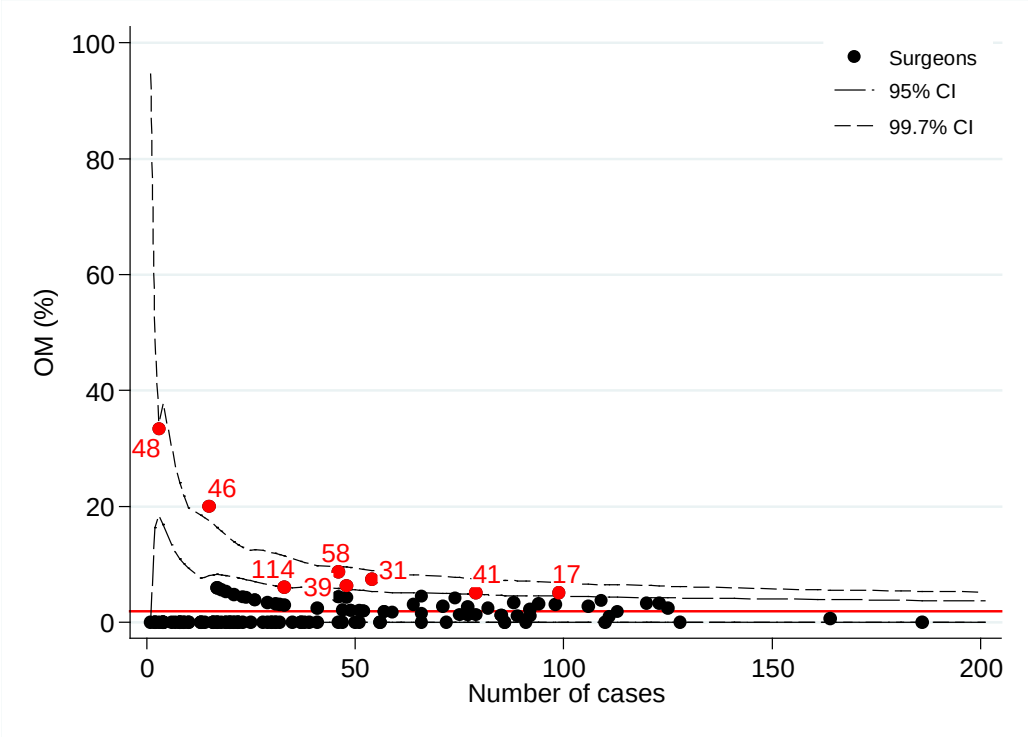


Figure 39. OM following AVR for individual surgeons, 2012-2016

2.5.2 Mitral valve repair

The average OM for 2012-2016 is 0.4% (Figure 40). The number of OM relative to number of cases, is tabulated in Appendix E-VII.

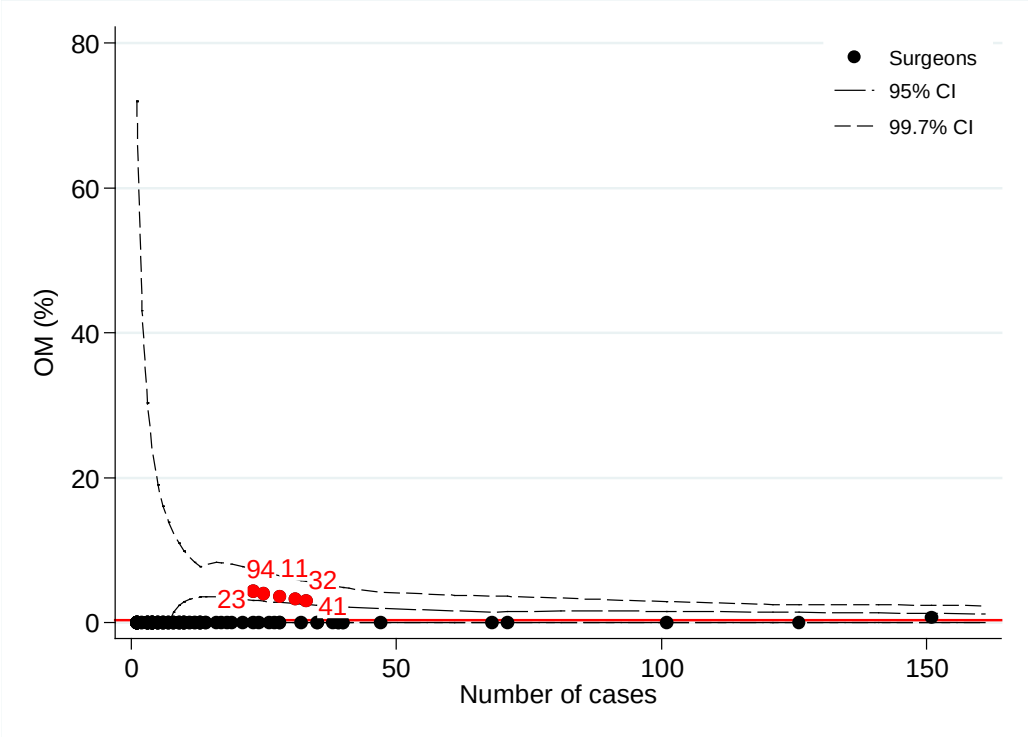


Figure 40. OM following MV repair for individual surgeons, 2012-2016

2.5.2 Mitral valve replacement

The average OM for 2012-2016 is 3.2% (Figure 41). The number of OM relative to number of cases, is tabulated in Appendix E-VIII.

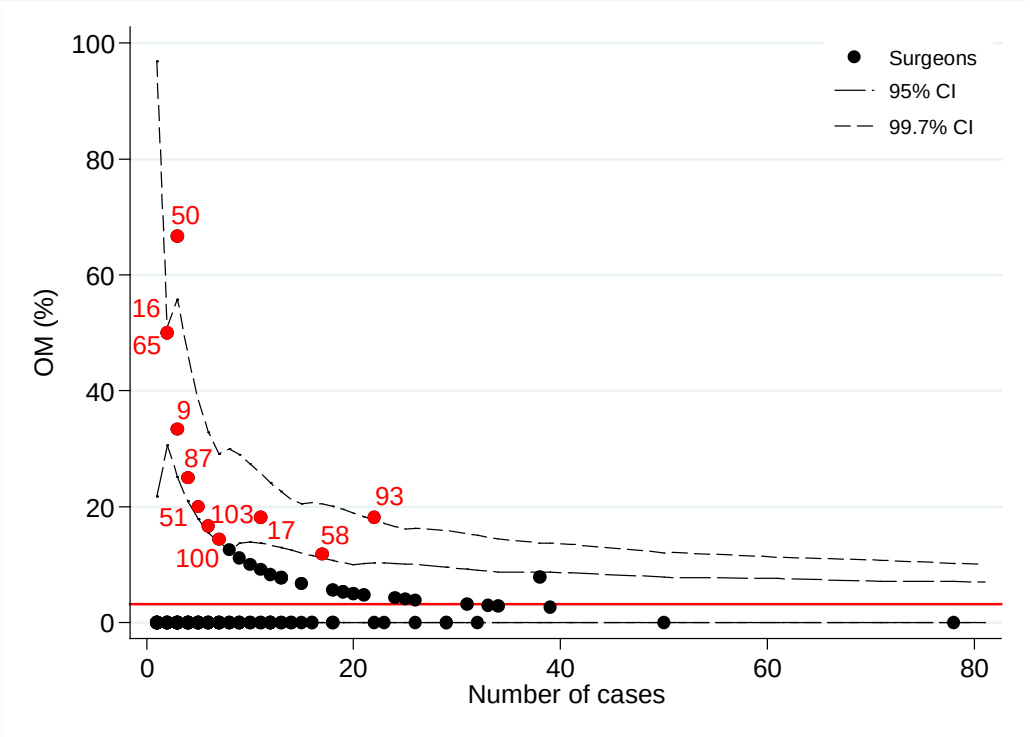


Figure 41. OM following MVR for individual surgeons, 2012-2016

2.6 Five year trends for complications and resource utilisation for valve surgery

2.6.1 Complications

Annual incidence of complications varies with the operation performed (Table 6), being generally higher after MVR than after MV repair or AVR.

Table 6. Complications (%) based on isolated valve procedures

Post-operative complication (%)	Procedure type	2016	2015	2014	2013	2012
Any CVA	AVR	1.8	1.6	1.8	1.6	1.8
	MVR	4.6	4.0	3.6	2.9	3.7
	MV repair	1.3	2.1	0.6	1.0	1.4
DNRI	AVR	3.2	3.5	3.5	4.4	4.2
	MVR	4.6	4.7	5.2	4.6	6.6
	MV repair	2.6	1.6	3.2	2.7	1.7
DSWI	AVR	1.5	0.8	0.7	0.5	0.3
	MVR	1.6	1.1	0.4	0.4	0.4
	MV repair	0.0	0.0	0.3	0.0	0.7
NCA	AVR	32.5	32.4	31.7	30.7	32.2
	MVR	35.8	30.2	29.4	25.8	28.0
	MV repair	29.2	29.6	24.2	27.1	29.7
Re-op for bleeding	AVR	3.7	3.6	3.2	2.4	2.8
	MVR	4.9	5.5	3.6	4.6	4.5
	MV repair	2.1	3.2	1.4	3.1	3.1
Readmission	AVR	10.1	10.8	9.9	9.0	10.0
	MVR	13.0	17.8	9.0	13.4	9.6
	MV repair	9.3	10.3	10.7	7.2	11.7

2.6.2 Resource utilisation

Annual resource utilisation also depends on the operation performed (Table 7). It is generally higher after MVR than after MV repair or AVR.

Table 7. Resource utilisation by patients undergoing an isolated valve procedure

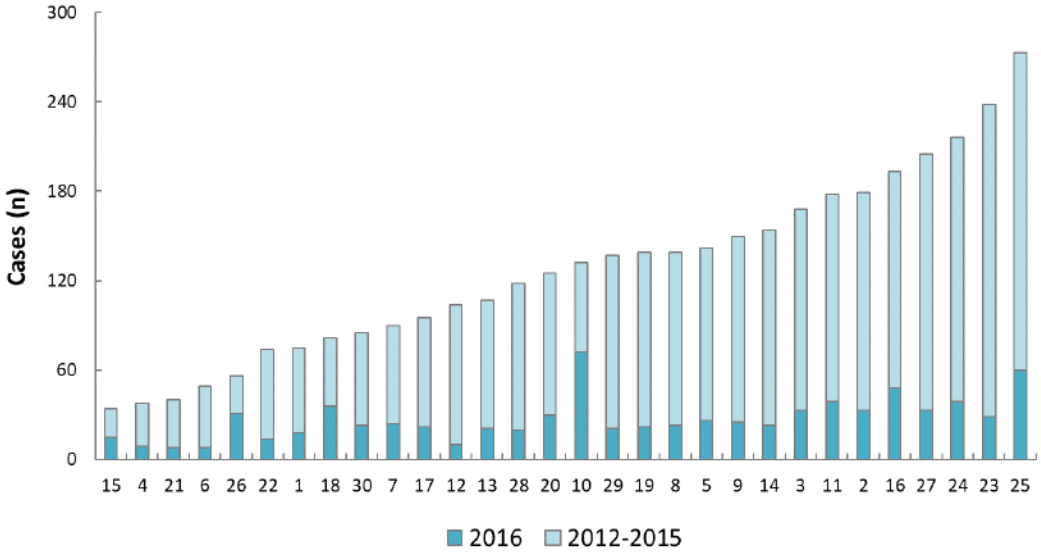
Resource utilisation	Procedure type	2016	2015	2014	2013	2012
ICU (h)	AVR	44.0	44.2	47.4	46.5	43.4
	MVR	50.3	45.8	65.7	51.0	51.0
	MV repair	44.5	43.6	46.5	45.3	44.7
VENT (h)	AVR	8.8	9.0	9.4	10.1	10.2
	MVR	10.8	11.3	12.6	14.0	14.0
	MV repair	7.0	7.0	8.3	7.2	6.9
Pre-PLOS (d)	AVR	1.0	1.0	1.0	1.0	1.0
	MVR	1.0	1.0	1.0	1.0	1.0
	MV repair	1.0	1.0	1.0	1.0	1.0
Post-PLOS (d)	AVR	8.0	7.0	8.0	8.0	8.0
	MVR	9.0	9.0	10.0	9.0	9.0
	MV repair	7.0	7.0	7.0	7.0	7.0
RBC (%)	AVR	27.3	26.5	32.1	34.9	36.8
	MVR	43.6	30.5	44.2	50.2	51.4
	MV repair	17.8	13.8	18.7	21.4	22.0
NRBC (%)	AVR	18.4	17.3	22.0	22.7	24.7
	MVR	31.3	25.8	32.5	38.9	42.4
	MV repair	9.0	12.7	13.5	16.3	15.7

2.7 Key Messages

- *Generally, OM increases with clinical urgency, most markedly for emergency patients.*
- *Overall, OM increases with age and is generally higher for women than men.*
- *Annual incidence of complications and resource utilisation is generally higher after MVR than after MV repair or AVR.*

3. Aortic Valve Replacement with CABG

In 2016, units 6 and 21 performed the fewest AVR with CABG procedures (n=8) and unit 10 the most (n=72; Figure 42). Not all units contributed for all of the preceding four years, therefore, numerical comparisons cannot be made for that period.



