Australasian Vascular Audit Public Report – 2018

AVA
AUSTRALASIAN VASCULAR AUDIT

ANZSVS
Australian and New Zealand Society for Vascular Surgery

Contents

Foreword

It gives me great pleasure to present the latest AVA report.

Since the inception in 2010 this has gone from strength to strength. The AVA remains one of the only fully-fledged surgical audits in Australasia. The most important features are the Audit Monitoring Committee and the identification of outlying surgeons. This will trigger some investigation and any correction of mislabeled events. However further investigation in truly identified events can be warranted and a change in practice has followed. The reflection on the practice element of the process may be just as important as more serious aspects of the inquiry.

We also continue to advocate to RACS for recognition of the AVA as the most integral part of Vascular Specific CPD.

There have been a number of published papers and presentations based on AVA data analysis.

We continue to strive for improvements in the system. In particular, improvements and simplification of data entry. It is acknowledged that we are often constrained by slow internet access.

I wish to thank those who have a governance role in this area, including Roxanne Wu (Chair of the Audit Monitoring Committee), Noel Atkinson (Chair Audit Committee) and Barry Beiles (Audit Administrator).

A Hill

President ANZSVS

Introduction

The Australasian Vascular Audit (AVA) was established in 2008 after constitutional changes had been adopted following a ballot with an overwhelming majority by the membership of the Australian and New Zealand Society for Vascular Surgery (ANZSVS). This had been a long-term goal of the Society with the aim of amalgamating the existing vascular audits throughout Australia and New Zealand. The audit is compulsory, with membership of the ANZSVS conditional upon participation in audit. Both public hospital and private practice data are collected at 2 points in the admission episode; at admission/operation and after discharge and only patients undergoing a surgical or endovascular procedure are entered in the database. Although all procedures are captured in the database, the following index procedures were selected for audit:

1. Aortic surgery –includes both aneurysmal and occlusive disease (survival)

   i. Open elective and emergency

   ii. Non-fenestrated elective and emergency endografts

   iii. Fenestrated endografts

2. Carotid procedures (freedom from stroke/death)

   i. Open carotid endarterectomy

   ii. Carotid stents

3. Infrainguinal bypasses (patency and limb salvage)

4. AV Fistula for dialysis (patency)

Audit monitoring committee

The executive committee of the ANZSVS has established an Audit Monitoring Committee (AMC), which consists of 4 members; the Chairman of the AMC, the immediate past-president of the ANZSVS, the administrator of the AVA (a vascular surgeon with computer and statistical skills) and the president or immediate past-president of the Vascular Society of New Zealand (VSNZ). These members are elected and are senior members of the ANZSVS engaged in active vascular surgical practice. Their roles and responsibilities are:

- to oversee protection of the collected data
- to ensure confidentiality of participants (both surgeon and patient alike)
- to monitor the collection of the audit data and to facilitate maximal compliance
- to prevent misuse of the data (including addressing complaints about misuse of the data)
- to investigate and verify statistical outliers according to a pre-determined algorithm

- to assess applications to determine suitability for participation in the AVA.
- to assess applications to use the collected data for non- audit purposes.
- to oversee the AVA verification process
- to provide an annual report of the AVA results for the ANZSVS AGM.
- to identify opportunities for performance improvement
- to identify opportunities for external publication
- to provide annual certificates of satisfactory vascular surgical audit participation
- to oversee the disclosure of audit data to a third party at the instigation of a participating member

Overview

There were 46,723 operations entered in 2018; 41,931 from Australia and 4,792 from New Zealand (Fig 1). Although the demographic data applies to all operations, the outcome analyses are based on the 46,578 discharged patients (99.7%).

Fig 1. Volume of vascular surgery by country 2018

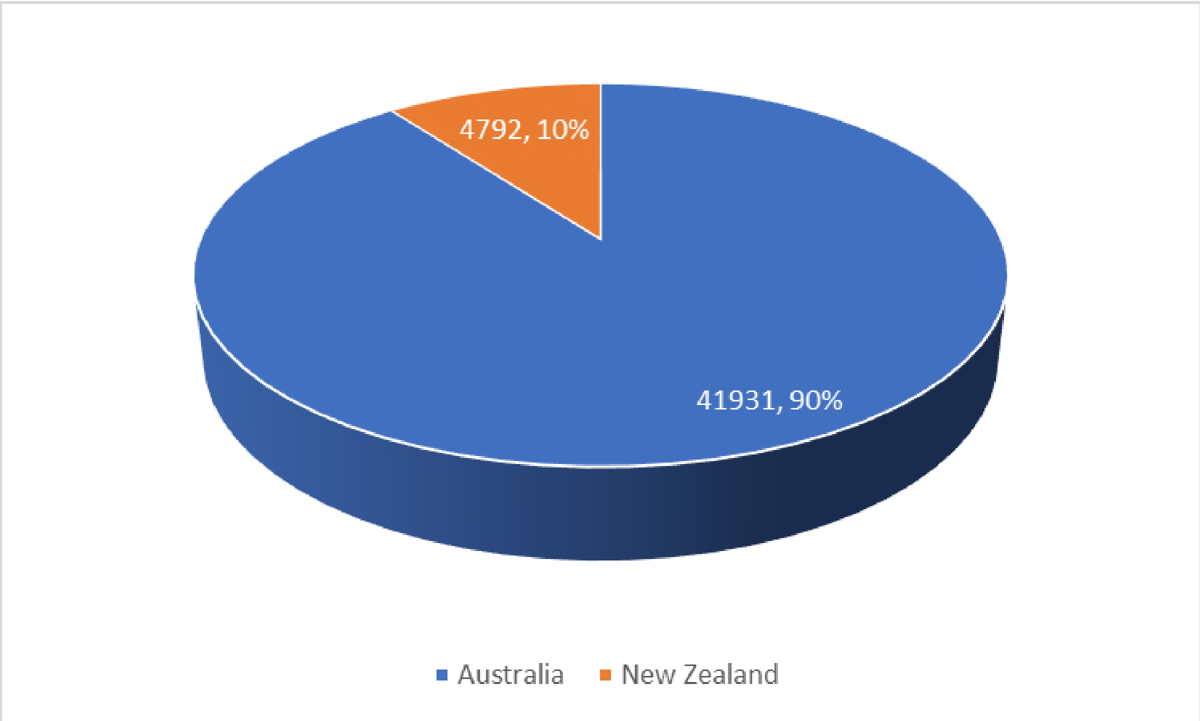
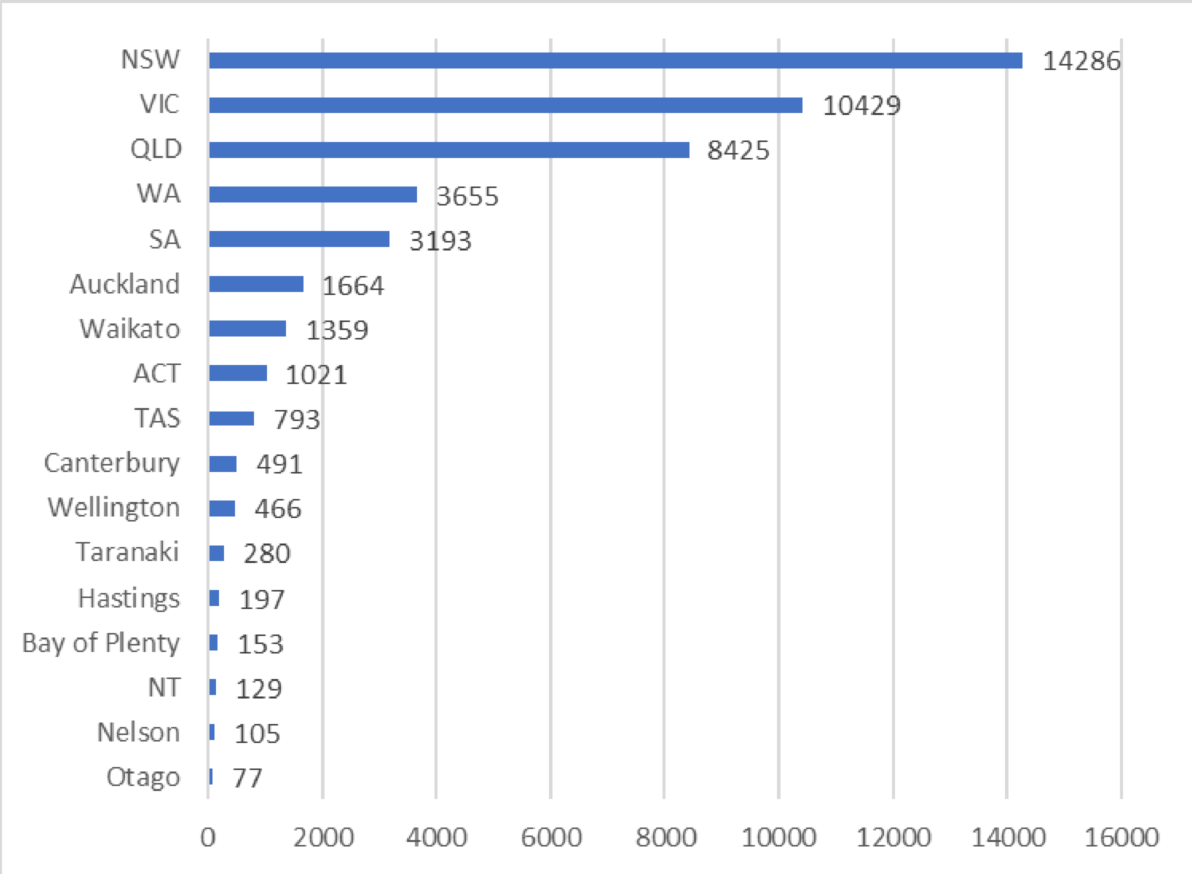


Fig 2. Operations by Australian State and New Zealand Region 2018



241 consultants entered data from 193 hospitals/clinics which are shown alphabetically in the following table.

Alfred Hospital-Melbourne
Allamanda Private Hospital-Southport
Armadale Kelmscott District Hospital-Armadale
Ascot Hospital-Remuera
Ashford Hospital-Ashford
Auburn Hospital-Auburn
Auckland City Hospital-Auckland
Austin Hospital-Heidelberg
xxx rooms-QLD
Ballarat Base Hospital-North Ballarat
Ballina District Hospital-Ballina
Bankstown Hospital-Bankstown
Beleura Private Hospital-Mornington
Berkeley Vale Private Hospital-Berkeley Vale
Blacktown Hospital-Blacktown
Blue Mountains Hospital-Katoomba
Box Hill Hospital-Box Hill
Brisbane Waters Private Hospital-Woy Woy
Buderim Private Hospital-Buderim
Cabrini Hospital-Malvern
Cairns Base Hospital-Cairns