Left vertical axis = Coloured columns (number)

Figure 42. AVR with CABG procedures performed by unit, 2012-2016

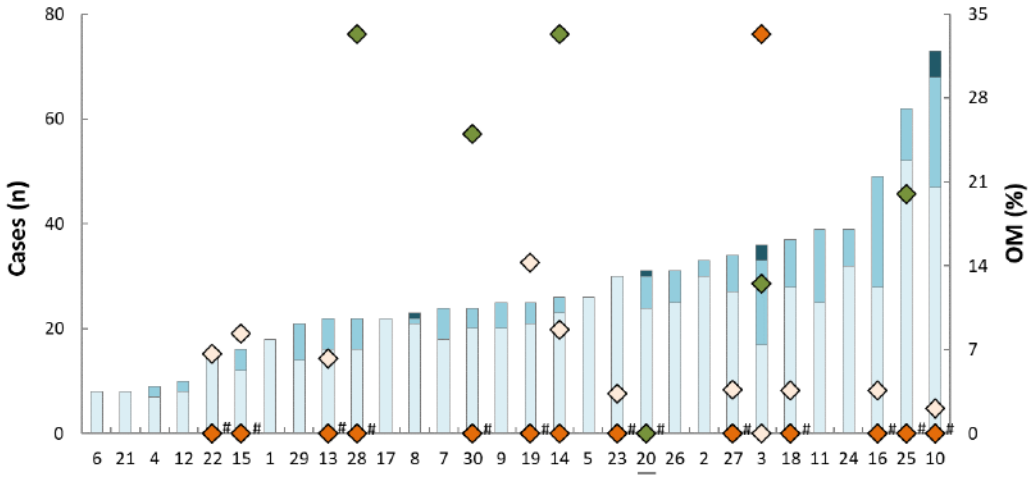
3.1 Patient characteristics

3.1.1 Clinical status

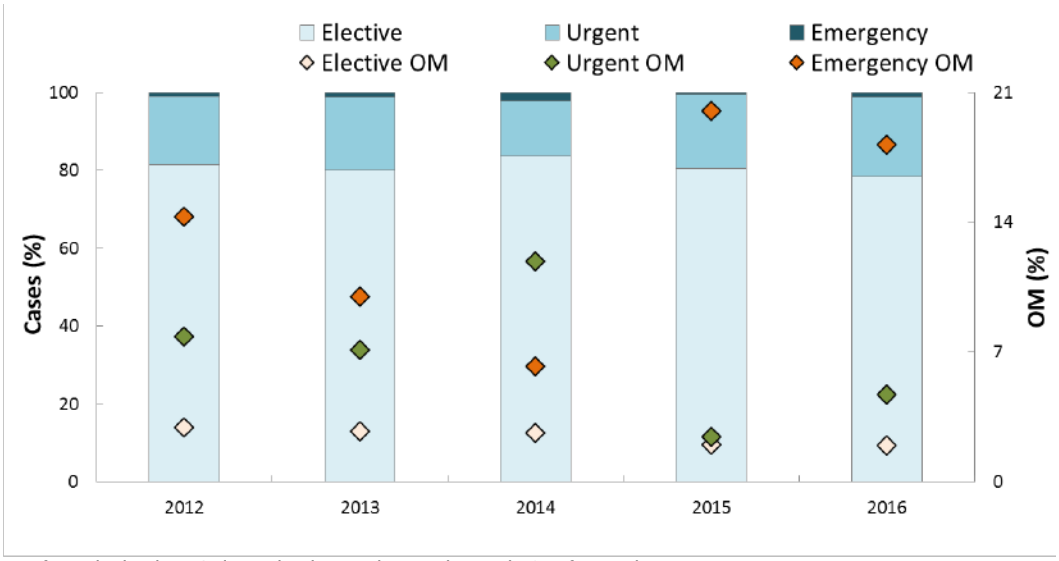
In 2016 OM was reported by ten units (2.1-14.3%) for elective patients (Figure 43a); for urgent by five units (12.5-33.3%); and for emergency by unit 3 (33.3%) and 20 (100%; OM=1).

Pooled unit data shows that since 2012, the majority of patients are elective (>78%), and less than 2% are emergency (Figure 43b). Averaged OM for elective patients is 2.4%, for urgent 6.3%, and for emergency 12.2 %. The number of deaths relative to number of cases, is tabulated in Appendix F-II.

a.



b.



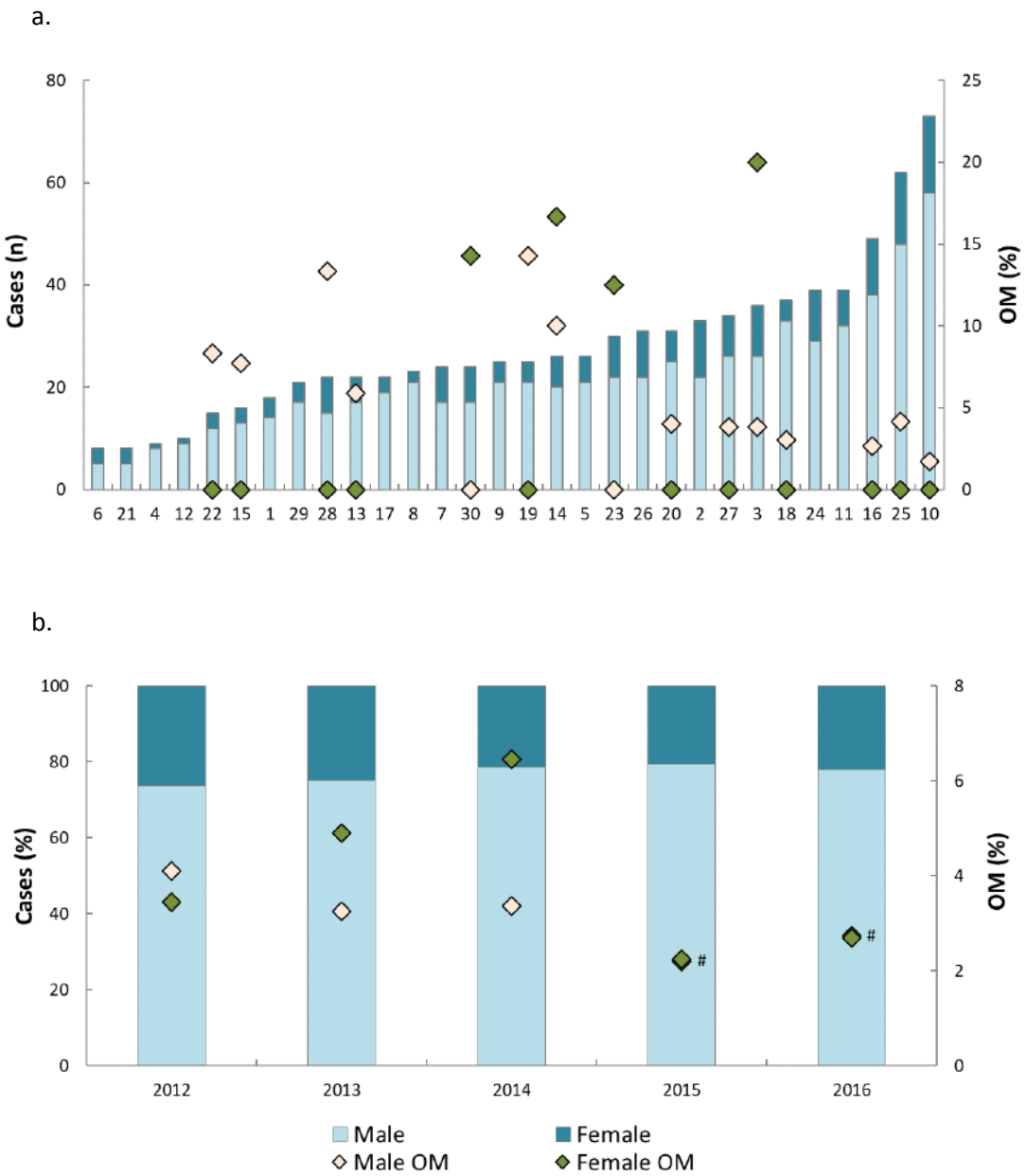
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined unit reported 100% OM for Emergency group

Figure 43. OM following AVR with CABG based on clinical status by a. unit and b. year

3.1.2 Gender and age

In 2016, the majority of patients who had an AVR with CABG were male (Figure 44a). Thirteen units reported OM for males (1.7-14.3%), and four units for females (12.5-20.0%).

Pooled unit data shows that over 73% of patients who had an AVR with CABG procedures are male. Averaged OM is 3.1% for males, and 3.9% for females (Figure 44b).

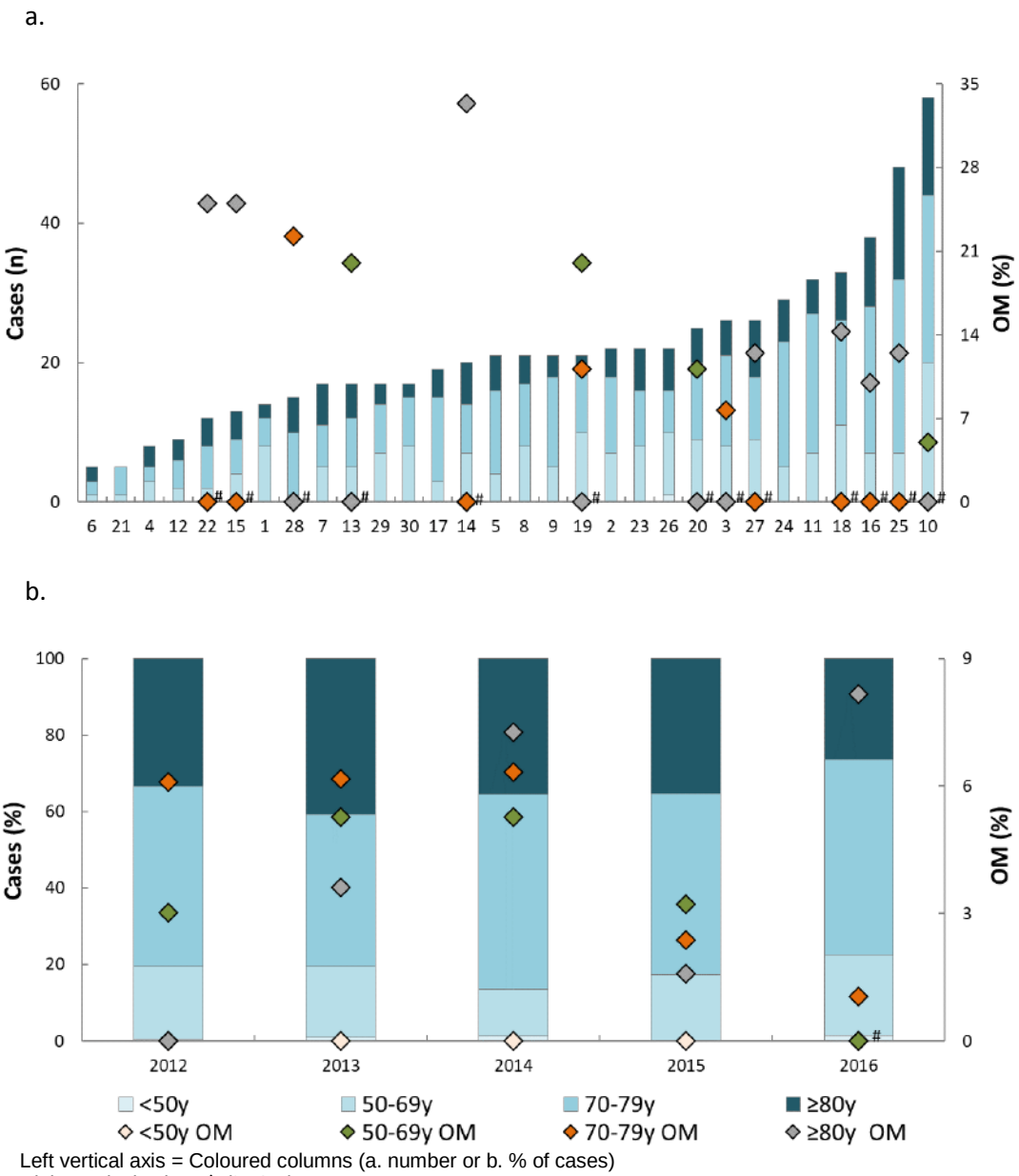


Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 44. OM following AVR with CABG based on gender by a. unit and b. year

In 2016, the largest cohort of male patients who had an AVR with CABG procedure, were aged 70-79 years (Figure 45a), older than those having isolated AVR. For men aged below 50 years, OM was not reported. For male patients aged 50-69 years, OM was reported by four units (5-20.0%), aged 70-79 years, by three units (7.7-22.2%) and aged 80 years and older, by seven units (12.5-33.3%). The number of deaths relative to number of cases is tabulated in Appendix F-III.

Pooled unit data also shows that the largest group of male patients who had AVR with CABG procedures are aged 70-79 years (≥45%; Figure 45b). Averaged OM is 3.1% for males aged 50-69 years, 4.3% for those aged 70-79 years and 3.9% aged 80 years and older. For males aged below 50 years, OM has not been reported since 2012.