Cairns Private Hospital-Cairns
Calvary Hospital-Central Districts
Calvary Hospital-Lenah Valley
Calvary Hospital-North Adelaide
Calvary Hospital-Wagga Wagga
Calvary Wakefield Hospital-Adelaide
Canberra Hospital-Garran
Canterbury Charity Hospital-Christchurch
Casey Hospital-Berwick
Christchurch Public Hospital-Addington
Coffs Harbour Health campus-Coffs Harbour
Concord Repatriation Hospital-Concord
Dandenong Hospital-Dandenong
Darwin Private Hospital-Tiwi
Dubbo Base Hospital-Dubbo
Dunedin Public Hospital-Dunedin
Epworth Eastern Hospital-Box Hill
Epworth Hawthorn-Hawthorn
Epworth Hospital-Geelong
Epworth Hospital-Richmond
Fairfield District Hospital-Prairiewood
Figtree Private Hospital-Figtree
Fiona Stanley Hospital-Murdoch
Flinders Medical Centre-Bedford Park
Flinders Private Hospital-Bedford Park
Frankston Hospital-Frankston
Fremantle Hospital-Fremantle
Friendly Society Private Hospital-Bundaberg West
Geelong Public Hospital-Geelong
Gold Coast Private Hospital-Parklands
Gold Coast Public Hospital-Southport
Gosford District Hospital-Gosford
Grace Hospital-Tauranga
Greenslopes Private Hospital-Greenslopes
Hastings Memorial Hospital-Camberley
Hobart Private Hospital-Hobart
Hollywood Private Hospital-Nedlands
Hollywood rooms-Nedlands
Holmesglen Private Hospital-Moorabbin
Hornsby Ku-ring-gai Hospital-Hornsby
Innisfail Hospital-Innisfail
John Fawkner Hospital-Coburg
John Flynn Private Hospital-Tugun
John Hunter Hospital-New Lambton
Joondalup Health Campus-Joondelup
Kareena Private Hospital-Caringbah
Katherine District Hospital-Katherine
Knox Private Hospital-Wantirna
Lady Cilento Childrens Hospital-South Brisbane
Lake Macquarie Private Hospital-Gateshead

Launceston General Hospital-Launceston
Linacre Private Hospital-Hampton
Lingard Private Hospital-Merewether
Lismore Base Hospital-Lismore
Liverpool Hospital-Liverpool
Macquarie University Hospital-North Ryde
Manly Hospital-Manly
Manukau Surgical Centre-Manurewa
Mater Adult Hospital-South Brisbane
Mater Hospital-Hyde Park-Townsville
Mater Hospital-Pimlico-Townsville
Mater Private Hospital-North Sydney
Melbourne Private Hospital-Parkville
Mercy Hospital-Epsom
Mid North Coast Diagnostic Imaging-Port Macquarie
Middlemore Hospital-Otahuhu
Mildura Private Hospital-Mildura
Monash Medical Centre-Clayton
Moorabbin Hospital-East Bentleigh
Mount Barker Hospital-Mt Barker
Mulgrave Private Hospital-Mulgrave
National Capital Private Hospital-Garran
Nelson Hospital-Nelson
New Bendigo Hospital-Bendigo
Newcastle Private Hospital-New Lambton Heights
North Gosford Private Hospital-North Gosford
xxx rooms-Geelong
North Shore Private Hospital-St Leonards
North West Private Hospital-Burnie
North West Private Hospital-Everton Park
Northern Beaches Hospital-Frenchs Forest
Northern Hospital-Epping
Northpark Private Hospital-Bundoora
Osborne Park Hospital-Stirling
Peninsula Private Hospital-Frankston
Pindara Private Hospital-Benowa
Port Macquarie Base Hospital-Port Macquarie
Port Macquarie Private Hospital-Port Macquarie
Prince of Wales Private Hospital-Randwick
Prince of Wales Public Hospital-Randwick
Princess Alexandra Hospital-Woolloongabba
Queen Elizabeth Hospital-Woodville West
Repatriation General Hospital-Daw Park
Riverland Regional Hospital-Berri
Rosebud Hospital-Rosebud
Royal Adelaide Hospital-Adelaide
Royal Brisbane and Womens Hospital-Herston
Royal Darwin Hospital-Casuarina
Royal Hobart Hospital-Hobart

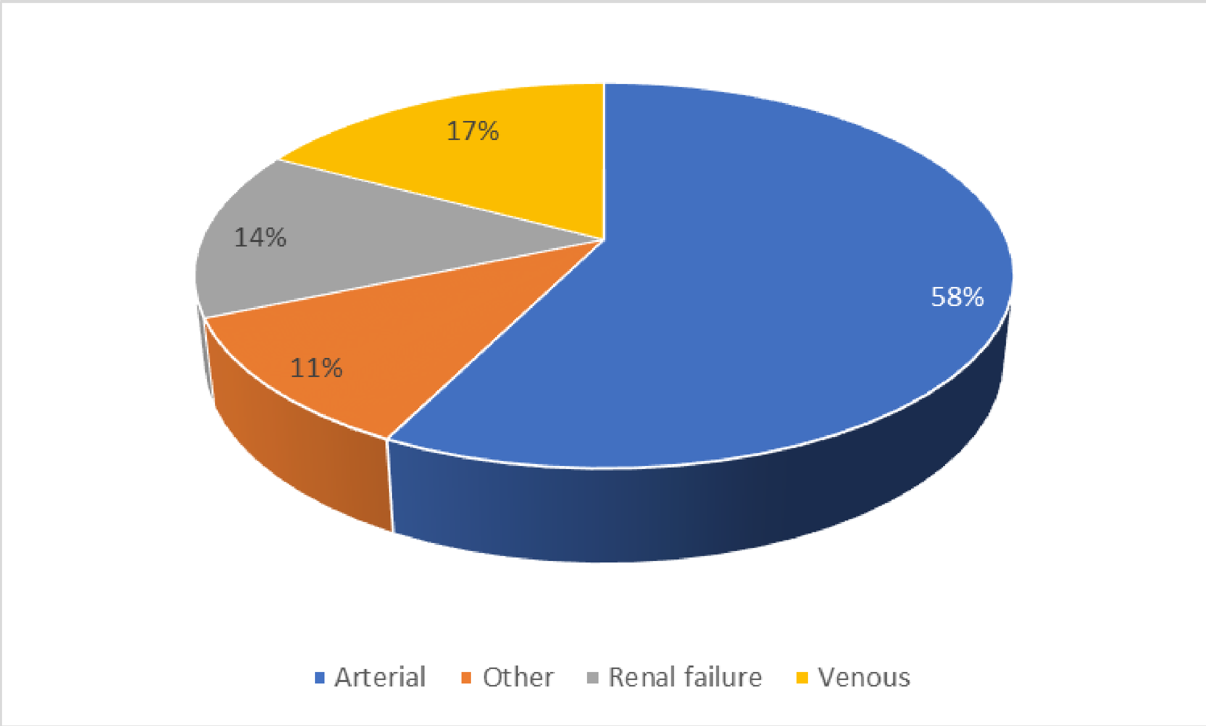
Royal Melbourne Hospital-Parkville
Royal Melbourne Transplant Unit-Parkville
Royal North Shore Hospital-St Leonards
Royal Perth Hospital-Perth
Royal Prince Alfred Hospital-Camperdown
Sir Charles Gairdner Hospital-Nedlands
Southern Cross Hospital-Christchurch
Southern Cross Hospital-Glenfield
Southern Cross Hospital-Wellington
Southern Highlands Private Hospital-Bowral
St Andrews Private Hospital-Adelaide
St Andrews Private Hospital-Ipswich
St Andrews Private Hospital-Toowoomba
St Andrews War Memorial Hospital-Brisbane
St George District Hospital-Kogarah
St George Private Hospital-Kogarah
St Georges Hospital-Christchurch
St JOG Hospital-Berwick
St JOG Hospital-Geelong
St JOG Hospital-Midland
St JOG Hospital-Murdoch
St JOG Hospital-North Ballarat
St JOG Hospital-Subiaco
St John's Hospital-South Hobart
St Vincents Private Hospital-Darlinghurst
St Vincents Private Hospital-East Lismore
St Vincents Private Hospital-Fitzroy
St Vincents Private Hospital-Griffith
St Vincents Private Hospital-Launceston
St Vincents Private Hospital-Northside
St Vincents Private Hospital-Werribee
St Vincents Public Hospital-Darlinghurst
St Vincents Public Hospital-Fitzroy
Steele Street Clinic-Devonport
Stirling Hospital-Stirling
Strathfield Private Hospital-Strathfield
Sunshine Coast Private Hospital-Buderim
Sunshine Coast University Public Hospital-Birtinya
Sunshine Hospital-St Albans
Sutherland District Hospital-Caringbah
Sydney Adventist Hospital-Wahroonga
Sydney South West Private Hospital-Liverpool
Tamworth Base Hospital-Tamworth
Taranaki Base Hospital-Westown
Tauranga Public Hospital-Tauranga
The Mount Hospital-Perth
The Nepean Hospital-Penrith
The Nepean Private Hospital-Kingswood
The Prince Charles Hospital-Chermside
The Surgery Centre-Hurstville

The Tweed Hospital-Tweed Heads
The Wesley Hospital-Auchenflower
Timaru Public Hospital-Timaru
Toowoomba Base Hospital-Toowoomba
Townsville Hospital-Townsville
Vascular Solutions-Subiaco
VCCC-Parkville
WA Vascular Centre-Bassendean
Wagga Wagga Rural Referral Hospital-Wagga Wagga
xxx rooms-Melbourne
Waikato Hospital-Hamilton
Warringal Private Hospital-Heidelberg
Wauchope District Hospital-Wauchope
Wellington Hospital-Wellington
Western Hospital-Footscray
Western Private Hospital-Footscray
Westmead Hospital-Westmead
Westmead Private Hospital-Westmead
Williamstown Hospital-Williamstown
Wimmera Base Hospital-Horsham
Wollongong Hospital-Wollongong
Wollongong Private Hospital-Wollongong
Wyong Public Hospital-Kanwal

The mean number of operations per hospital was 241 with a range of 1-1,359

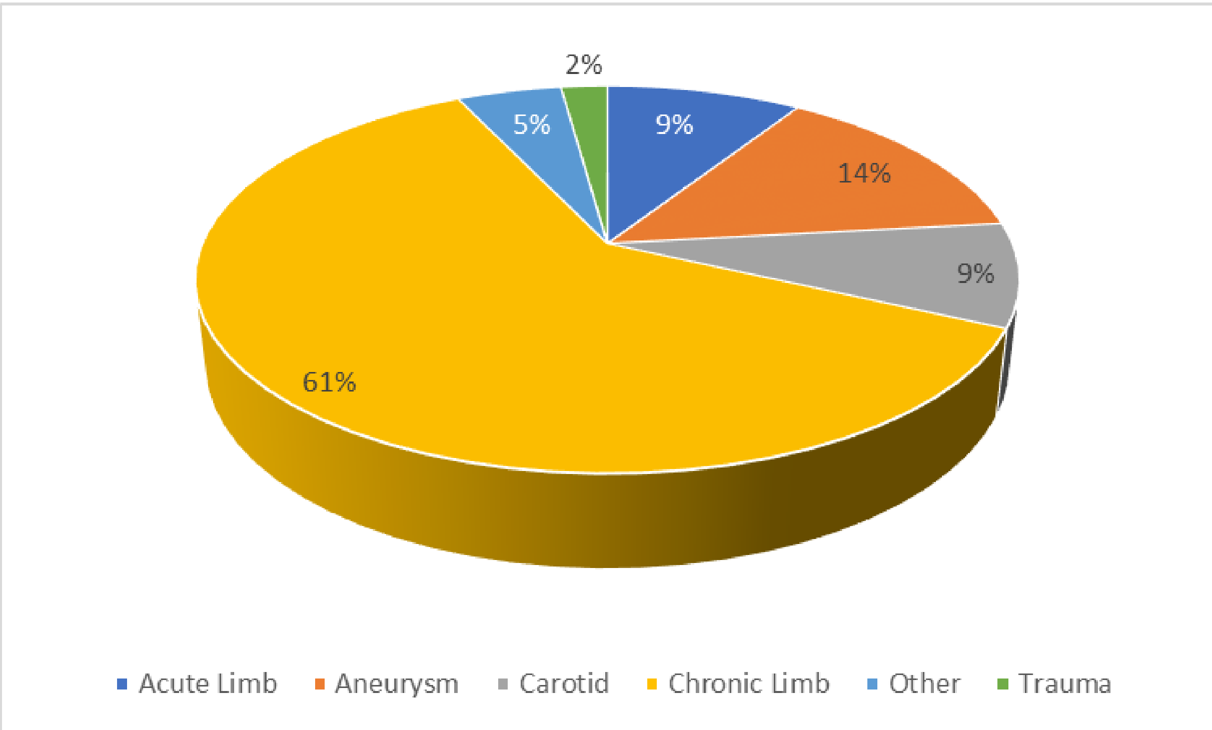
The distribution of procedures by patient type is shown in Fig. 3. The majority were arterial patients followed by venous disease then renal disease.

Fig 3. Patient type 2018



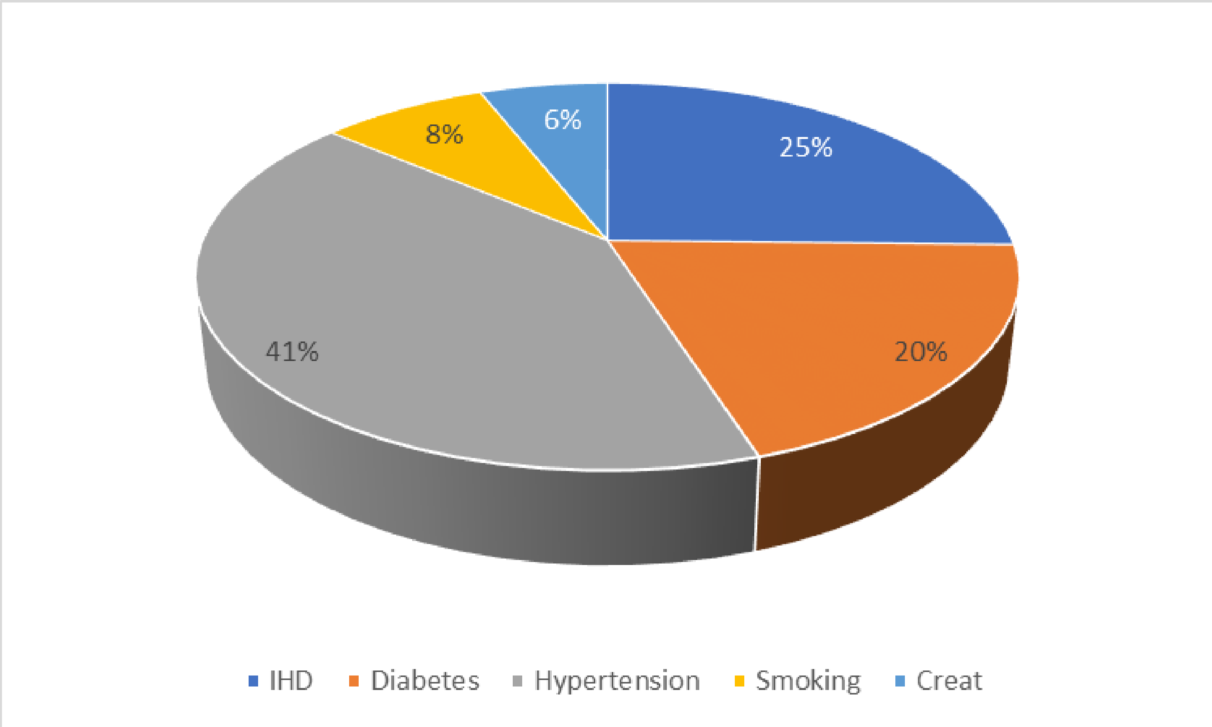
The distributions of procedures in the arterial category are shown in Fig. 4. The majority were for chronic limb operations followed by aneurysms then acute limb procedures.

Fig 4. Arterial categories 2018 (n=26,826)



In the 26,826 arterial operations the risk factors present are shown in Fig. 5. Hypertension was the most frequent risk factor recorded followed by ischaemic heart disease (IHD) then diabetes.

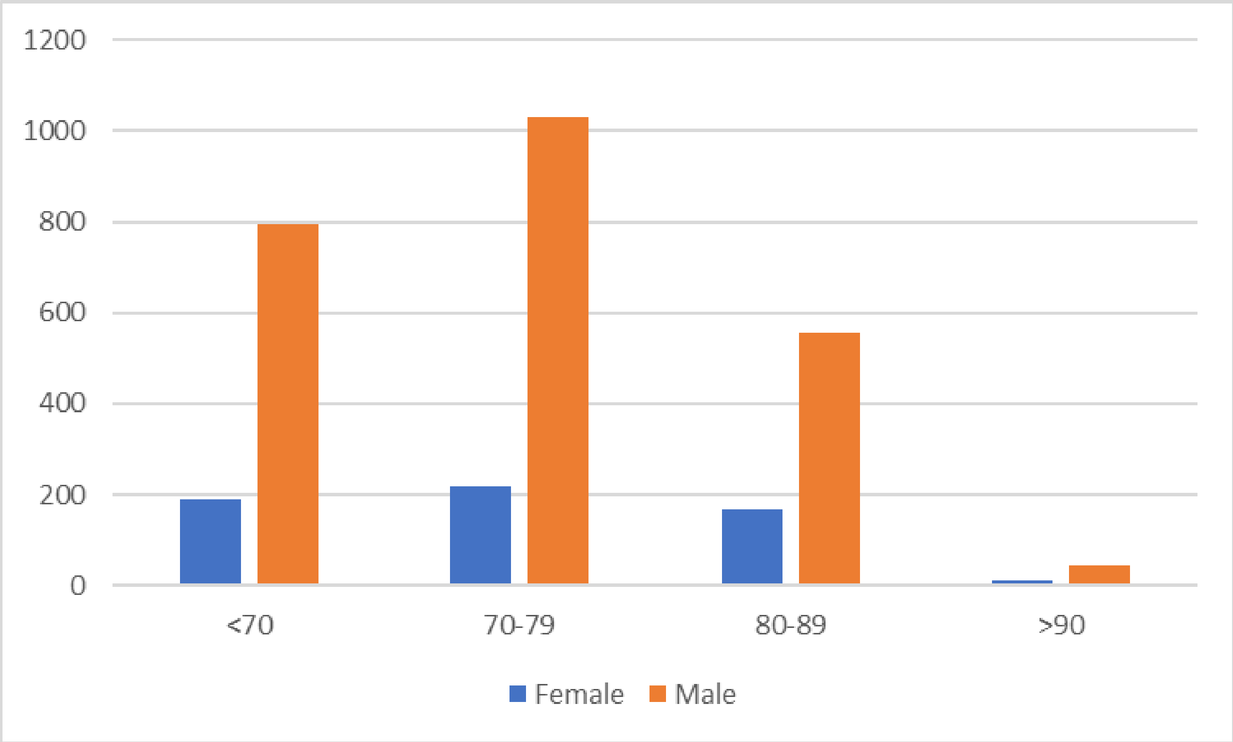
Fig 5. Risk factors in arterial operations 2018 (Creatinine = >150mMol/L, Smoking = current)



Aortic Surgery

There were 3,012 Aortic procedures performed in 2018. This category includes aneurysmal disease (emergency and elective), open and endoluminal (ELG) procedures and aortic operations for non-aneurysmal disease.

Age and gender are shown in Fig. 6



The distribution of procedures and crude mortality is shown in Table 1.

Table 1. Aortic surgery raw data

Category	Total
All Aortic procedures	3012
Open Aortic surgery	903
Open AAA	559
Open AAA-elective	356
Open AAA-ruptured	131
AAA-EVAR-elective	1514
AAA-EVAR-ruptured	94
Non-aneurysm abdominal aortic surgery	298
Thoracic ELG	268
Open Thoracoabdominal	14

i) Open aortic surgery

This includes all aneurysm and non-aneurysm surgery. The indications for the 298 non-AAA procedures are shown in Table 2.

Table 2. Non-aneurysm open aortic surgery

Indication	Total
Claudication	88
Rest pain	56
Acute ischemia	48
Mesenteric ischemia	42
Ulcer/gangrene(arterial)	23
Bypass / Stent graft / Patch sepsis	11
Dissection	5
Neoplasm-malignant	5
Aortoenteric fistula-secondary	3
Infection	3
Trauma(iatrogenic)-haemorrhage	3
Trauma(non iatrogenic)-haemorrhage	3
Retrieval device/FB	2
Aortoenteric fistula-primary	1
Exposure	1
Renal a stenosis/refractory hypertension	1
Secondary haemorrhage(>48 hours)	1
Trauma(iatrogenic)-occlusion	1

Outcomes for Open Aortic Surgery

This data was risk-adjusted using predictive models obtained by logistic regression analysis (see **Appendix 2**-statistical methods). A multilevel model was not significant so standard binary logistic regression analysis was used. All variables used in this model (and for all other index procedures in this report) are presented in Appendix 2.

The open aortic surgery model displayed excellent calibration (a measure of the ability to predict mortality across the spectrum of low and high risk patients), determined by "goodness of fit" tests that do not show a difference, as well as good discrimination (the ability of the model to predict mortality in any particular patient) as determined by the area under the ROC, with a value of this C-statistic of > 0.7 signifying good discrimination.

The ROC graph for the model for open aortic surgery is shown in Fig. 7 with a C-statistic of 0.80