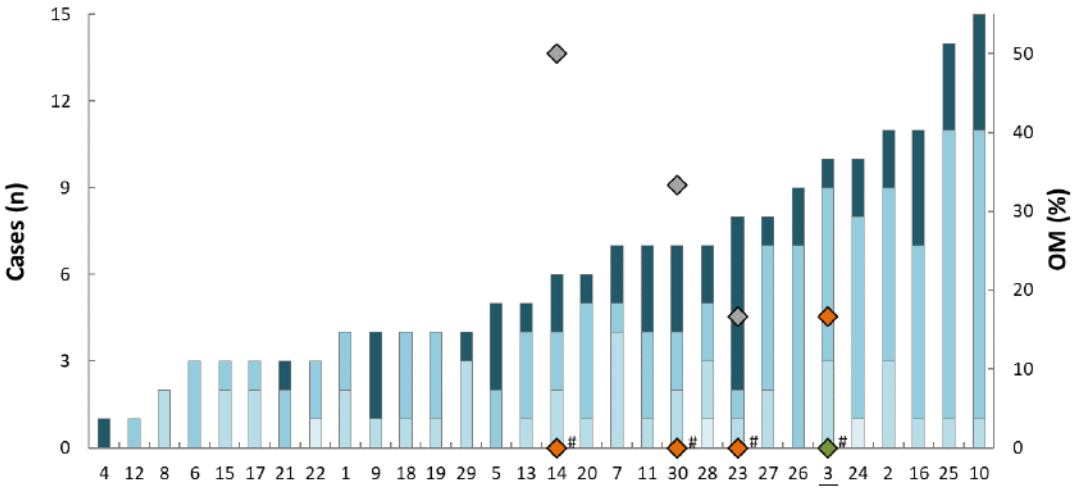
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 45. OM for male patients following AVR with CABG based on age by a. unit and b. year

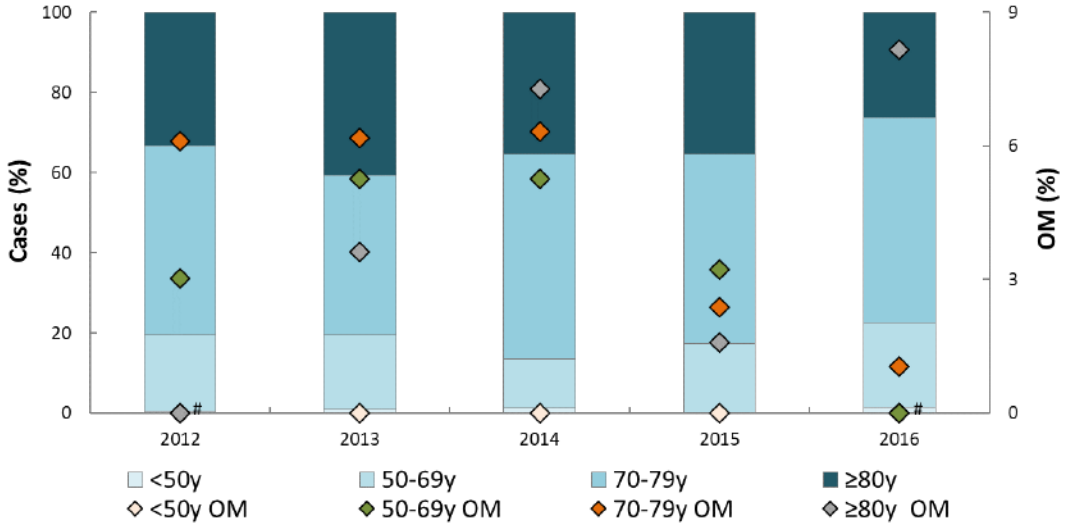
In 2016, most female patients who had an AVR with CABG procedure, were also aged 70-79 years (48%; Figure 46a). No OM was reported for female patients under 70 years. For patients aged 70-79 years, only unit 3 reported OM (17%); and aged 80 and above, four units (17-100%). The number of deaths relative to number of cases, is tabulated in Appendix F-IV.

Pooled unit data confirms that the majority of female patients who had AVR with CABG procedures are aged 70-79 years (47%; Figure 46b). Averaged OM is 3.1% for females aged 50-69 years, 4.3% for those aged 70-79 years and 3.9% for those 80 years and older. For females aged below 50 years, there has been no OM since 2012.

a.



b.



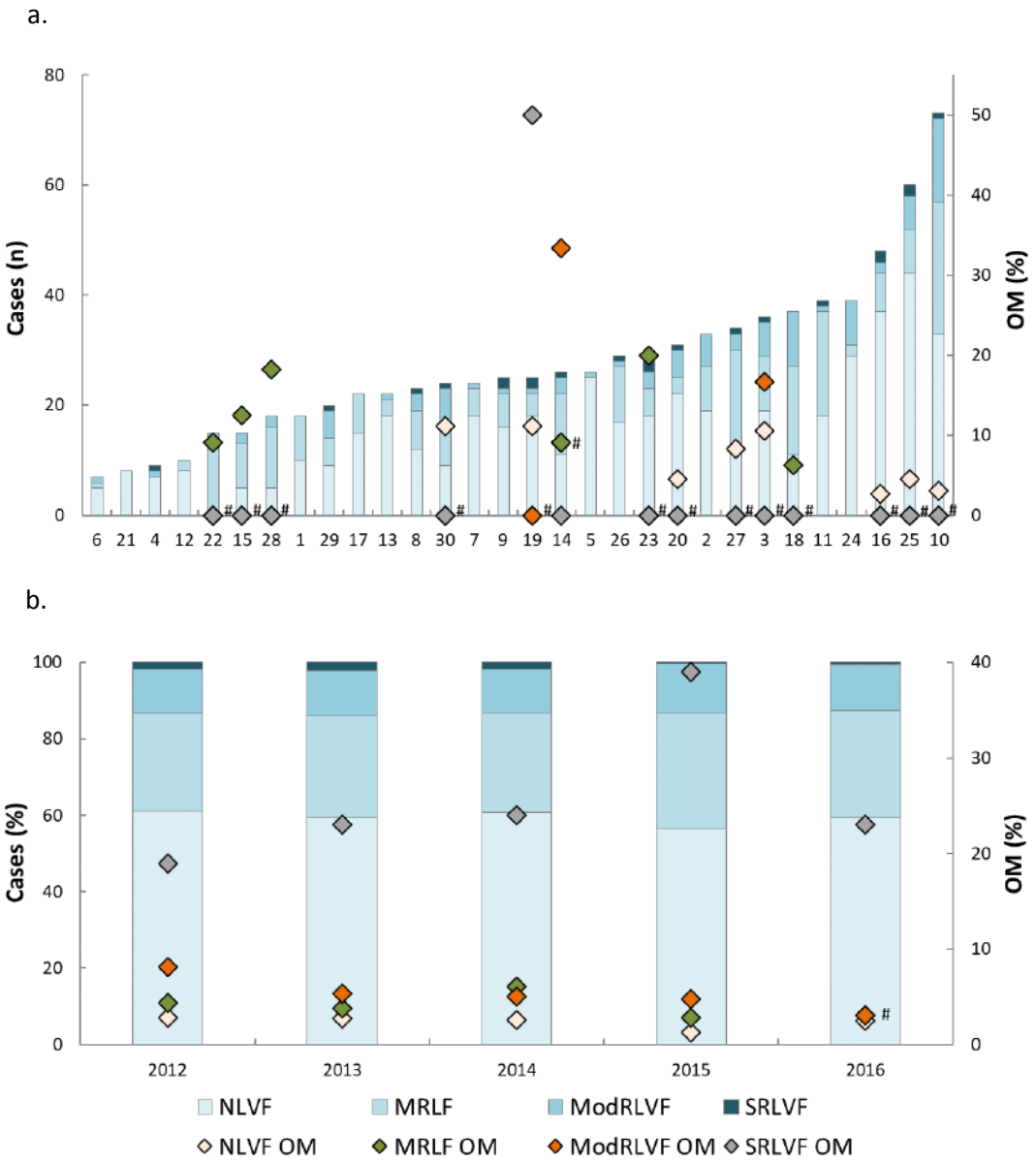
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined unit reported 100% OM for Emergency cases

Figure 46. OM for female patients following AVR with CABG based on age by a. unit and b. year

3.1.4 Left ventricular function

The majority of patients who had AVR with CABG procedures in 2016 had NLVR (59%; Figure 47a). Sixteen units reported nil OM. Nine units reported OM for patients with NLVF (2.7-11.1%), six units for patients with MLVF (6.3-20.0%), two units for patients with ModRLVF (16.7-33.3%) and only unit 19 for patients with SRLVF (50%; OM=2).

Pooled unit data shows that since 2012, the majority of patients have NLVF (>59%) and less than 2.0% have SRLVF (Figure 47b). Annual OM is 2.4% for patients with NLVF, 3.9% for those with MRLVF, 5.1% for those with ModRLVF and 26% for those with SRLVF.



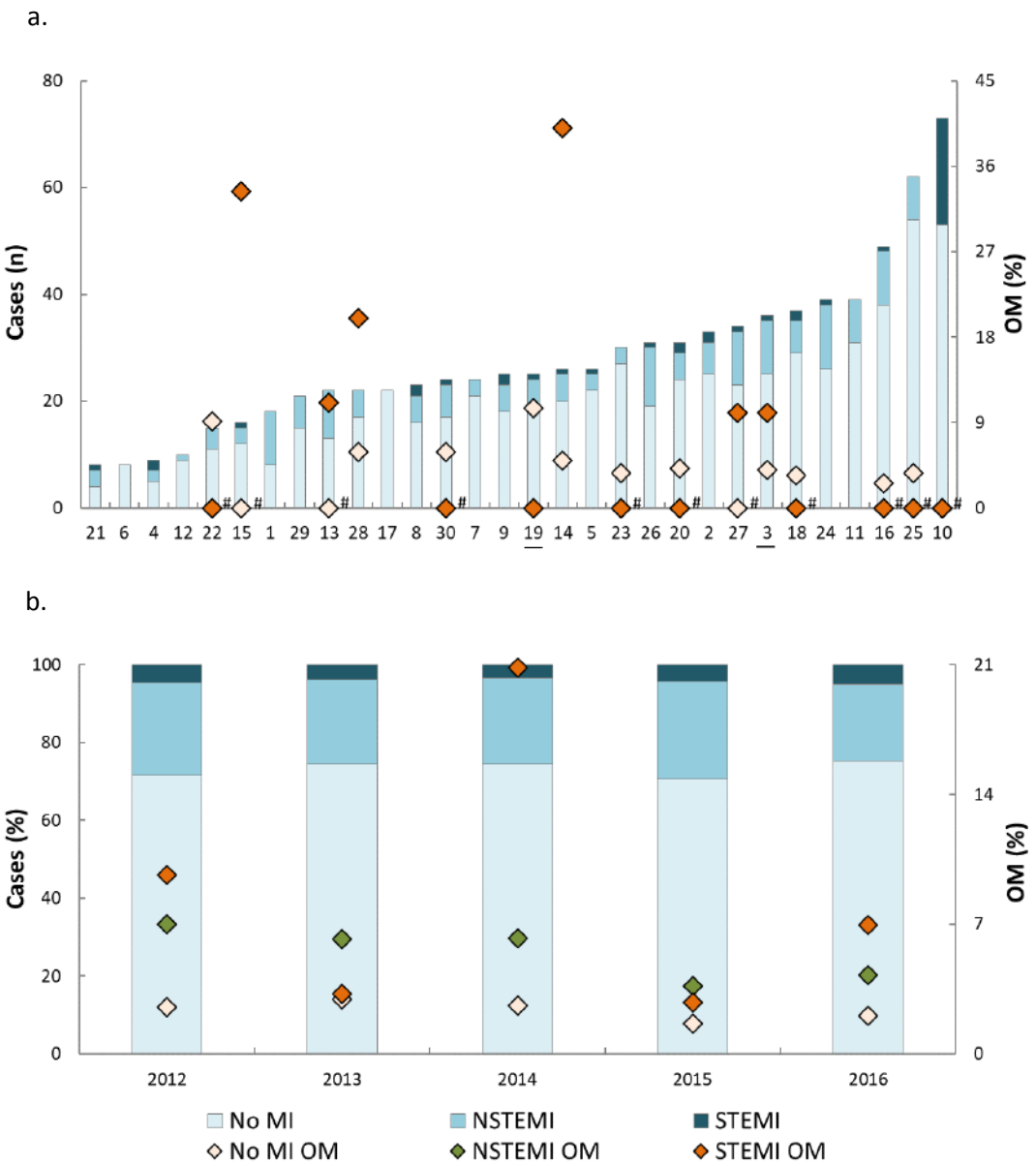
Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure 47. OM following AVR with CABG procedures based on pre-procedure LVF by a. unit and b. year

3.1.4 Prior myocardial infarction

In 2016, most patients who had AVR with CABG did not have a prior MI (Figure 48a). Eleven units reported OM for patients without prior MI (2.6-10.5%), six units for patients with NSTEMI (10.0-40.0%) and only unit 10 for patients with STEMI (5%).

Pooled unit data shows that since 2012, the majority (>73%) of patients who had AVR with CABG procedures did not have a previous MI. Averaged OM is 2.3% for patients without prior MI, 5.4% for those with prior NSTEMI and 7.3% for those with prior STEMI (Figure 48b).