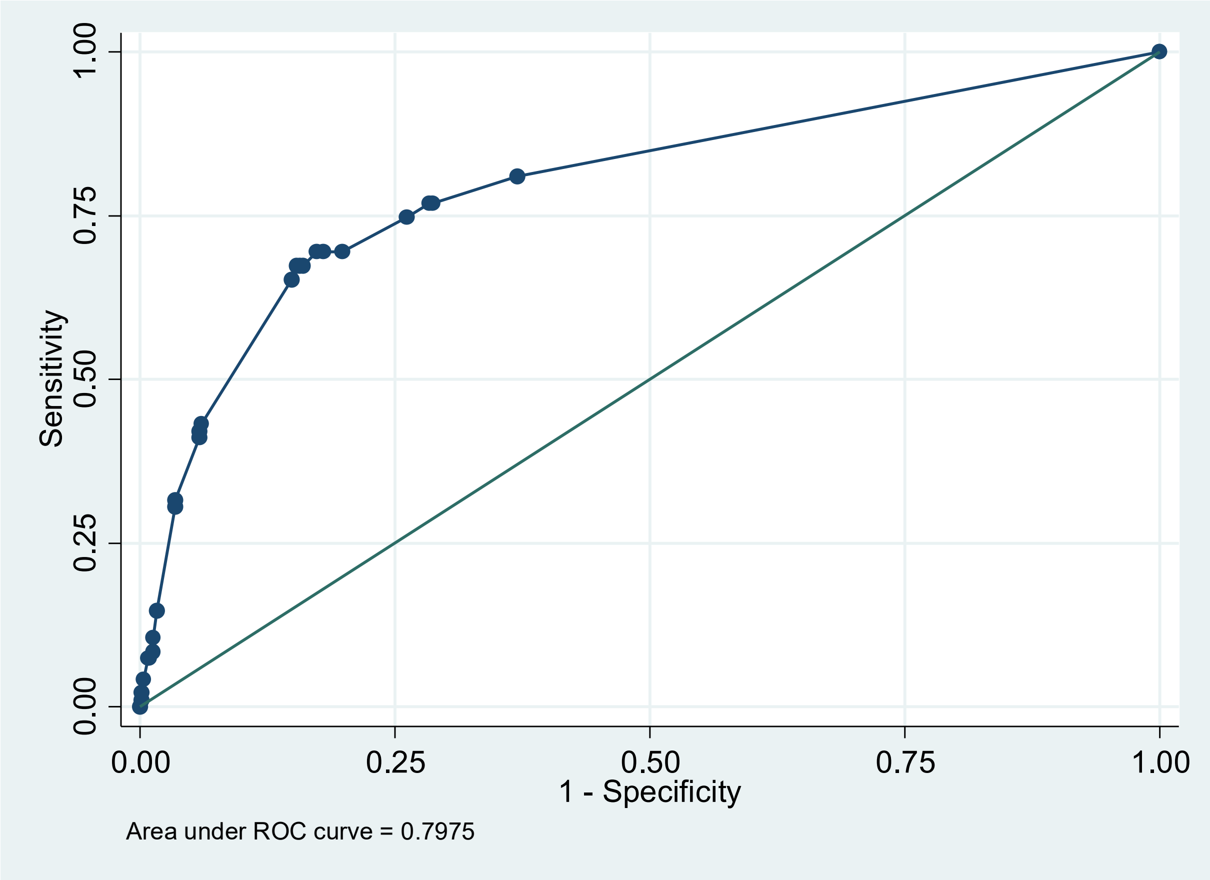


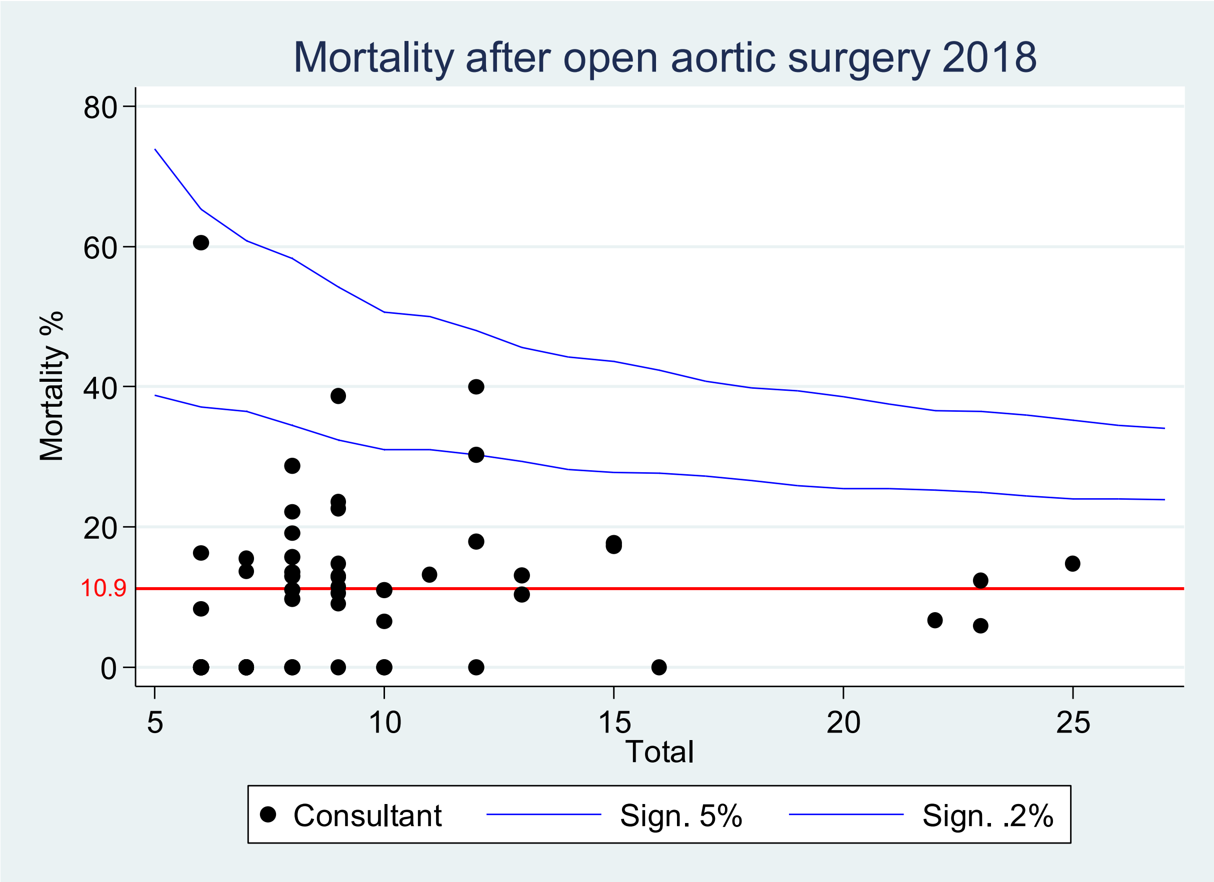
Table 3 shows the significant variables used in the model for all open aortic surgery 2018.

Parameter	Odds Ratio	P value
Creat>150mmol/L	3.28	0.003
Aneurysm Mycotic	10.47	0.008
AE Fistula	10.1	0.001
Rupture	3.18	0.002
Mesenteric Ischemia	3.51	0.002
80+years	2.92	0.001
Emergency	3.39	0.001

Once a predictive model is obtained, probabilities of mortality are obtained from the model and used to display risk-adjusted mortality based upon an expected mortality rate for each patient.

Funnel plots have been constructed and were plotted by including 59 consultants where 6 or more cases were performed during 2018. This plot shows adjusted standardized mortality rate on the Y-axis against total cases done on the X-axis. Another graph using 95% and 99% Poisson confidence intervals of the expected mortality for each surgeon is superimposed. This produces an easy to read graph showing any outliers.

Fig 8. Risk-adjusted funnel plot for open aortic surgery for consultants with 6 or more cases (59)



Outliers

No outliers were identified.

Open AAA

157 surgeons operated upon 559 patients in 2018. This dataset was restricted to patients with abdominal aneurysm repair, excluding thoraco-abdominal aneurysms. This allowed comparison of postoperative complications between 428 intact (elective, mycotic, painful, occluded) aneurysms and 131 ruptured AAA (Table 4). Mean aneurysm diameter was 66mm.

Complication	Intact AAA (428)	Ruptured AAA (131)
AMI	10(2.3%)	7(5.3%)
Gut ischaemia	7(1.6%)	10(7.6%)
Renal failure/impairment	26(6.1%)	20(15.3%)
Died	19(4.4%)	41(31.3%)

iii) Endoluminal abdominal aortic surgery

Abdominal aortic aneurysm

197 surgeons inserted 1,813 non-thoracic ELG during 2018. 84% patients had percutaneous access with closure device insertion used in 99% of these. Mean aneurysm diameter was 58mm. There were 37 type 1, 47 type 2 and 4 type 3 endoleaks. There were 11 occluded limbs and 3 conversions to an open repair, 2 of which died. GA was used in 95%.

The indication for EVAR was not confined to AAA as shown in Table 5.

Table 5. Indications for EVAR 2018

Indication	Total
Aneurysm-elective	1514
Aneurysm-pain	127
Aneurysm-ruptured	94
Claudication	18
Endoleak	18
Aneurysm-mycotic	14
Aneurysm-occluded	8
Rest pain	4
Aortoenteric fistula-secondary	3
Bypass / Stent graft / Patch sepsis	3
Dissection	3
Acute ischemia	2
Ulcer/gangrene(arterial)	2
Aneurysm-false(iatrogenic trauma)	1
Aortoenteric fistula-primary	1
Penetrating aortic ulcer	1

Comparison of complications between intact and ruptured ELG insertion is shown in Table 7 (the intact group includes AAA and other ELG inserted for non-AAA).

Table 6. Complications after intraabdominal ELG (n = 1,813)

Complication	Intact Aorta (1,719)	Ruptured AAA (94)
Conversion	2	1
AMI	10	2
Gut ischaemia	6	1
Renal failure/impairment	32	11
Endoleak type 1	36	1
Endoleak type 2	46	1
Endoleak type 3	4	0
Died	25(1.5%)	11(11.7%)

iv) Fenestrated and branched ELG

The configuration of all ELG is shown in Table 7. The subsets of branched and fenestrated grafts are evident; 11.3% were fenestrated with a mortality of 13/204 (6.4%) vs non-fenestrated 23/1,609 (1.4%) P=0.03. Endoleaks occurred in 4.7% of non-fenestrated vs 5.9% in fenestrated ELG (ns).

Table 7. Configuration of ELG 2018

Configuration	Total
Bifurcated	1451
Fenestrated Renal(s)-SMA-Coeliac	68
Tube	61
Fenestrated Renal(s)-SMA	57
Fenestrated both Renals	40
Bifurcated-bifurcated(+/- IBD)	32
Fenestrated + Branched endograft	31
Branched endograft R Iliac	20
Aorto-uni-iliac-no x-over	17
Aorto-uni-Iliac and Fem fem bypass	15
Branched endograft L Iliac	10
Fenestrated L Renal	5
Fenestrated R Renal	2
Bifurcated;Bifurcated	1
Branched endograft L Iliac;Bifurcated-bifurcated(+/- IBD)	1
Scalloped	1

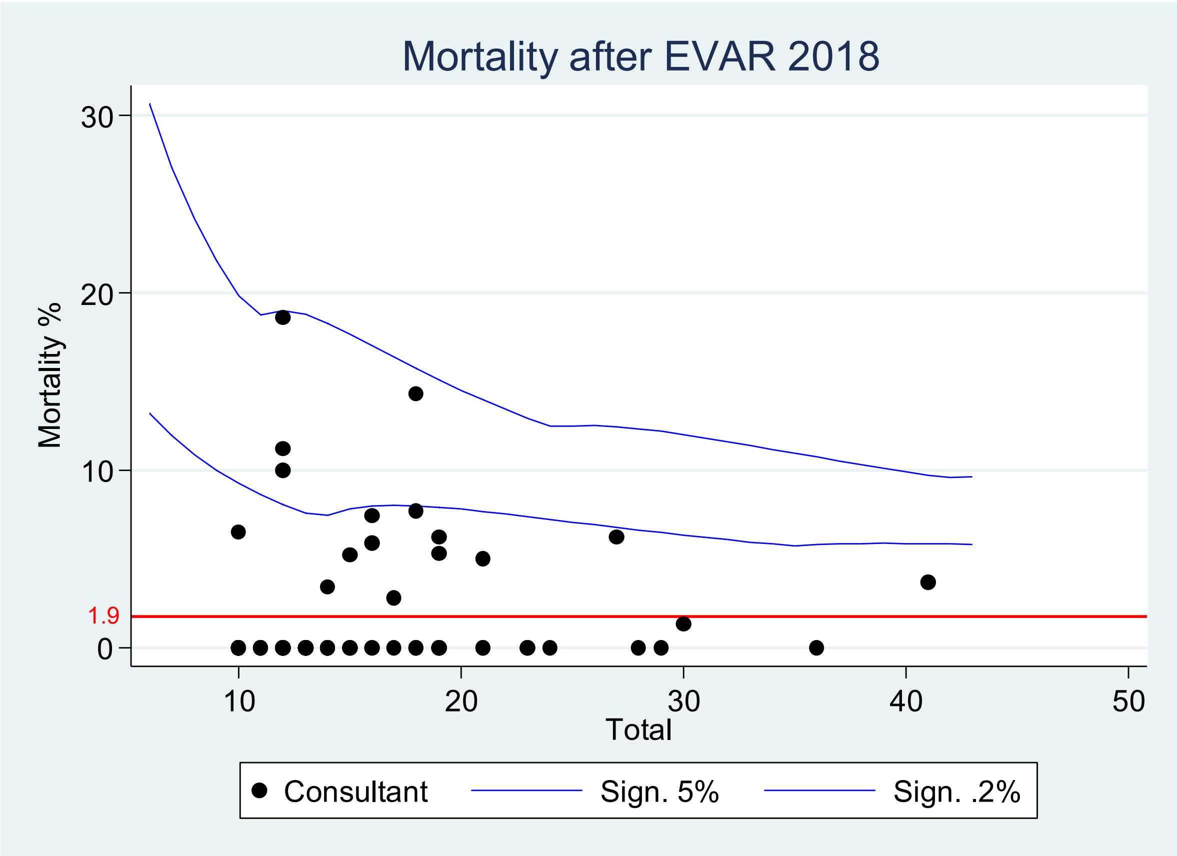
Outcomes

Mean mortality for all EVAR (for AAA only) was 1.9%. No outliers were identified in the multilevel risk adjusted funnel plot in 2018. The c-statistic was 0.83. Significant variables in the model were Age 80-89, Fenestrated graft and ruptured AAA.