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined units reported 100% OM for STEMI group

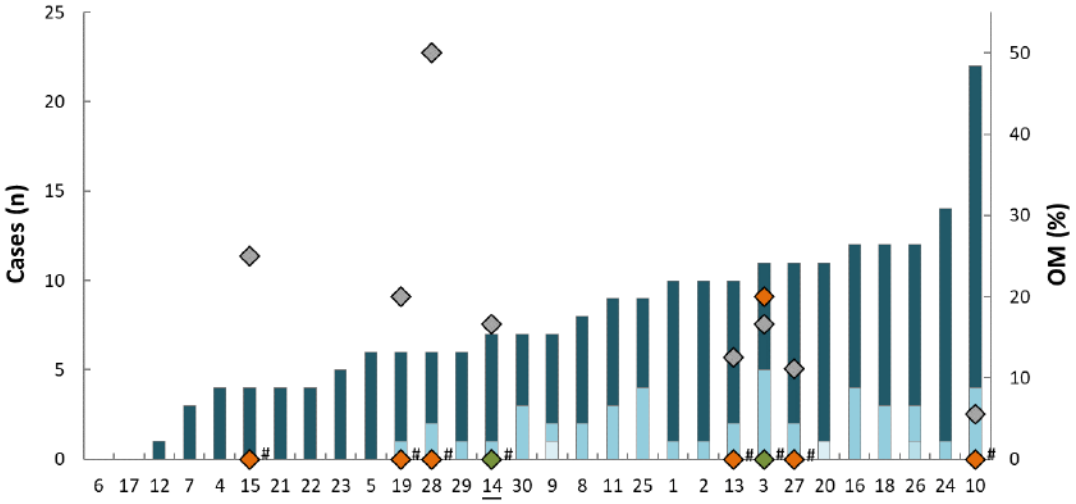
Figure 48. OM following AVR with CABG procedures based on prior MI by a. unit and b. year

3.1.5 Timing of prior myocardial infarction

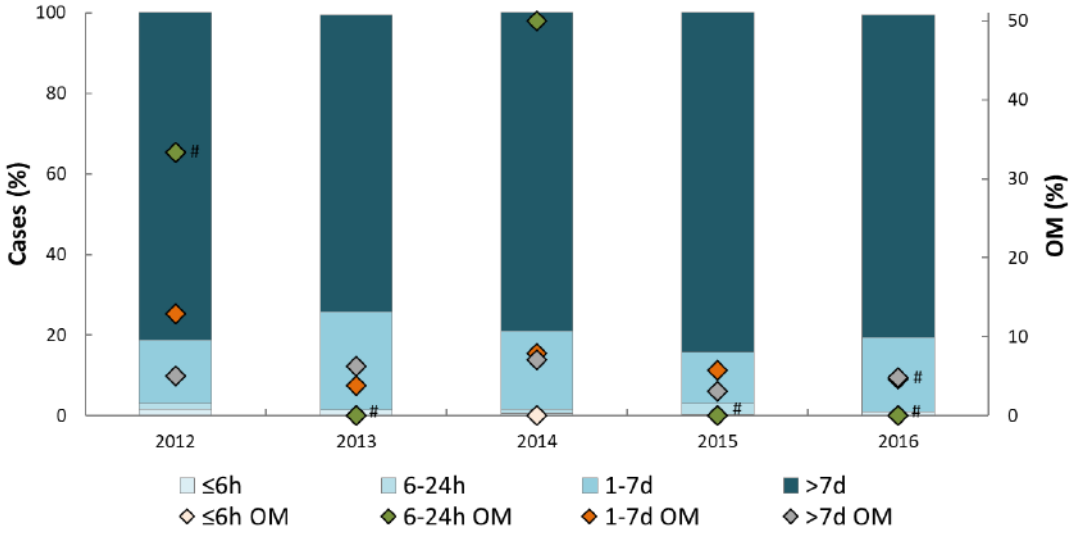
In 2016, the majority of patients with prior MI, reported the incident occurring more than 7 days before AVR with CABG surgery (Figure 49a). For patients with MI occurring less than 1 day prior to surgery, no OM was reported. Units 3 and 14 reported OM of 20% and 100% (OM=1) respectively for patients with MI occurring 1-7 days prior and 8 units (6-50%) for patients with MI occurring more than 7 days before surgery.

Pooled unit data shows that since 2012, the majority (>74%) of prior MI occurred more than 7 days prior to surgery (Figure 49b). Averaged OM for MI occurring 6 or less hours prior is 10.0%, for 6-24 hours prior, 14.3%, 1-7days prior, 6.5% and more than 7days prior to surgery, 5.1%.

a.



b.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined unit reported 100% OM for 1-7d group

Figure 49. OM following AVR with CABG procedures based on timing of pre-procedure MI by a. unit and b. year

3.2 Complications based on risk factors

3.2.1 Pre-existing diabetes or renal impairment

Patients with diabetes have a higher incidence of post-operative complications, than patients without (Table 8). Patients with prior renal failure, have higher incidences of DNRI and NCA, than patients without.

Table 8. Complications (%) based on diabetes and renal function status

Post-operative complication	Year	Diabetes*		Pre-op creatinine		Pre-op eGFR	
		No	Yes	<200 µmol/L	≥200 µmol/L	>60mL /min/1.73m^2	≤60mL /min/1.73m^2
n	2016	514	327	805	36	558	283
	2012-2015	1973	1087	2932	131	1747	1316
Any CVA	2016	1.6	2.1	1.9	0.0	2.0	1.4
	2012-2015	2.3	3.8	2.7	5.3	2.3	3.4
DNRI	2016	4.5	5.5	4.2	19.4	3.2	8.1
	2012-2015	5.0	7.0	5.5	9.9	4.8	6.9
DSWI	2016	1.2	1.5	1.4	0.0	0.9	2.1
	2012-2015	1.1	2.5	1.5	2.3	1.6	1.5
NCA	2016	35.3	39.0	36.9	33.3	35.6	38.9
	2012-2015	39.2	36.2	38.3	35.1	37.1	39.6
Re-op for bleeding	2016	4.1	4.9	4.5	2.8	5.0	3.2
	2012-2015	4.0	3.8	3.9	5.3	3.8	4.1

* Three missing cases 2012-2015

3.2.2 Age

Advancing age is generally associated with a higher incidence of post-operative complications following AVR with CABG surgery, the exception being re-op for bleeding (Table 9).

Table 9. Complications (%) based on patient age

Post-operative complication	Year	Age			
		<50 y	50-69 y	70-79 y	>80 y
n	2016	6	228	402	205
	2012-2015	33	735	1420	874
Any CVA	2016	0.0	1.8	1.5	2.4
	2012-2015	0.0	2.4	2.6	3.5
DNRI	2016	0.0	4.8	3.0	8.8
	2012-2015	9.1	4.5	5.8	6.4
DSWI	2016	0.0	1.8	0.5	2.4
	2012-2015	6.1	2.0	1.5	1.1
NCA	2016	16.7	33.5	36.3	41.7
	2012-2015	21.2	34.7	38.7	40.8
Re-op for bleeding	2016	16.7	5.3	4.0	3.9
	2012-2015	9.1	3.7	3.9	4.0

3.2.3 Redo surgery

The number of redo AVR with CABG surgery is low (Table 10). Four-year data shows that compared to initial surgery, redo surgery is associated with higher incidence of DNRI and re-op for bleeding.

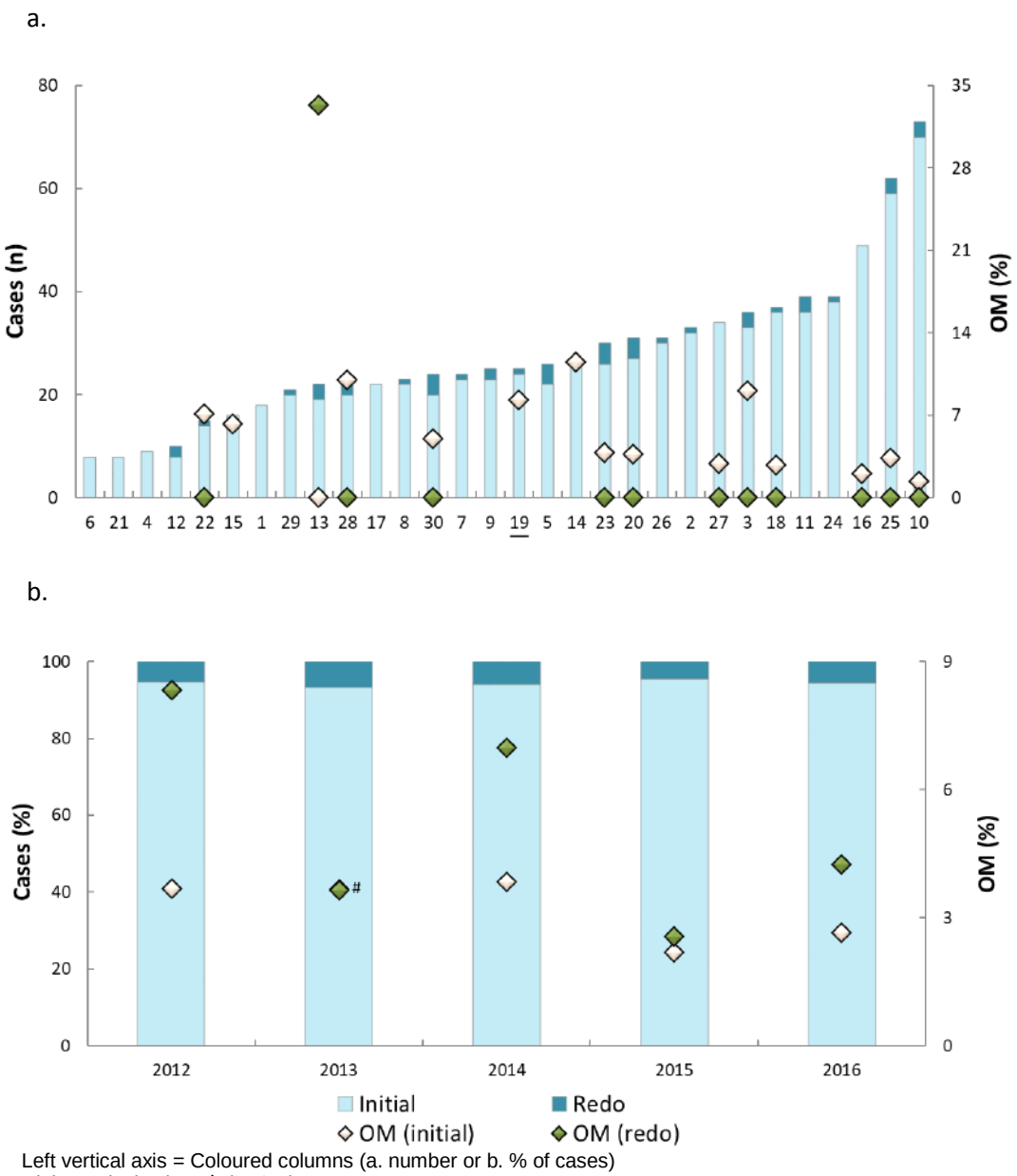
Table 10. Complications (%) based on surgery type

Post-operative complication	Year	Surgery	
		Initial	Redo
n	2016	794	47
	2012-2015	2890	173
Any CVA	2016	1.6	4.3
	2012-2015	2.9	1.7
DNRI	2016	4.7	8.5
	2012-2015	5.7	5.8
DSWI	2016	1.1	4.3
	2012-2015	1.6	1.2
NCA	2016	36.7	37.0
	2012-2015	38.0	40.7
Re-op for bleeding	2016	4.5	2.1
	2012-2015	3.7	8.1

3.3 Mortality based on initial and redo surgery

In 2016, the number of initial procedures performed ranged from 8 (units 6 and 21) to 70 (unit 10); and of redo procedures from 1 (nine units) to 4 (four units; Figure 50a). Fifteen units reported OM for initial procedures in 2016, while for redo procedures, OM was only reported by units 13 (33.3%; OM=3) and 19 (100%, OM=1).

Pooled unit data shows annually, less than 6% of procedures are redo AVR with CABG (Figure 50b). Averaged OM for initial AVR with CABG is 3.1%, and for redo 5.0%.



Left vertical axis = Coloured columns (a. number or b. % of cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups
Underlined unit reported 100% OM for Redo group

Figure 50. OM following initial versus redo AVR with CABG by a. unit and b. year

3.4 Unit outcomes – mortality, complications and resource utilisation

Given the low number of cases (<80 per unit) reported for AVR with CABG procedures in 2016, only pooled 2012-2016 data is shown.

3.4.1 Mortality

The average OM for 2012-2016 is 3.3% (Figure 51).

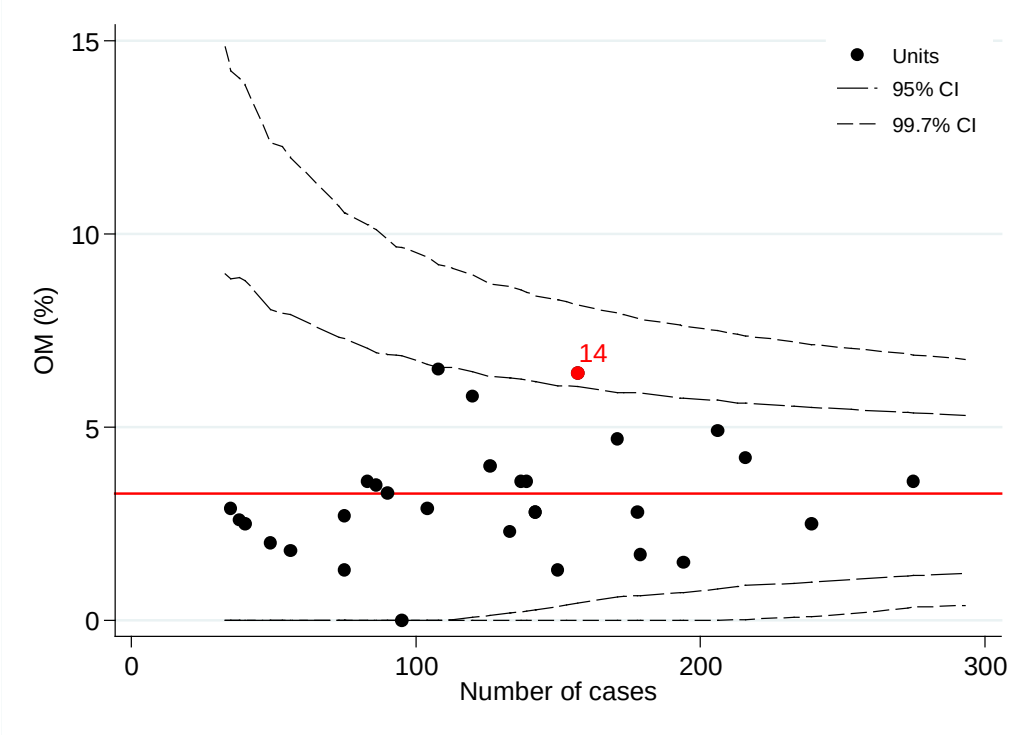


Figure 51. OM following AVR with CABG by unit, 2012-2016

3.4.2 Complications 2012-2016

For pooled five year complications data (Figure 52), average complication rates were: CVA 2.6%; DNRI 5.5%; DSWI 1.5%; NCA 38%; re-op for bleeding 4.0%; readmission 11%.