Table 8. Significant variables for mortality after EVAR 2018

Parameter	Odds Ratio	P value
Fenestrated	12.661639	P < 0.0001
Ruptured	17.239333	P < 0.0001
age80-89	5.122014	P < 0.0001

Fig. 9. Risk-adjusted Funnel plot of mortality after EVAR in 2018 (>9 cases for 72 surgeons).



There were no outliers.

iv) Thoracic and thoraco-abdominal procedures

Endoluminal. Of the thoracic and thoracoabdominal ELG (n=268), the group consisted of dissecting aneurysms (21), non-dissecting aneurysms (108), acute dissection (48), chronic dissection (32), traumatic aortic tear (26) penetrating ulcer (31) and fistula (2). There were 24 deaths (9%). 111 surgeons inserted a mean of 2 ELG with a range from 1-9. Configuration is shown in Table 9.

Configuration	Total
Overlapping Stent grafts	132
Single Stent graft	114
Stent graft(s) with distal bare stent	12
Stent graft(s) with intra-abdominal fenestration(s)	10

There were 7 patients with paraplegia (2.6%) and 8 strokes (3%) following TEVAR. 5 patients had renal failure or impairment and 1 developed intestinal infarction. There were 4 type 1, 2 type 2 and 0 type 3 endoleaks. 2 patients had conversion to open. Breakdown of complications by aetiology is shown in Table 10.

Table 10. Complications according to the main pathology types (n=268)

Pathology	Total	Mortality	Stroke	Paraplegia
Aneurysm(dissecting)	21	1		0
Aneurysm(non-dissecting)	108	12	5	4
Dissection-acute	48	5		1
Dissection-chronic	32	1	1	1
Fistula	2		1	
Penetrating ulcer	31			1
Traumatic tear	26	5	1	

Outcomes

No predictive model was produced. Because of low numbers no outlier detection could be run for TEVAR in 2018. A cumulative report will be produced in 2020 to correct this, as was the case in the 2015-2017 report.

Open. There were 14 open thoracoabdominal procedures with 2 deaths, which is not considered significant in view of the low numbers and recognized higher mortality for this subcategory. One surgeon had performed most cases (8) with a single mortality. There were no paraplegias or strokes. There was 1 aneurysm rupture that died and 13 intact aneurysms with a single mortality. Mean diameter of the aneurysms was 64mm.

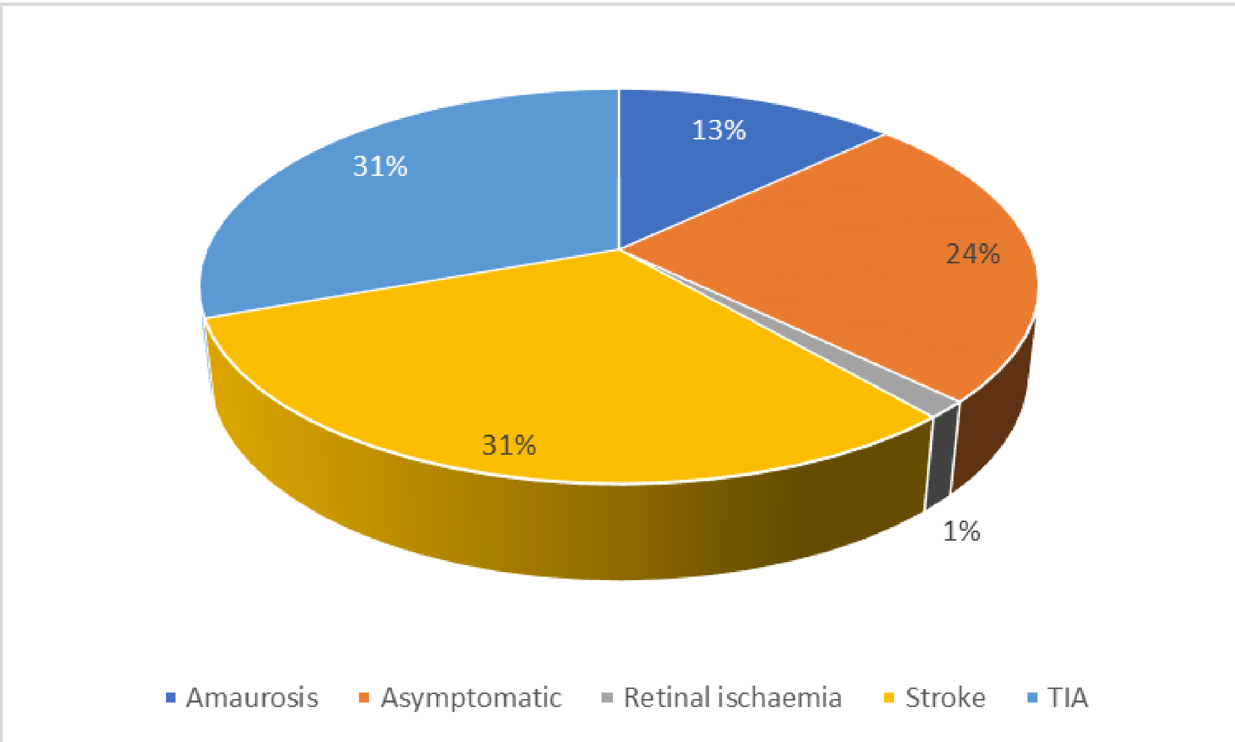
Carotid Surgery

There were 2,239 carotid interventions, 2,058 carotid endarterectomies (CEA) and 181 carotid stents (CAS).

i) Carotid Endarterectomy

211 surgeons performed 2,058 CEA in 2018. The indications for CEA are shown in Fig.10 with 24% having no symptoms.

Fig 10. Indication for CEA



The time from onset of symptoms to surgery in symptomatic patients was < 2 weeks in 56%, 2-4 weeks in 23% and > 4 weeks in 21%. NICE guidelines recommend that the goal should be to operate within 2 weeks from the onset of symptoms to have the lowest stroke incidence. General anaesthesia was used in 80% of the patients.

Eversion endarterectomy was performed in 12.3% of patients and 47% were shunted. Patches were used in 86% of CEA (Table 11).

Table 11. Patches after CEA.

Patch	Total
Polyurethane	813
Pericardium	410
Dacron	362
No patch/conduit	191
PTFE	86
Prosthetic (Other)	47
GSV-reversed	32
Vein (Other)	13
Neck vein	11
GSV-non reversed	8
Ext carotid	4
Arm vein	3
Homograft	2

Complications after CEA are shown in table 12.

Table 12. Complications after CEA (n= 2,058)

Complication	Percent
Haemorrhage requiring exploration	2.7
Cranial nerve trauma	1
Myocardial infarction	0.2
Major/minor stroke	1.1
TIA	0.1
Hyperperfusion	0.2
Death	0.2
Stroke or death	1.2

Outcomes

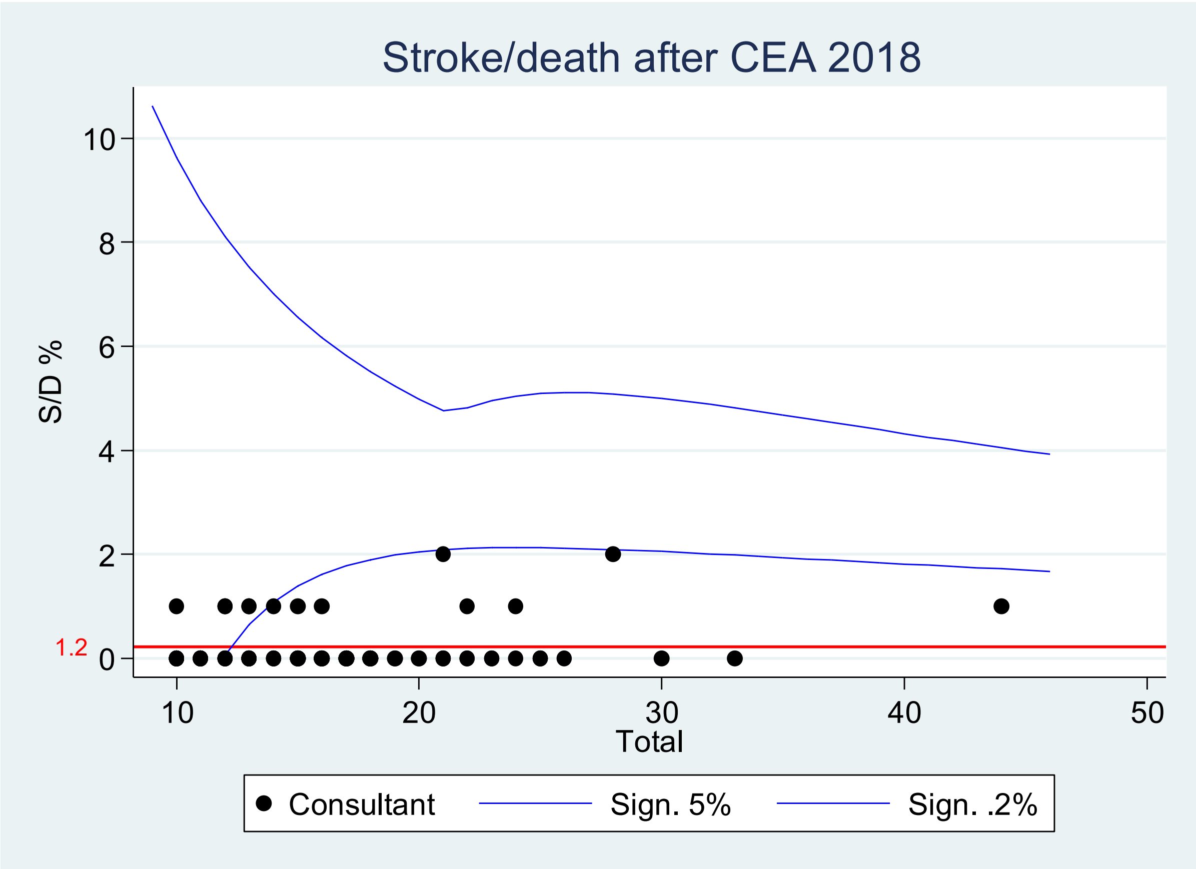
Only 2 variables were significant in the model for stroke/death (Table 16). A multilevel model was not significant, so a binary logistic regression model was used. The c-statistic was 0.67.

Table 13. Significant variables for S/D after CEA 2018

Parameter	Odds Ratio	P value
Contralat occlusion	4.101618	P = 0.0063
Current Smoker	4.488877	P = 0.0004

Because the numbers were low, only those surgeons (83) who performed 10 or more CEA were assessed by a funnel plot. The mean stroke/death(S/D) rate was 1.2% and no outliers were apparent. Symptomatic S/D rate was 1.4% and Asymptomatic S/D was 0.6%. postop S/D rate for stroke as the indication for operation was 1.6%.