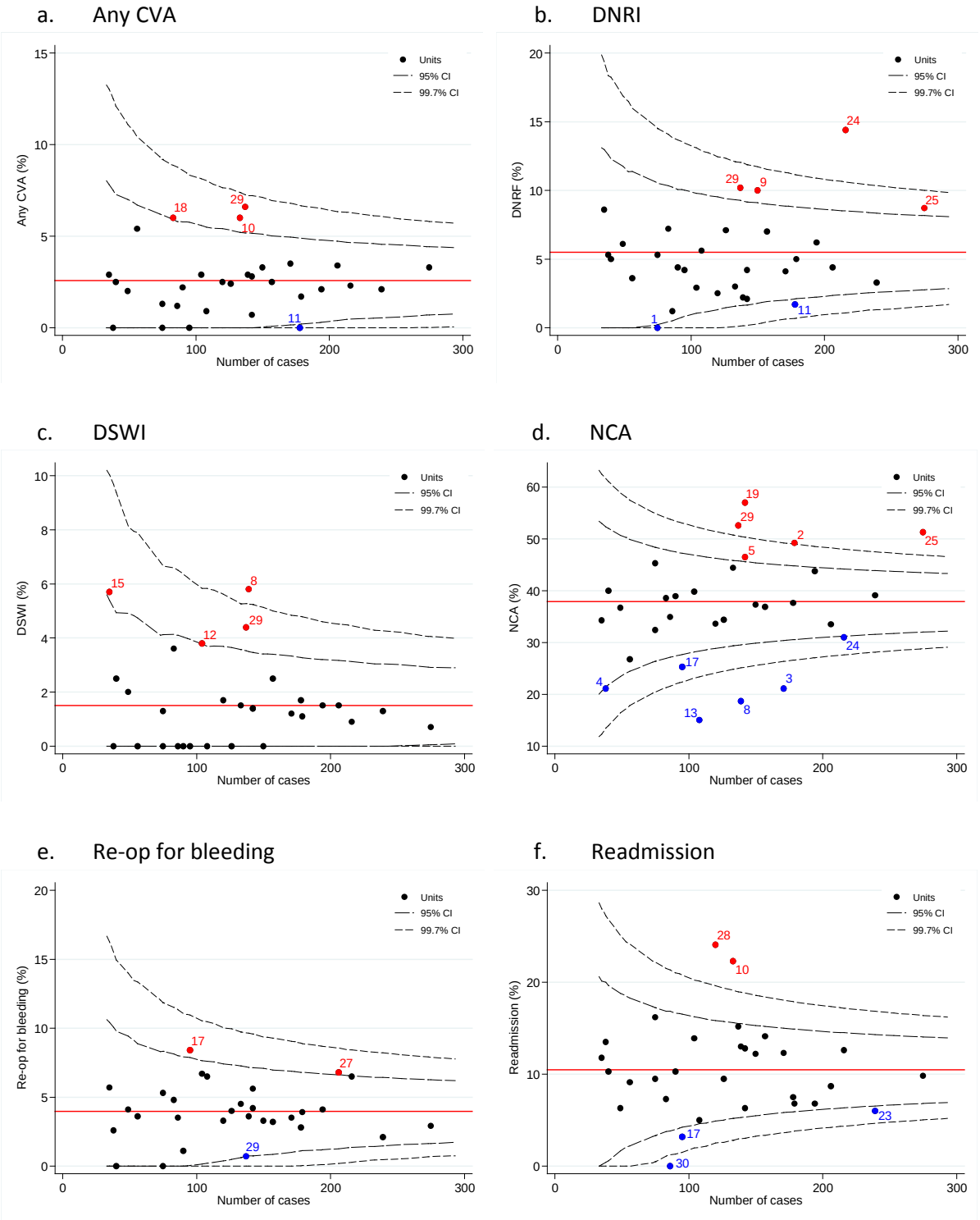


Figure 52. Five-year complication outcomes following AVR with CABG

3.4.3 Resource utilisation 2012-2016

For pooled five-year data (Figure 53), averaged median resource utilisation times were: ICU 53 hours; VENT 12 hours; Pre-PLOS 0.8 days; Post-PLOS 8.5 days. The average percentages of patients transfused with blood products were RBC 50% and NRBC 34%. All units were within 95% CI for Post-PLOS.

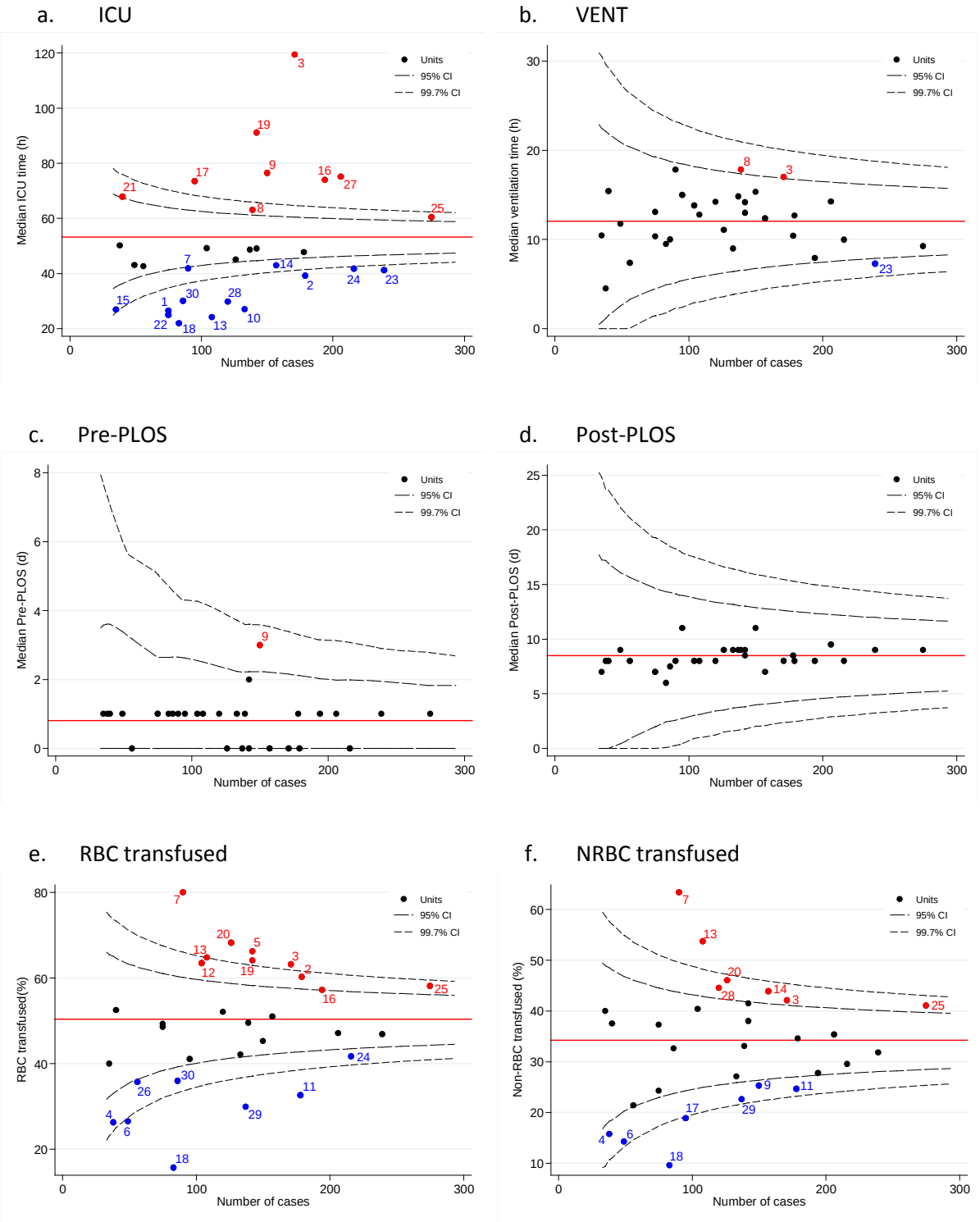


Figure 53. Five-year resource utilisation following AVR with CABG

3.5 Surgeons' outcomes – mortality

The average OM for 2012-2016 is 3.2% (Figure 54).

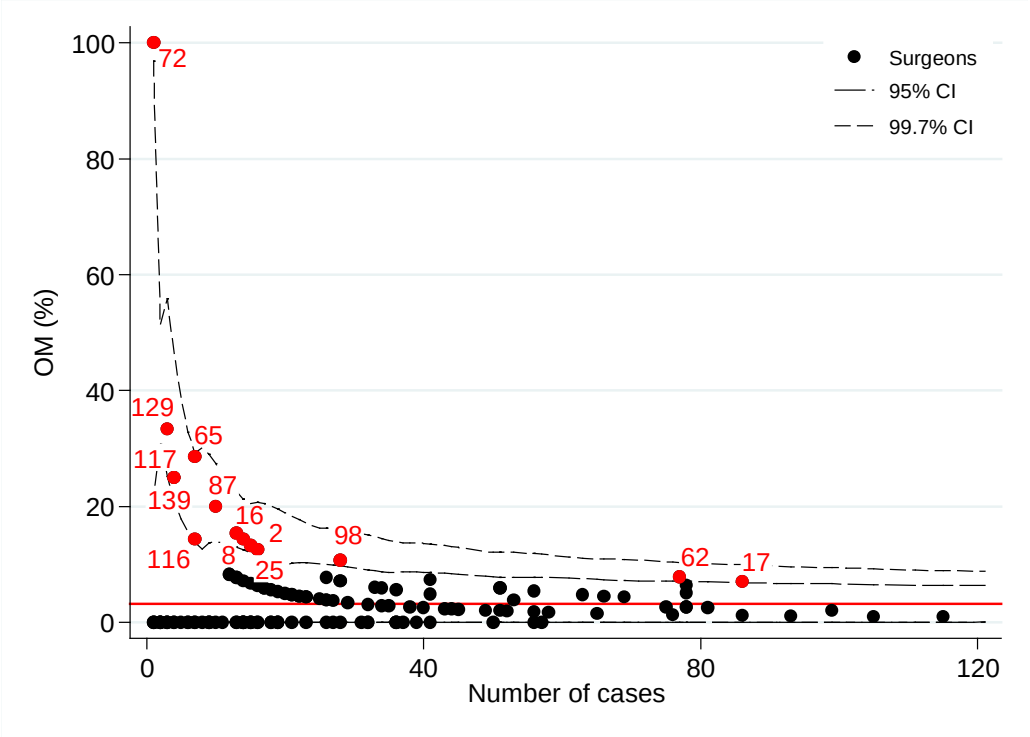


Figure 54. OM following AVR with CABG for individual surgeons, 2012-2016

3.6 Key Messages

- *Generally, OM increases with clinical urgency, most markedly for emergency patients.*
- *Overall, OM increases with age and is generally higher for women than in men.*
- *Impaired LVF is associated with a higher risk of OM.*
- *Previous AMI is associated with higher OM.*
- *Patients with diabetes have a higher incidence of post-operative complications.*
- *Patients with prior renal impairment, have higher incidences of DNRI and NCA.*
- *Advancing age is generally associated with a higher incidence of post-operative complications, the exception being re-op for bleeding.*
- *Redo surgery is associated with higher incidence of DNRI and re-op for bleeding.*
- *Combined Valve and CABG surgery increases the risk of surgery.*

4. Other Cardiac Surgery

Table 11 reports on OM for all other cardiac procedures not listed in sections 1-3. Some of these procedures are low-risk but not performed in isolation, therefore OM is not necessarily indicative of that specific procedure. This applies particularly for the last three procedures on the list.

Table 11. Other uncommon procedures and associated OM in 2016

Surgery type (not mutually exclusive)	n	OM (%)
LV Aneurysm	23	4.3
Acquired ventricular septal defect	24	8.3
Aortic Procedure^	947	6.7
Aneurysm – Ascending only	239	2.9
– Ascending + Arch	64	1.6
– Arch only	10	10.0
– Descending	2	-
– Thoracic/Abdominal only	2	-
– Arch + Descending	1	100
– Ascending + Arch + Descending	10	70.0
– Others	-	-
Dissection – Ascending – Acute	98	13.3
– Ascending – Chronic	6	16.7
– Descending – Acute	2	-
– Descending – Chronic	-	-
Acute Traumatic Aortic Transection	3	-
Cardiac Trauma	4	-
LVOT Myectomy for HOCM	101	3.0
LV Rupture Repair	6	33.3
Pericardiectomy	22	0.0
Pulmonary Thrombo-endarterectomy	22	9.1
Carotid Endarterectomy	13	0.0
LV Reconstruction	3	0.0
Pulmonary Embolectomy	21	9.5
Cardiac Tumour	79	2.5
Cardiac Transplant	173	3.5
Cardiopulmonary Transplant	18	0.0
Congenital – Atrial septal defect	156	0.6
– Other	143	1.4
Permanent LV Epicardial Lead	101	8.9
Atrial Arrhythmia Surgery	137	7.3
Left Atrial Appendage Closure	371	4.6

^Some units did not submit Aortic Procedure Type data despite answering yes to Aortic Procedure

Concluding Remarks

Review of data completeness shows over 99% completeness for all 12 reported KPIs, assuring minimal to no selection bias in analyses. Based on AIHW records (http://www.aihw.gov.au/cardiovascular-disease/hospital-care/), approximately 60% of Australian cardiac surgery patients are included in the ANZSCTS Database. We strive toward the ideal of including all adult patients from every cardiac surgical unit so that the performance of all units and surgeons may be evaluated.