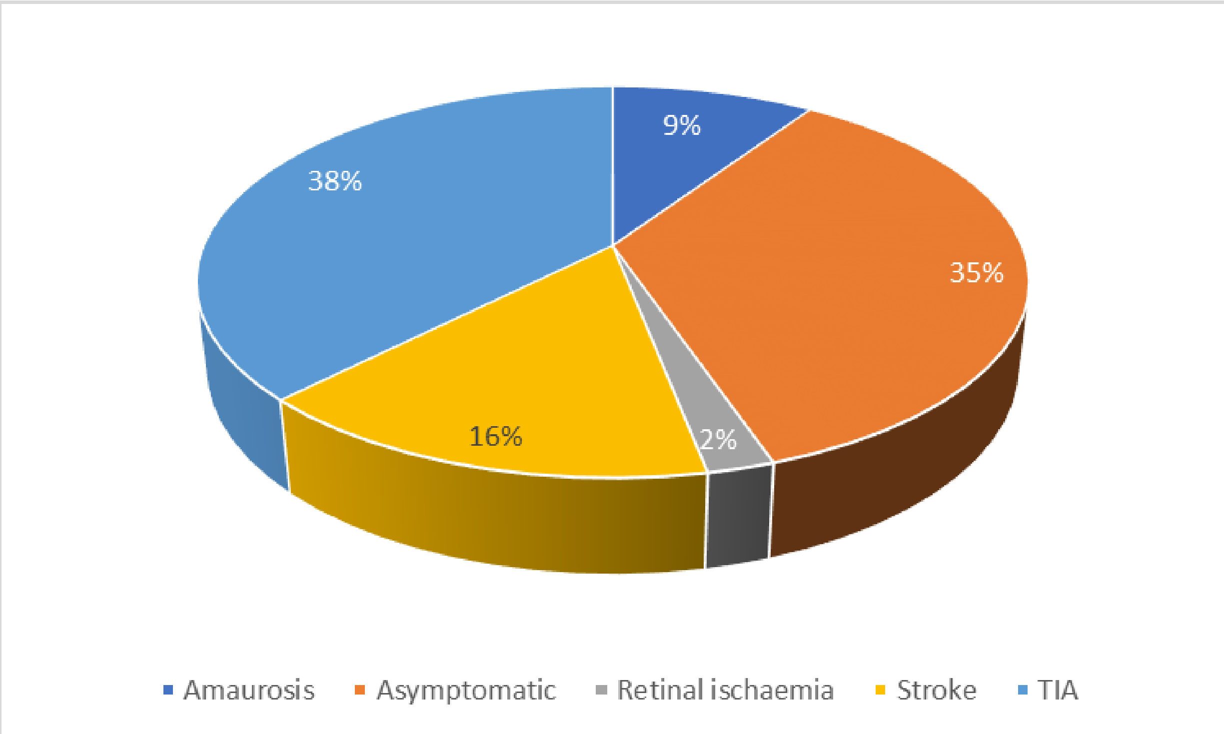
Fig 11. Risk-adjusted Funnel plot for stroke and death after CEA 2018



ii) Carotid Stents

181 carotid stents were placed in 2018.

Indications for CAS are shown in Fig 12, with the most frequent being TIA.



Technical details. n=181

Access was via a long sheath in 128 and via a short sheath with guiding catheter in 53. There was a type 1 arch in 74, type 2 in 74 and type 3 in 17 patients.

No protection device was employed in 10 patients.

Outcomes

There was a single post op TIA (who also died) giving a stroke and death rate of 1/181(0.6%). There were no AMIs, 2 arrhythmias and 1 renal impairment.

Infrainguinal bypass

211 surgeons performed 1,734 Infrainguinal bypasses (IIB) in 2018. The average age of patients was 68 with the M: F ratio of 3.5:1. General anaesthetic was used in 96%.

Indications for surgery are shown in Fig 13 with tissue loss being the most frequent.

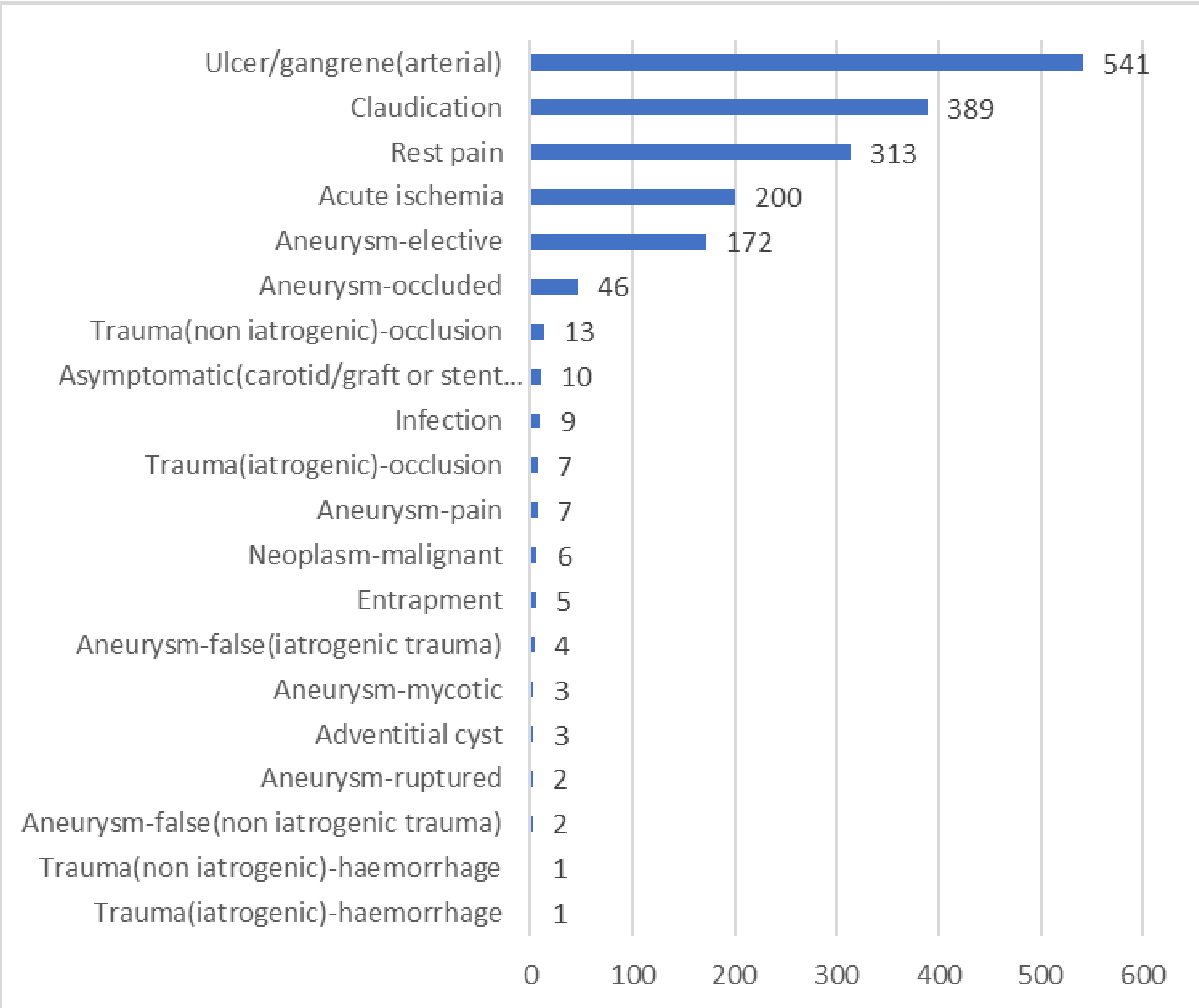
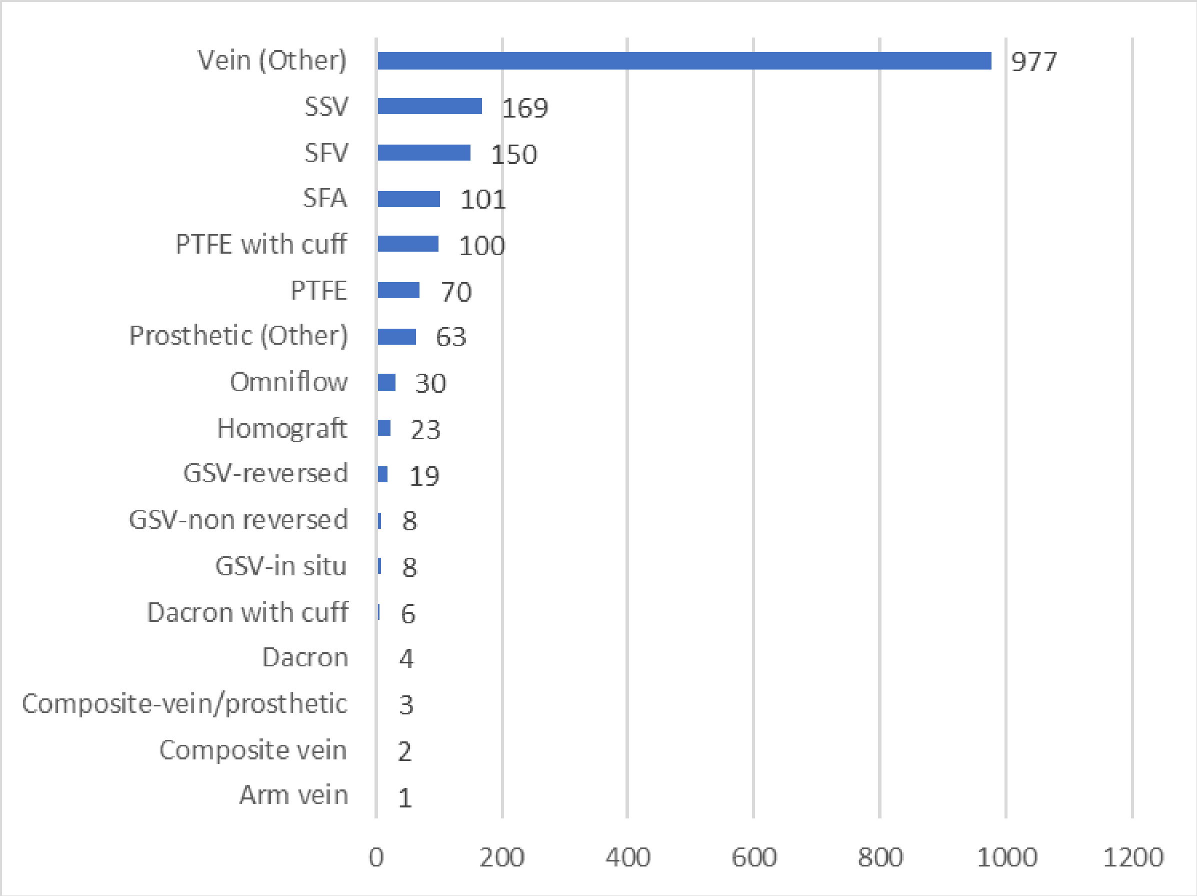
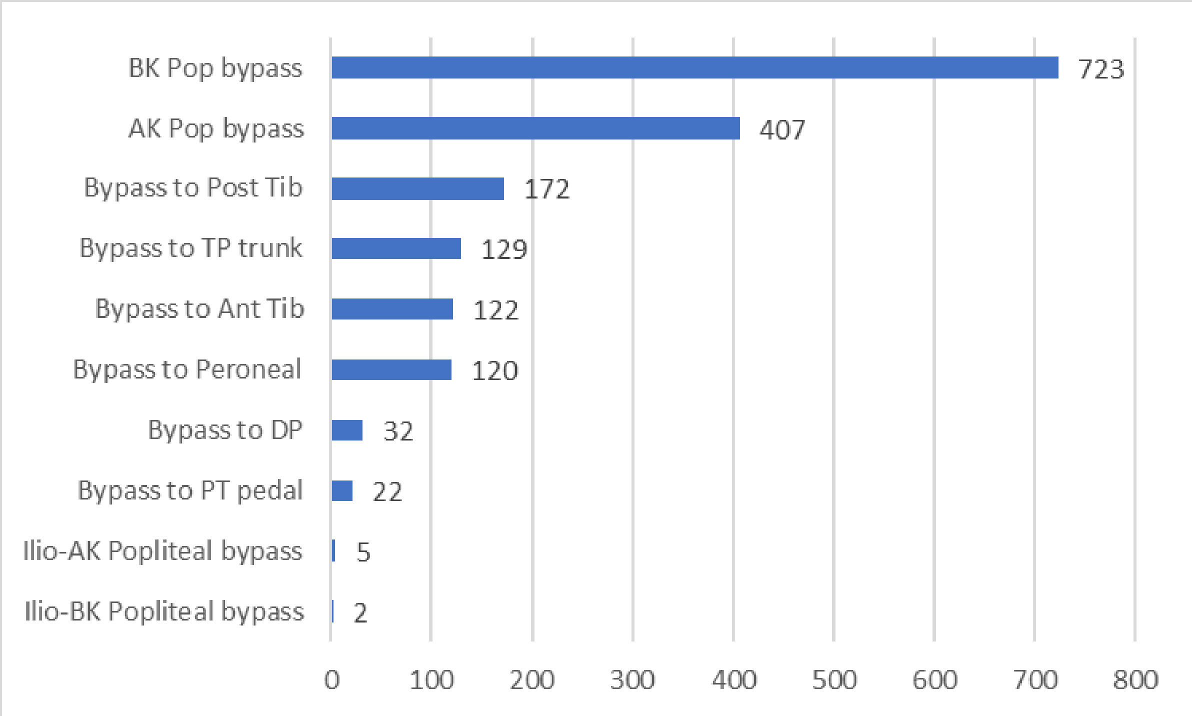


Fig. 14 Conduits for infrainguinal bypass.



Bypass configuration is shown in Fig 15.



Post-operative complications are shown in table 14 (n = 1,734)

Complication	Percent
Myocardial infarction	0.1
Stroke	0.2
Renal impairment/ failure	0.5
Wound complications	3.2
Haemorrhage requiring reoperation	2.2
Death	1

Outcomes

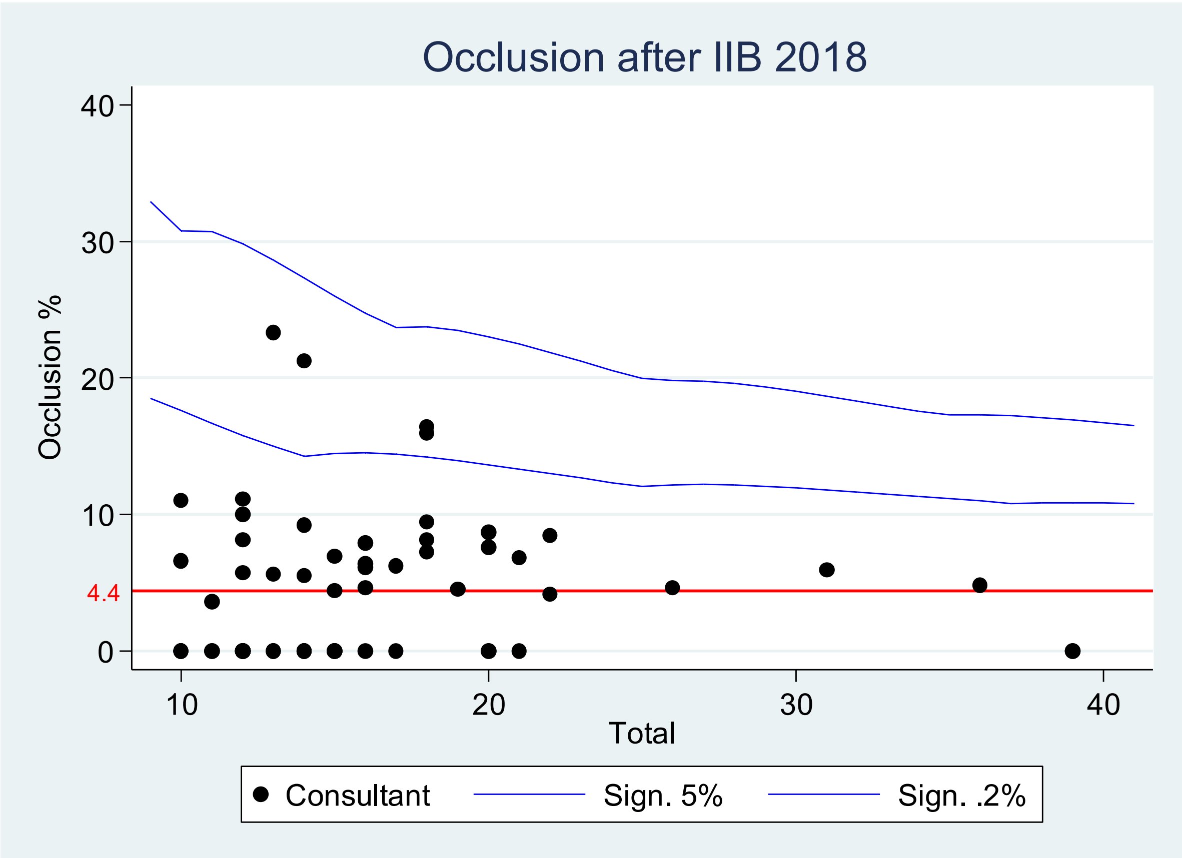
i) Occlusion

In the absence of a significant multilevel model, a binary logistic regression model for occlusion after IIB was obtained with a c-statistic of 0.77. Variables included are shown in table 15.

Parameter	Odds Ratio	P value
AK Fempop	0.129785	P = 0.0444
Unplanned Return	3.516931	P = 0.0002
ATA	4.559764	P < 0.0001
Peroneal	2.501088	P = 0.0359
PT	4.858802	P < 0.0001
Pedal bypass	7.606276	P < 0.0001
Current Smoker	2.774078	P < 0.0001

Occlusion rates were assessed using a risk adjusted funnel plot for those consultants that performed 10 or more bypasses (Fig 16). No outliers were detected in 2018. The mean occlusion rate was 4.4% and mortality was 1%.

Fig 16. Risk adjusted funnel plot for occlusion after IIB 2018 (> 9 cases)



Popliteal Aneurysm: There were 227 bypasses for aneurysm (elective, occluded, pain or rupture). The graft occlusion rate for these was 1.3% and the major amputation rate was 0%. In non-aneurysm patients the graft occlusion rate was 4.9% and the amputation rate was 1.1 %.

Claudicants *vs* tissue loss: In the 389 claudicants, the occlusion rate was 2.6% and there were no amputations. In 541 patients with tissue loss the occlusion rate was 4.4% and the amputation rate was 1.3%.

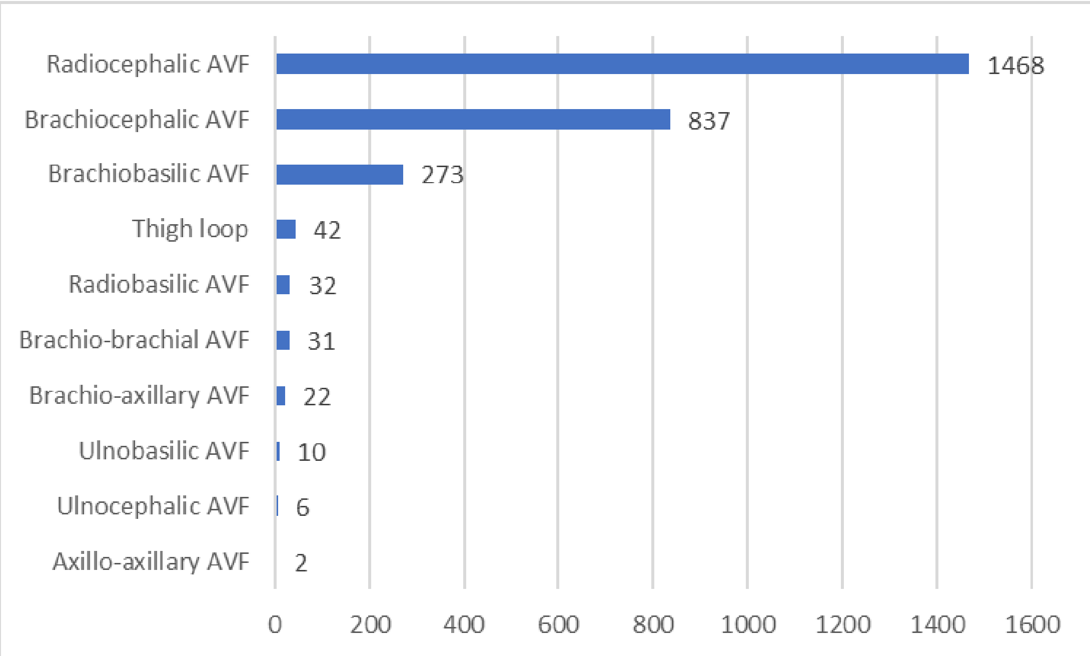
ii) Amputation

The limb salvage rate was 99.8%. 17 limbs were amputated and 5 of these occurred with a patent graft. 3 patients in this patient subgroup were diabetic.

Arteriovenous Fistulae

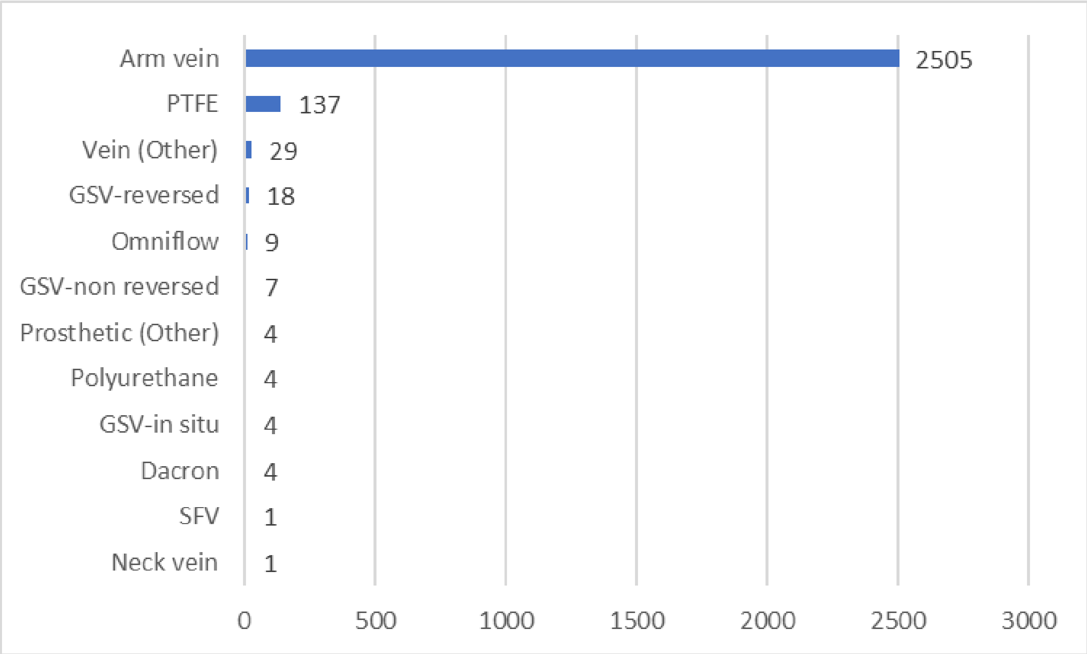
2,723 patients had an arteriovenous fistula (AVF) placed by 183 surgeons in 2018. The locations of AVF are shown in Fig 17.