The significant changes made by the Program in 2016/2017 have been: to release an updated Web System with refined data definitions reflecting changes in clinical practice; inclusion of TAVR and TMVR procedures; release of a new public website amalgamated within the Society website http://anzscts-database.org/; and recruitment of seven additional private cardiac units.

Our goals for the remainder of 2017 are to release downloadable web reports showing comparative KPIs for all participating units; enhance the Web System data entry portal for efficient data entry; and encourage engagement by distribution of feedback reports to all participating surgeons.

Long-term goals for ANZSCTS Database will focus on extending the scope of the information collected through linkage of our data with other key external data sources; establishing a Cardiac Surgical Prosthesis Registry; evaluation of quality of life through collecting longitudinal Patient Reported Outcome Measures (PROMs); and improving our reporting processes to health professionals and to the public.

We take this opportunity to thank contributors for their dedicated efforts with data collection and financial support, both of which are integral to our efforts.

Appendix A

Management of Unit Outliers – Review Timeline

Week 0: Identification of outlier during the Steering Committee (SC) quarterly review on funnel plot (outside the 95% confidence interval) for either the rolling 36-month period or two consecutive quarters.

Week 2: Unit contacted by the Chair of the SC and asked to undertake internal review of data. Data that may have an overall impact on KPI in question, is reviewed by unit and ANZSCTS Database team, within 8 weeks of notification.

Week 12: SC to review two independent reports from unit and ANZSCTS Database team. These reports are compared with most recent quarterly KPI data.

If the results have fallen back within control limits no further action is taken.

If the KPI still remains out of range the Chair of the SC will make a recommendation that the unit agrees to an external review of their data.

- The Peer Review and Quality Assurance Committee (PRQAC) will be activated and comprises of members of ANZSCTS:
    - The President of the Society
    - The Vice-President of the Society
    - The ANZSCTS Representative to the Royal Australian College of Surgeons Council
    - The Chairman of the Board of Studies
    - The Chairman of the Science and Education Committee of The Society
    - The Chairman of the Board of The Australasian Cardiac Surgery Research Institution Ltd.
    - Ordinary or senior member of the Society, elected by ballot of all members of the Society.

Week 24: SC to review external audit report and monitor most recent (rolling 36 month and current quarter) KPI data.

- If sufficient data is available and results have fallen within control limits the unit will be informed along with the hospital administrative body that the review is finalised and no further action is required.
- If sufficient data is available and results still remain outside limits then the unit will be informed and a meeting will be arranged between the PRQAC, hospital administration and the Head of Unit.

Week 36: The SC will continue to monitor the unit's data if there is insufficient data for a statistical analysis. At 36 weeks the SC will review past 6 months of data and all data relating to KPI at the next quarterly review including:

- The local audit report
- The external audit report

- If the KPI still remains out of range the unit will be informed and a meeting will be arranged between PRQAC, hospital administration and the Head of Unit.

Appendix B

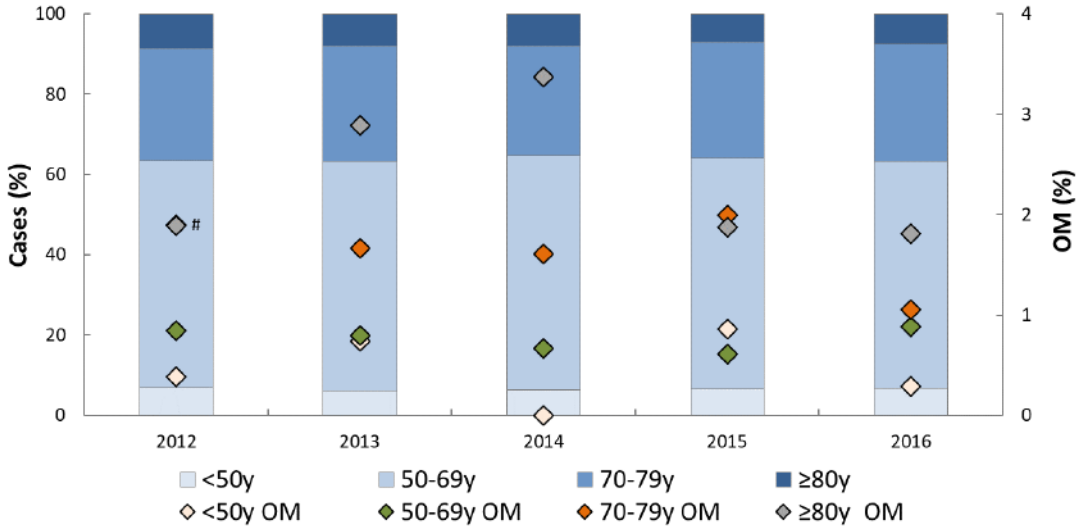
Appendix B-I - Interpretation of Stacked Bar Chart

Stack bar charts feature prominently in this report; they are snapshots of dense data. They are useful to compare various cohorts for various criteria.

The graph below displays the proportional distribution of four age groups (primary y-axis; % cases) over the past five years (x-axis). Each age group is represented by a coloured box stacked vertically. As seen below the 50-69-year-old age group represents the greatest proportion (number/% cases) of isolated CABG patients annually over five years.

On the secondary y-axis on the right-hand side a procedural outcome (complication or mortality) is plotted as a scatter plot of diamond symbols. As shown below the different coloured diamonds refer to different groups. As a point of reference, in 2013, 2014 and 2016 the group with the highest mortality are patients 80 years or older.

Where two or more groups overlap, a hash symbol is placed next to the diamond symbol. As example, in 2015, age groups ≥80 years and <50 years overlap on observed mortality (OM).



Left vertical axis = Coloured boxes (number/% cases)
Right vertical axis = ◆ (% OM)
= Two or more groups overlap
Units with no diamonds reported 0% OM for all groups

Figure B-I. OM of patients based on age by year

Appendix B-II - Interpretation of Funnel Plots

Funnel plots are another approach to compare performance standards of hospital units or individual surgeons. They are especially useful in this situation as there is usually a difference in the numbers of procedures (sample size) included in the data plot. For example, the figure below illustrates the observed mortality (OM) after coronary artery bypass surgery in Australia between 2012 and 2015.

The solid line represents the average OM, the two-dotted lines are the 95% CIs and the two-dashed lines are the 99.7% CIs. The funnel plot allows the CIs to narrow as the number of procedures increases. This representation supports the 95% CI plot to illustrate the invalidity of ranking all of those units from "best" to "worst" as only 2 were worse than the majority, all of which had statistically similar outcomes.

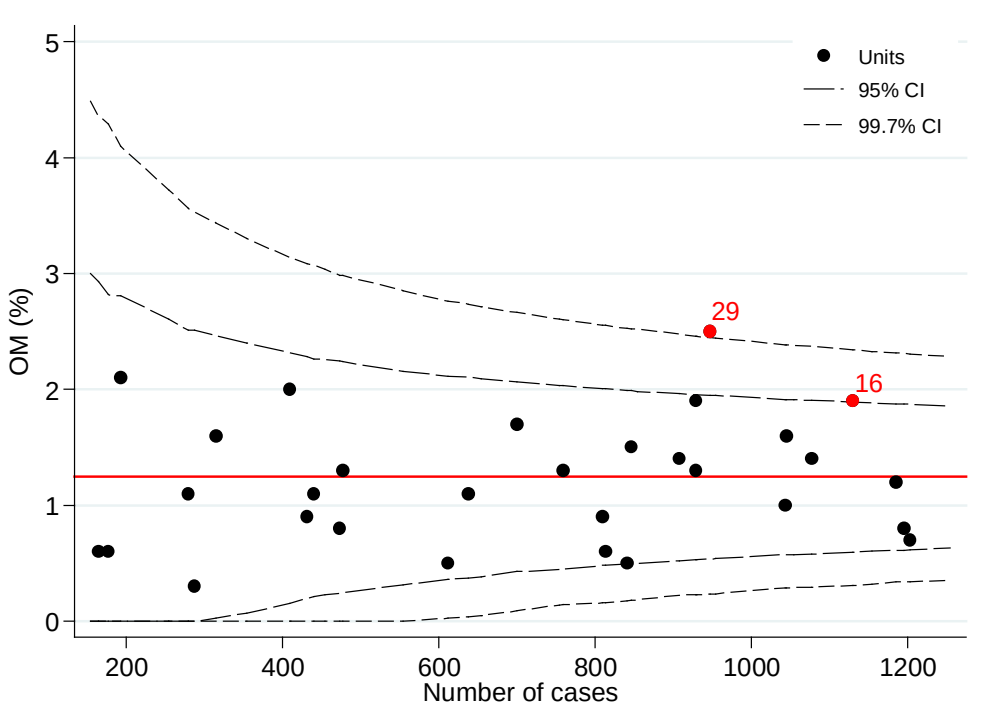


Figure B-II. OM following CABG, by unit

Appendix C

All Procedures Risk Adjustment Model

The All Procedures Score (Billah, *et. al.*, 2010) is a validated preoperative risk prediction model, used for risk-adjustment for 30-day mortality for all cardiac surgery, in Australia. The model was developed based on a large number of procedures using standardised data collection methodology. Subsequent validation of the model shows that it is a good fit for Australian data and correctly classified the risk of a large number of procedures.

The Risk Adjusted Mortality Rate (RAMR) takes into account a number of risk factors listed in Table C-I. The ratio of the observed mortality (OM) rate to the predicted mortality rate indicates the relative performance adjusted for the severity of illness or risk. A ratio of 1 indicates results as expected, less than 1 indicates results better than expected, and greater than 1 indicates results worse than expected. This ratio is then multiplied by the Observed Average Mortality Rate to yield a RAMR which normalises the individual unit for its case mix.

RAMR is calculated as follows:

$$\text{RAMR} = \left[\frac{\text{OM Rate}}{\text{Predicted Mortality Rate}} \right] \times \text{Average OM Rate}$$

RAMR is therefore, a predictor of mortality for a given patient set which takes into account the risks for those patients.

Table C-I. Variables that define overall patient risk in the All Procedures Risk-Adjustment Model

Age	Gender	Clinical Status
Procedure type	Previous Cardiac Surgery	NYHA* class
EF Grade	Preoperative Dialysis	Hypercholesterolaemia
Previous vascular disease	BMI>25kg/m^2	

* New York Heart Association functional classification for angina

Appendix D

Tables of Raw Number Mortality – Isolated CABG

Table D-I. OM following CABG procedures based on clinical status by unit

Unit	Clinical status					
	Elective		Urgent		Emergency	
	OM	n	OM	n	OM	n
1	1	151	2	16	1	4
2	4	212	-	21	-	7
3	-	127	3	153	1	8
4	-	25	-	15	-	3
5	1	185	2	38	1	5
6	-	30	-	21	1	5
7	-	123	-	55	-	3
8	2	138	-	31	-	10
9	2	214	1	33	-	5
10	3	223	2	221	-	31
11	1	134	-	93	-	5
12	-	28	-	15	-	1
13	1	55	-	80	-	1
14	-	142	-	19	-	14
15	-	80	-	84	-	10
16	-	116	-	252	-	9
17	-	106	-	6	-	-
18	1	147	1	199	-	6
19	3	211	-	43	-	13
20	-	159	2	68	-	9
21	1	87	-	4	-	2
22	2	99	-	1	1	1
23	-	173	1	24	-	2
24	1	160	4	114	-	3
25	-	211	1	91	-	9
26	2	168	-	48	1	9
27	2	220	3	75	-	4
28	-	72	2	122	3	13
29	-	105	4	98	1	13
30	-	102	-	69	-	6

Table D-II. OM of male patients following CABG procedures based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	12	2	79	1	37	1	13
2	-	18	3	112	1	58	-	16
3	-	20	4	140	-	65	-	13
4	-	1	-	10	-	17	-	9
5	-	11	2	105	1	60	-	16
6	-	3	-	27	-	16	-	3
7	-	9	-	92	-	33	-	10
8	-	15	2	83	-	41	-	6
9	-	18	1	125	1	45	-	15
10	-	18	1	207	2	117	1	33
11	-	5	-	92	1	75	-	22
12	-	1	-	21	-	16	-	3
13	-	9	-	68	1	31	-	9
14	-	4	-	87	-	40	-	14
15	-	7	-	78	-	50	-	13
16	-	26	-	185	-	87	-	17
17	-	2	-	49	-	31	-	10
18	-	16	-	195	1	72	-	4
19	-	22	1	118	-	55	1	13
20	-	15	1	112	1	46	-	14
21	-	1	1	39	-	30	-	9
22	-	3	-	39	-	32	-	3
23	-	1	-	81	-	74	-	19
24	-	15	3	126	1	65	1	19
25	-	4	1	132	-	88	-	27
26	-	18	1	114	1	45	-	8
27	-	24	1	144	2	69	-	16
28	1	16	2	91	1	44	-	7
29	-	16	-	95	1	44	3	17
30	-	13	-	91	-	35	-	8

Table D-III. OM of female patients following CABG procedures based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	4	-	15	-	11	-	-
2	-	2	-	18	-	15	-	1
3	-	1	-	17	-	24	-	8
4	-	-	-	2	-	3	-	1
5	-	3	1	18	-	10	-	5
6	-	-	1	2	-	4	-	1
7	-	3	-	19	-	11	-	4
8	-	7	-	15	-	8	-	4
9	-	5	1	25	-	14	-	5
10	-	4	1	50	-	38	-	8
11	-	-	-	15	-	17	-	6
12	-	-	-	2	-	-	-	1
13	-	4	-	10	-	4	-	1
14	-	1	-	15	-	12	-	2
15	-	1	-	12	-	11	-	2
16	-	2	-	31	-	25	-	4
17	-	-	-	11	-	7	-	2
18	-	7	1	34	-	19	-	5
19	-	5	-	33	-	15	1	6
20	-	3	-	27	-	14	-	5
21	-	1	-	6	-	6	-	1
22	-	-	1	6	1	13	1	5
23	-	-	-	6	1	12	-	6
24	-	3	-	28	-	18	-	3
25	-	-	-	26	-	21	-	13
26	-	5	-	20	1	11	-	3
27	-	3	-	23	1	13	1	7
28	-	9	-	23	1	14	-	3
29	-	2	-	22	1	17	-	3
30	-	1	-	14	-	12	-	3

Table D-IV. OM following CABG procedures based on pre-procedure LVF by unit

Unit	Pre-procedure LVF							
	NLVF		MRLF		ModRLVF		SRLVF	
	OM	n	OM	n	OM	n	OM	n
1	-	80	2	65	-	21	2	5
2	2	135	2	61	-	32	-	12
3	-	159	1	79	2	39	1	10
4	-	22	-	15	-	5	-	1
5	2	147	-	42	-	31	2	7
6	-	30	-	15	-	9	1	1
7	-	113	-	36	-	24	-	8
8	1	80	-	60	1	33	-	6
9	-	123	2	83	1	29	-	12
10	3	154	1	231	-	69	1	17
11	-	101	1	116	-	10	-	2
12	-	18	-	17	-	4	-	5
13	1	69	-	41	-	21	-	4
14	-	80	-	67	-	16	-	12
15	-	56	-	66	-	20	-	7
16	-	255	-	61	-	48	-	10
17	-	68	-	22	-	4	-	3
18	-	65	1	181	1	85	-	20
19	-	133	1	83	2	43	-	8
20	-	145	1	53	1	26	-	11
21	1	54	-	18	-	14	-	5
22	1	41	1	51	1	8	-	0
23	-	127	-	48	-	19	1	5
24	2	136	1	91	1	40	1	10
25	-	219	-	49	1	34	-	9
26	1	99	-	69	1	37	1	9
27	2	138	2	97	1	51	-	8
28	-	43	2	108	2	40	1	6
29	2	108	1	63	1	29	1	12
30	-	71	-	68	-	35	-	3

Table D-V. OM following CABG procedures based on timing of pre-procedure MI by unit

Unit	Timing of pre-procedure MI							
	≤6h		6-24h		1-7d		>7d	
	OM	n	OM	n	OM	n	OM	n
1	1	1	-	1	-	28	1	73
2	-	-	-	2	-	18	1	97
3	-	3	1	3	2	47	1	114
4	-	1	-	-	-	5	-	11
5	-	3	1	6	1	44	1	56
6	-	-	-	1	-	8	1	15
7	-	-	-	3	-	19	-	70
8	-	4	-	4	-	21	1	69
9	-	1	-	2	1	49	1	81
10	-	2	-	10	2	102	1	168
11	-	3	-	1	-	42	-	36
12	-	-	-	1	-	11	-	13
13	-	1	-	2	-	27	1	62
14	-	3	-	5	-	32	-	61
15	-	1	-	3	-	27	-	44
16	-	4	-	3	-	76	-	154
17	-	-	-	-	-	2	-	10
18	-	1	-	4	1	76	1	143
19	-	-	-	6	1	46	1	70
20	-	3	-	5	-	28	2	91
21	-	-	-	1	-	11	1	33
22	-	-	-	-	3	20	-	38
23	-	-	-	4	1	27	-	30
24	-	1	-	-	1	40	3	112
25	-	1	-	5	1	45	-	45
26	-	-	1	3	1	23	1	112
27	-	3	1	6	1	54	2	95
28	-	2	1	7	1	46	1	75
29	1	4	-	7	2	42	2	56
30	-	2	-	1	-	53	-	33

Table D-VI. Number of arterial and venous anastomoses by a. unit and b. year

a) unit

Unit	Arterial and venous anastomoses					Total number of anastomoses
	BITA	LITA or RITA	RA (x1 or x2)	SVG	GEPA	
1	7	189	15	379	-	590
2	95	208	186	289	-	778
3	26	269	72	498	-	865
4	3	52	30	37	-	122
5	7	242	32	444	-	725
6	31	53	57	44	-	185
7	-	134	8	444	2	588
8	2	162	2	335	-	501
9	69	233	34	465	2	803
10	-	438	100	804	-	1342
11	138	167	146	193	-	644
12	34	40	9	50	1	134
13	-	135	18	252	-	405
14	27	160	120	245	-	552
15	2	152	9	288	-	451
16	49	376	285	484	1	1195
17	-	107	2	220	2	331
18	6	383	36	708	2	1135
19	190	192	218	202	-	802
20	75	215	294	218	1	803
21	11	93	14	165	-	283
22	16	86	39	144	-	285
23	38	226	193	201	-	658
24	70	293	443	121	-	927
25	217	264	383	207	-	1071
26	16	213	45	399	-	673
27	7	334	8	611	-	960
28	45	197	90	353	-	685
29	60	223	206	223	1	713
30	4	295	25	284	-	608

b) year

Year	Arterial and venous anastomoses					Total number of anastomoses
	BITA	LITA or RITA	RA (x1 or x2)	SVG	GEPA	
2012	899	4382	2361	6977	28	14647
2013	1169	5084	2662	8129	60	17104
2014	1419	4820	2795	6966	36	16036
2015	1463	6258	3082	9885	36	20724
2016	1245	6131	3119	9307	12	19814

Table D-VII. OM following CABG procedures for individual surgeons, 2016

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	1	128	44	-	95	93	-	69
2	1	41	45	-	36	94	2	46
3	-	95	46	3	67	95	1	41
4	-	118	49	-	35	97	3	64
5	1	56	51	-	48	98	1	57
6	-	65	52	1	42	99	1	80
7	-	23	53	-	67	100	-	95
8	1	15	54	-	50	101	-	2
9	1	28	55	-	18	102	-	3
11	-	103	56	3	79	103	-	6
12	-	37	57	-	87	104	-	8
13	-	22	58	1	19	105	-	3
14	-	97	59	-	83	107	1	44
15	-	3	60	1	65	108	-	62
16	1	11	61	-	34	109	1	106
17	1	50	62	1	80	110	1	106
18	2	113	63	-	28	111	1	43
19	-	80	64	-	31	112	-	38
20	1	19	65	-	19	114	-	59
21	-	55	66	-	58	115	-	13
23	-	47	67	1	54	116	1	86
24	-	20	68	2	90	117	1	38
25	-	1	70	1	59	118	-	67
26	-	27	71	-	28	119	1	74
27	-	74	73	-	63	121	-	9
28	1	2	74	2	94	122	1	94
29	-	9	75	-	118	123	-	68
30	1	65	76	-	18	124	-	85
31	1	14	78	-	63	125	3	43
32	3	75	79	-	31	126	2	125
33	-	78	80	-	36	127	3	74
34	-	78	81	-	55	128	-	57
35	-	66	83	-	57	129	-	29
36	-	83	84	-	40	130	-	10
37	1	56	85	2	68	131	1	16
38	-	65	86	-	73	132	1	44
39	-	26	88	2	94	133	-	10
40	-	69	89	-	66	134	-	6
41	-	33	91	-	99	135	2	99
43	-	21	92	-	50	136	-	1

Table D-VIII. OM following CABG procedures for individual surgeons, 2012-2015

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	3	367	43	3	126	86	1	161
2	2	121	44	2	339	87	2	101
3	11	388	45	1	100	88	-	270
4	7	438	46	2	108	89	1	218
5	1	98	47	5	279	91	3	383
6	1	206	48	-	47	92	1	146
7	3	202	49	-	150	93	7	473
8	3	115	50	-	22	94	2	205
9	1	116	51	2	209	95	6	314
10	2	104	52	2	347	96	5	161
11	1	341	53	4	313	97	1	244
12	7	226	54	3	183	98	4	172
13	1	137	55	-	90	99	1	51
14	5	375	56	2	348	100	2	128
15	2	84	57	5	310	101	-	58
16	3	106	58	1	229	102	1	55
17	8	358	59	-	208	103	-	78
18	7	520	60	1	168	104	-	124
19	4	301	61	1	156	105	-	16
20	1	62	62	-	314	107	1	49
21	2	185	63	-	14	108	4	145
22	-	1	64	-	37	109	2	99
23	6	380	65	-	67	110	-	106
24	-	129	66	2	184	111	-	40
25	2	154	67	2	229	112	-	15
26	-	92	68	5	331	114	-	74
27	1	236	69	1	117	115	-	23
28	-	70	70	-	287	116	-	28
29	1	116	71	1	219	117	2	48
30	3	254	72	-	29	118	-	63
31	1	71	73	6	311	119	1	82
32	7	325	74	7	366	121	-	5
33	4	512	75	8	382	122	1	77
34	4	276	76	-	50	123	1	83
35	4	210	78	-	108	124	2	76
36	2	353	79	3	133	125	1	63
37	3	254	80	2	238	126	-	43
38	5	249	81	4	174	136	-	9
39	1	133	82	1	30	137	1	18
40	1	185	83	1	113	138	-	28
41	5	262	84	1	205	139	1	16
42	6	174	85	8	160	140	-	19

Appendix E

Tables of Raw Number Mortality – Isolated Valve

Table E-I. OM following single valve procedures based on clinical status by unit

Unit	Clinical status					
	Elective		Urgent		Emergency	
	OM	n	OM	n	OM	n
1	-	46	-	2	-	2
2	-	63	-	4	-	-
3	2	62	1	18	1	1
4	-	8	-	6	-	-
5	1	57	-	6	-	-
6	1	12	-		-	2
7	-	25	-	8	-	1
8	2	73	-	3	-	2
9	1	90	-	3	1	2
10	2	148	3	75	-	13
11	2	108	-	10	-	-
12	-	16	-		-	-
13	1	54	1	16	-	-
14	-	42	-	6	-	1
15	1	72	1	9	-	2
16	-	78	-	28	-	2
17	3	38	-		-	-
18	-	86	-	12	-	3
19	1	77	-	9	-	4
20	1	40	-	7	1	3
21	-	45	-		-	-
22	1	54	-		-	-
23	2	77	-	2	-	-
24	-	79	1	10	-	-
25	-	121	1	5	-	-
26	-	56	-	11	1	1
27	2	78	-	8	-	1
28	1	41	-	5	2	5
29	-	58	-	5	1	1
30	-	62	-	11	-	-

Table E-II. OM following single valve surgery based on gender by unit

Unit	Gender			
	Male		Female	
	OM	n	OM	n
1	-	30	-	20
2	-	43	-	24
3	2	41	2	40
4	-	11	-	3
5	-	41	1	22
6	-	8	1	6
7	-	20	-	14
8	1	43	1	35
9	-	57	2	38
10	2	130	3	106
11	1	81	1	37
12	-	9	-	7
13	2	43	-	27
14	-	28	-	21
15	1	55	1	28
16	-	84	-	24
17	2	29	1	9
18	-	68	-	33
19	1	60	-	30
20	-	29	2	21
21	-	33	-	12
22	-	35	1	19
23	1	48	1	31
24	1	56	-	33
25	-	88	1	38
26	-	45	1	23
27	-	46	2	41
28	1	32	2	19
29	1	39	-	25
30	-	41	-	32

Table E-III. OM of male patients following single valve procedures based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	11	-	10	-	7	-	2
2	-	5	-	17	-	17	-	4
3	-	13	1	18	-	4	1	6
4	-	1	-	3	-	5	-	2
5	-	3	-	20	-	12	-	6
6	-	1	-	3	-	3	-	1
7	-	4	-	6	-	6	-	4
8	1	12	-	14	-	11	-	6
9	-	11	-	23	-	12	-	11
10	1	26	1	54	-	38	-	12
11	-	9	1	32	-	29	-	11
12	-	1	-	6	-	2	-	-
13	-	5	1	22	1	14	-	2
14	-	3	-	12	-	8	-	5
15	-	8	1	21	-	20	-	6
16	-	15	-	32	-	27	-	10
17	-	1	-	9	2	16	-	3
18	-	19	-	24	-	19	-	6
19	-	7	-	20	1	21	-	12
20	-	6	-	10	-	8	-	5
21	-	5	-	12	-	14	-	2
22	-		-	15	-	13	-	7
23	-	4	1	20	-	18	-	6
24	1	17	-	25	-	13	-	1
25	-	16	-	39	-	26	-	7
26	-	12	-	17	-	9	-	6
27	-	8	-	18	-	18	-	2
28	-	8	-	13	1	11	-	-
29	-	5	1	22	-	9	-	3
30	-	4	-	18	-	14	-	5

Table E-IV. OM of female patients following single valve procedures based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	5	-	6	-	8	-	1
2	-	5	-	7	-	6	-	6
3	1	11	1	12	-	11	-	6
4	-	-	-	1	-	2	-	-
5	-	3	-	6	1	10	-	3
6	-	1	-	1	1	3	-	1
7	-	2	-	3	-	8	-	1
8	-	10	-	14	1	9	-	2
9	1	9	1	15	-	9	-	5
10	-	14	1	41	2	38	-	13
11	-	4	-	14	1	14	-	5
12	-	-	-	1	-	5	-	1
13	-	3	-	12	-	9	-	3
14	-	2	-	6	-	8	-	5
15	-	2	-	12	-	10	1	4
16	-	3	-	10	-	8	-	3
17	-	1	1	3	-	3	-	2
18	-	4	-	16	-	10	-	3
19	-	1	-	13	-	11	-	5
20	-	-	-	9	2	8	-	4
21	-	1	-	6	-	3	-	2
22	-	-	-	9	-	4	1	6
23	-	-	-	11	1	11	-	9
24	-	6	-	10	-	13	-	4
25	-	2	-	15	-	17	1	4
26	1	4	-	9	-	7	-	3
27	-	5	-	10	1	18	1	8
28	1	4	-	6	1	7	-	2
29	-	2	-	13	-	7	-	3
30	-	2	-	14	-	11	-	5

Table E-V. OM following single valve procedures by unit

Unit	Valve procedure							
	AVR		MVR		MV Repair		T/P	
	OM	n	OM	n	OM	n	OM	n
1	-	25	-	9	-	10	-	6
2	-	44	-	9	-	12	-	2
3	2	48	1	14	-	10	1	9
4	-	13	-	-	-	1	-	-
5	1	47	-	4	-	9	-	3
6	-	12	1	1	-	-	-	1
7	-	24	-	3	-	7	-	-
8	1	46	1	21	-	11	-	-
9	1	56	1	23	-	14	-	2
10	3	159	1	30	-	23	1	24
11	1	78	1	9	-	30	-	1
12	-	12	-	-	-	3	-	1
13	1	52	-	11	1	6	-	1
14	-	32	-	9	-	8	-	-
15	2	58	-	10	-	14	-	1
16	-	66	-	18	-	22	-	2
17	3	30	-	7	-	1	-	-
18	-	64	-	11	-	24	-	2
19	1	56	-	13	-	20	-	1
20	2	35	-	5	-	10	-	-
21	-	23	-	12	-	10	-	-
22	1	43	-	8	-	2	-	1
23	1	49	-	10	-	19	1	1
24	-	65	-	7	-	8	1	9
25	1	65	-	14	-	41	-	5
26	1	51	-	5	-	12	-	-
27	2	57	-	9	-	18	-	3
28	2	31	1	14	-	6	-	-
29	1	46	-	4	-	13	-	1
30	-	30	-	17	-	23	-	3

Table E-VI. OM following AVR for individual surgeons, 2012-2016

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	1	164	46	3	15	94	-	56
2	-	16	47	-	50	95	3	74
3	3	125	48	1	3	96	-	16
4	1	111	49	-	21	97	-	72
5	-	30	50	1	19	98	1	24
6	2	64	51	-	13	99	-	37
7	-	21	52	1	21	100	-	37
8	-	16	53	1	66	101	-	8
9	1	23	54	-	23	102	1	29
10	1	18	55	-	31	103	-	19
11	1	85	56	-	86	104	1	17
12	3	66	57	4	109	105	-	4
13	1	49	58	4	46	107	1	52
14	1	52	59	-	22	108	-	56
15	-	17	60	1	57	109	1	32
16	-	17	61	-	41	110	1	26
17	5	99	62	1	92	111	-	22
18	-	91	63	-	6	112	-	10
19	2	77	64	-	20	114	2	33
20	1	49	65	-	20	115	-	25
21	1	47	66	3	106	116	-	14
23	1	89	67	-	35	117	-	8
24	1	85	68	1	59	118	-	31
25	-	22	69	-	10	119	-	28
26	1	41	70	1	79	121	-	9
27	-	46	71	-	66	122	-	29
28	-	9	73	2	46	123	-	39
29	-	13	74	1	75	124	1	31
30	-	128	75	2	113	125	1	26
31	4	54	76	-	32	126	-	30
32	-	86	78	-	20	127	-	8
33	-	110	79	-	18	128	-	3
34	2	71	80	3	94	129	-	8
35	2	92	81	2	82	130	-	1
36	4	123	83	-	17	131	-	2
37	4	120	84	3	98	132	-	2
38	2	46	85	1	33	133	-	2
39	3	48	86	-	38	135	-	13
40	2	48	87	1	17	136	-	4
41	4	79	88	-	47	137	-	4
42	1	51	89	1	77	138	-	4
43	1	57	91	-	186	139	-	4
44	-	51	92	1	77	140	-	7
45	-	19	93	3	88	-	-	-

Table E-VII. OM following MV repair for individual surgeons, 2012-2016

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	-	35	41	1	33	84	-	13
2	-	4	42	-	8	85	-	4
3	-	68	43	-	32	86	-	12
4	-	47	44	-	4	88	-	13
5	-	6	45	-	9	89	-	126
6	-	17	47	-	1	90	-	1
7	-	1	48	-	1	91	-	24
8	-	10	49	-	8	92	-	40
9	-	3	51	-	2	93	-	5
10	-	3	52	-	13	94	1	25
11	1	28	53	-	7	95	-	5
12	-	23	54	-	10	96	-	1
13	-	39	55	-	28	97	-	6
14	-	4	56	-	5	99	-	7
15	-	3	57	-	4	100	-	8
16	-	4	58	-	26	102	-	18
17	-	11	59	-	4	103	-	1
18	1	151	60	-	10	107	-	14
19	-	16	61	-	27	108	-	6
20	-	13	62	-	39	109	-	4
21	-	8	64	-	7	110	-	4
23	1	23	65	-	1	111	-	1
24	-	7	66	-	6	114	-	4
26	-	4	67	-	3	116	-	1
27	-	6	68	-	9	117	-	1
29	-	2	70	-	71	118	-	3
30	-	101	71	-	11	119	-	5
31	-	9	73	-	5	121	-	12
32	1	31	74	-	3	122	-	40
33	-	38	75	-	21	123	-	10
34	-	35	76	-	10	124	-	1
35	-	28	78	-	3	125	-	1
36	-	14	79	-	9	128	-	1
39	-	4	80	-	10	129	-	3
40	-	13	81	-	19	140	-	1
41	1	33	83	-	5			

Table E-VIII. OM following MVR for individual surgeons, 2012-2016

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	-	18	42	-	3	88	1	9
2	-	3	43	1	19	89	1	25
3	1	18	45	-	5	91	1	19
4	1	26	46	-	8	92	-	16
5	-	6	49	-	11	93	4	22
6	1	11	50	2	3	94	1	39
7	-	3	51	1	5	95	-	12
8	-	3	52	-	8	96	-	8
9	1	3	53	-	6	97	-	12
10	-	1	54	-	7	98	-	3
11	-	10	55	-	16	99	-	5
12	-	18	56	-	4	100	1	7
13	1	24	57	1	20	102	-	14
14	-	5	58	2	17	103	1	6
15	-	1	59	-	5	104	-	3
16	1	2	60	-	13	107	-	9
17	2	11	61	1	8	108	-	15
18	1	33	62	-	14	109	-	4
19	-	11	64	-	6	110	-	4
20	-	12	65	1	2	111	-	2
21	-	12	66	-	29	112	-	2
23	-	29	67	-	7	114	-	6
24	-	22	68	1	21	115	-	12
25	-	1	69	-	7	116	-	4
26	-	5	70	-	78	117	-	1
27	-	10	71	1	13	118	-	6
28	-	3	73	-	4	119	1	10
29	-	2	74	1	31	121	-	5
30	-	23	75	1	13	122	-	13
31	-	9	76	-	9	123	-	4
32	1	15	78	-	1	124	-	3
33	3	38	79	-	2	125	-	3
34	-	9	80	1	15	127	-	1
35	1	34	81	-	7	129	-	2
36	-	50	83	-	1	132	-	1
37	-	26	84	-	32	135	-	2
39	-	4	85	-	5	136	-	1
40	1	12	86	-	7	137	-	1
41	1	13	87	1	4	140	-	2

Appendix F

Tables of Raw Number Mortality – AVR with CABG

Table F-I. OM following AVR with CABG based on clinical status by a. unit and b. year

a). unit

Unit	Clinical status					
	Elective		Urgent		Emergency	
	OM	n	OM	n	OM	n
1	-	18	-	-	-	-
2	-	30	-	3	-	-
3	-	17	2	16	1	3
4	-	7	-	2	-	-
5	-	26	-	-	-	-
6	-	8	-	-	-	-
7	-	18	-	6	-	-
8	-	21	-	1	-	1
9	-	20	-	5	-	-
10	1	47	-	21	-	5
11	-	25	-	14	-	-
12	-	8	-	2	-	-
13	1	16	-	6	-	-
14	2	23	1	3	-	-
15	1	12	-	4	-	-
16	1	28	-	21	-	-
17	-	22	-	-	-	-
18	1	28	-	9	-	-
19	3	21	-	4	-	-
20	-	24	-	6	1	1
21	-	8	-	-	-	-
22	1	15	-	-	-	-
23	1	30	-	-	-	-
24	-	32	-	7	-	-
25	-	52	2	10	-	-
26	-	25	-	6	-	-
27	1	27	-	7	-	-
28	-	16	2	6	-	-
29	-	14	-	7	-	-
30	-	20	1	4	-	-

b). year

Year	Clinical status					
	Elective		Urgent		Emergency	
	OM	n	OM	n	OM	n
2012	16	539	9	115	1	7
2013	18	655	11	154	1	10
2014	16	603	12	101	1	16
2015	14	695	4	163	1	5
2016	13	660	8	170	2	11

Table F-II. OM of male patients following AVR with CABG based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	-	-	8	-	4	-	2
2	-	-	-	7	-	11	-	4
3	-	-	-	8	1	13	-	5
4	-	-	-	3	-	2	-	3
5	-	-	-	4	-	12	-	5
6	-	-	-	1	-	2	-	2
7	-	-	-	5	-	6	-	6
8	-	-	-	8	-	9	-	4
9	-	-	-	5	-	13	-	3
10	-	-	1	20	-	24	-	14
11	-	-	-	7	-	20	-	5
12	-	-	-	2	-	4	-	3
13	-	-	1	5	-	7	-	5
14	-	1	-	6	-	7	2	6
15	-	-	-	4	-	5	1	4
16	-	-	-	7	-	21	1	10
17	-	-	-	3	-	12	-	4
18	-	-	-	11	-	15	1	7
19	-	-	2	10	1	9	-	2
20	-	-	1	9	-	11	-	5
21	-	-	-	1	-	4	-	-
22	-	-	-	2	-	6	1	4
23	-	-	-	8	-	8	-	6
24	-	-	-	5	-	18	-	6
25	-	-	-	7	-	25	2	16
26	-	1	-	9	-	6	-	6
27	-	1	-	8	-	9	1	8
28	-	-	-	1	2	9	-	5
29	-	-	-	7	-	7	-	3
30	-	-	-	8	-	7	-	2

Table F-III. OM of female patients following AVR with CABG based on age by unit

Unit	Age							
	<50y		50-69y		70-79y		≥80y	
	OM	n	OM	n	OM	n	OM	n
1	-	-	-	2	-	2	-	-
2	-	-	-	3	-	6	-	2
3	-	-	-	3	1	6	1	1
4	-	-	-	-	-	-	-	1
5	-	-	-	-	-	2	-	3
6	-	-	-	-	-	3	-	-
7	-	-	-	4	-	1	-	2
8	-	-	-	2	-	-	-	-
9	-	-	-	1	-	-	-	3
10	-	-	-	1	-	10	-	4
11	-	-	-	1	-	3	-	3
12	-	-	-	-	-	1	-	-
13	-	-	-	1	-	3	-	1
14	-	-	-	2	-	2	1	2
15	-	-	-	2	-	1	-	-
16	-	-	-	1	-	6	-	4
17	-	-	-	2	-	1	-	-
18	-	-	-	1	-	3	-	-
19	-	-	-	1	-	3	-	-
20	-	-	-	1	-	4	-	1
21	-	-	-	-	-	2	-	1
22	-	1	-	-	-	2	-	-
23	-	-	-	1	-	1	1	6
24	-	1	-	-	-	7	-	2
25	-	-	-	1	-	10	-	3
26	-	-	-	-	-	7	-	2
27	-	-	-	2	-	5	-	1
28	-	1	-	2	-	2	-	2
29	-	-	-	3	-	-	-	1
30	-	-	-	2	-	2	1	3

Table F-IV. OM following AVR + CABG for individual surgeons, 2012-2016

Surgeon	OM	n	Surgeon	OM	n	Surgeon	OM	n
1	1	105	45	1	15	91	1	76
2	2	15	46	1	17	92	3	51
3	1	93	47	-	36	93	4	78
4	2	78	48	-	3	94	1	34
5	1	22	49	1	26	95	3	66
6	1	65	50	-	7	96	-	16
7	-	6	51	1	21	97	2	33
8	2	14	52	1	49	98	3	28
9	-	14	53	2	34	99	1	23
10	1	12	54	1	23	100	-	36
11	1	115	55	-	15	101	-	8
12	1	51	56	3	56	102	-	21
13	1	17	57	1	52	103	1	13
14	-	26	58	3	41	104	-	9
15	-	15	59	2	36	105	-	2
16	2	13	60	-	32	107	1	19
17	6	86	61	-	13	108	-	37
18	2	81	62	6	77	109	2	26
19	2	53	63	-	1	110	1	23
20	-	16	64	-	11	111	-	13
21	2	28	65	2	7	112	-	2
23	3	69	66	1	45	114	-	18
24	1	56	67	-	27	115	-	14
25	2	16	68	-	36	116	1	7
26	1	26	69	-	9	117	1	4
27	-	41	70	-	50	118	-	19
28	-	9	71	-	39	119	-	19
29	-	4	72	1	1	121	-	3
30	3	63	73	1	40	122	-	18
31	-	14	74	-	57	123	1	12
32	5	78	75	2	78	124	1	20
33	1	86	76	-	15	125	1	14
34	1	43	78	1	13	126	-	7
35	1	29	79	1	27	127	-	5
36	1	58	80	1	35	128	-	3
37	2	75	81	-	23	129	1	3
38	1	25	83	-	14	130	-	1
39	1	32	84	1	38	131	-	2
40	1	21	85	-	32	135	-	6
41	2	41	86	-	31	136	-	4
42	3	51	87	2	10	137	-	2
43	2	28	88	1	22	139	1	4
44	-	56	89	1	44	140	-	1

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