Fig 17. AVF configuration



The majority of AVF were autogenous (2,565) and 5.8% were prosthetic. The conduits used are shown in Fig 18.

Fig 18. Conduits used



Outcomes

There were 160 occlusions (2.3%). Autogenous fistulae occluded in 131/6527(2%) and Prosthetic fistulae occluded in 29/523(5.5%) (P=<0.001). 4 patients had a steal syndrome, 1 of these was a thigh loops and 1 occurred in a wrist fistula. The other 2 were in brachiocephalic AVF.

A multilevel predictive model was obtained with logistic regression for occlusion and a c-statistic of 0.71. Variables used are shown in table 16.

Parameter	Odds Ratio	P value
Omniflow	21.056126	P = 0.0003
Current Smoker	2.719062	P = 0.0117
Diabetes	0.334558	P < 0.0001
Female	2.359464	P = 0.0012

4 outliers occurred in surgeons who performed 10 or more AVF in 2018 (one of the outlier points represents 2 surgeons). The AMC have reviewed these surgeons and found that there were no areas of concern with the clinical management of the patients involved.

Data validation and conclusions

This audit report has been the culmination of much hard work by the committee and the contributing membership. The most important conclusion is that the standard of Australasian vascular surgery remains high with excellent outcomes in all the selected areas of audit. The outcomes chosen for audit in these 4 procedures are the best method of assessing the clinical and technical skill of a vascular surgeon. The most important facet of an activity such as this remains the "audit of the audit", and there are methods that were established during the inaugural year for both external and internal validation of this activity. External validation for Australian data has compared data capture between the AIHW database and the AVA (by financial year for the preceding years as data becomes available). Overall capture in the AVA for all Australian private and public hospital operations in the 4 index procedures has been shown to be 63.2% compared to AIHW data up to the 2016/7 financial year. Data validation in the private sector only is available by accessing Medicare data. This is available for all billed procedures, which excludes VA and public patients. This data has been analysed for calendar years 2010-8 for the following categories of patient (Australia only):

Carotid endarterectomy

Item numbers 33500 and 32703

Intact AAA (open and endoluminal)

Item numbers 33112, 33115, 33116, 33118, 33119, 33121, 33136, 33139

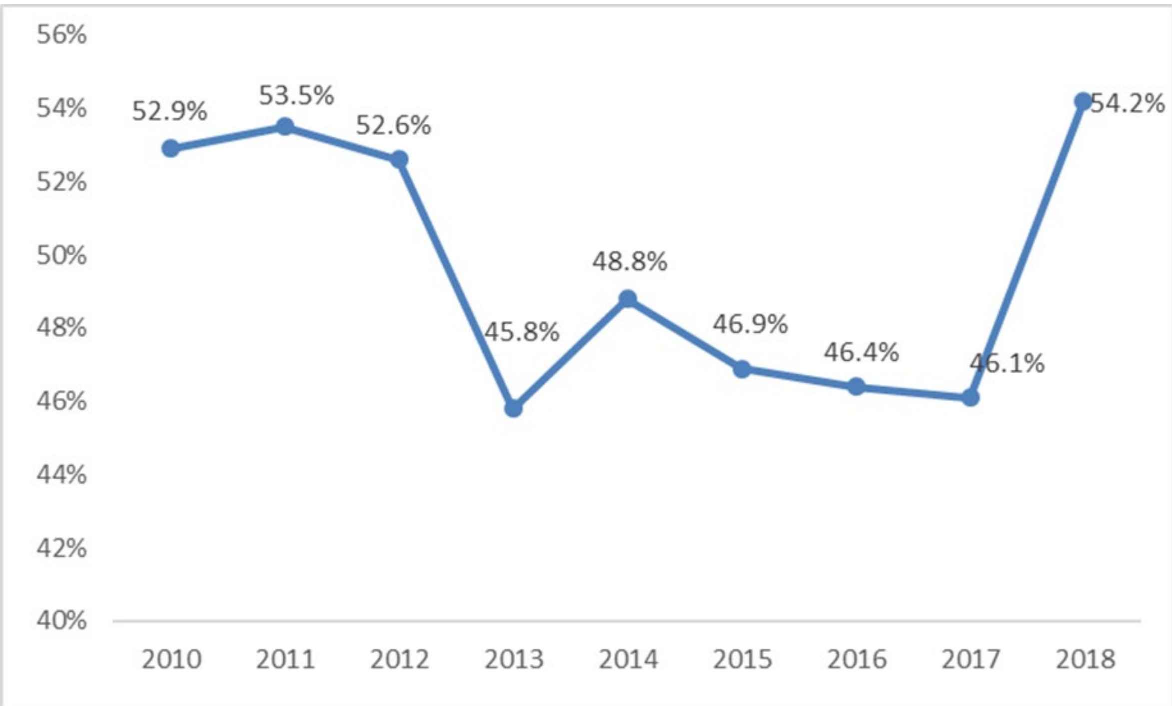
Infrainguinal bypass

Item numbers 32739, 32742, 32745, 32748, 32751, 32754, 32757, 32763, 33050, 33055

AV Fistula

Item numbers 34503, 34509, 34512

This data was compared with AVA data over the same period after exclusion of public and VA patients. This shows that there is poor entry of private data, and was still < 50% in 2017. Further measures are required to increase this percentage. Fig 19. Private practice participation in the AVA for Australia 2010-2018

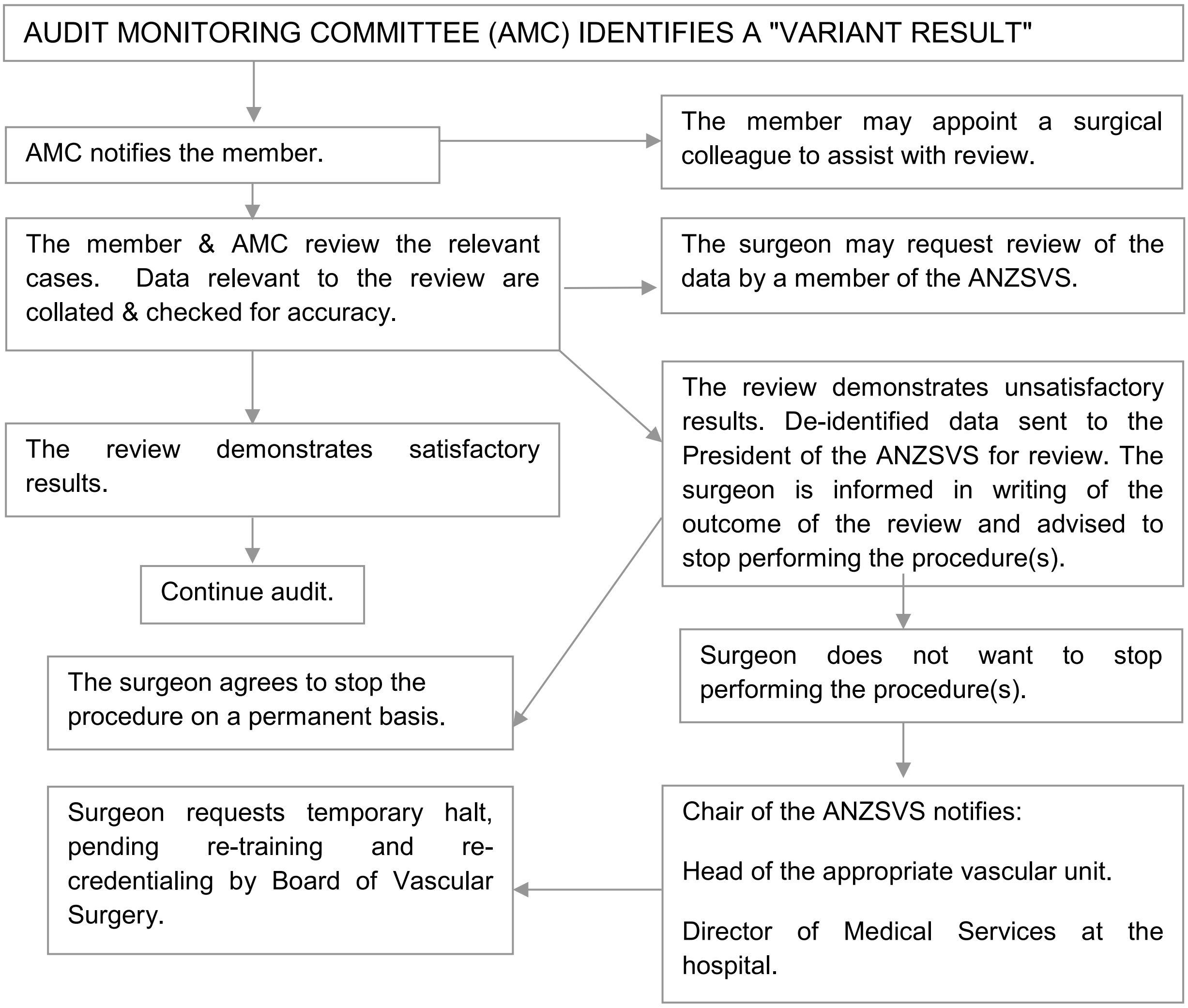


Internal validation was performed at the end of 2017 comparing a 5% sample of patients with the actual case notes by nominated members at each hospital. This showed that data entry was of high quality with only 2.7% having incorrect field data entered out of a total of 3,225 fields studied. This study is repeated every 3 years. Performance of vascular surgery in Australasia is at a high standard and our Society is enhanced by the existence of the AVA, especially with its unique audit loop. Members can continue to participate in the knowledge that it is a completely confidential activity, monitored by a committee that has a dual role of scrutiny of outcomes together with a genuine concern for the natural justice of members.

C Barry Beiles, Administrator

Appendix 1

Algorithm for audit



Note 1. The members of the ANZSVS Audit Monitoring Committee (AMC) are responsible for determining the thresholds for complications warranting review, after discussion and agreement by the members. Where appropriate, the thresholds used by the ACHS may be the limit chosen.

Note 2. If it is not possible for the independent reviewer chosen by the member and the AMC to reach consensus, the issue will be referred to the Board of Vascular Surgery for a final determination of satisfactory or unsatisfactory performance or other recommendation.

Note 3. The algorithm does not envisage advice to stop all operating unless audit showed unsatisfactory results in all types of operations performed. Thus the surgeon would only cease performing that particular operation that gave unsatisfactory results. Referral to the Medical Board may result in the suspension of all operating rights.

If there are continuing issues with the surgeon performing operations at an unsafe level then notification of the concerns of the AMC may be made to the Medical Board after discussion in writing with the president of the ANZSVS.

Appendix 2

Statistical methods

When performing institutional or individual comparisons for outcomes of health data, it is important to recognise that this has been fraught with difficulties in the past. The now discredited league tables are misleading and have been replaced with funnel plots, which are easy to interpret at a glance. The league table approach has been used to rank institutions based on performance, and this has led to "gaming", whereby institutions tackling the more complicated high-risk cases have avoided these procedures in order to improve their position in the table. There is also a 5% risk that a hospital or surgeon will be at the bottom of the table by chance, as these tables use 95% confidence intervals. It should also be recognised that it is a statistical certainty that an institution or surgeon can have a run of bad luck, and while they might reside at the bottom of the table in 1 year, this may be an isolated phenomenon.

Whichever method is used in assessing performance, some method of risk-adjustment is important, so that those hospitals or surgeons undertaking the high-risk cases will not be disadvantaged. It is recognised that methods of obtaining risk-adjustment are not an exact science, but the most widely utilised technique applied to outcomes that are 'binary' (where the outcome is one of 2 choices, ie. death or survival; patency or occlusion), is multilevel logistic regression analysis. Multilevel analysis determines the effect of the hospital on patients treated by the same surgeon at different locations. The outcome variable is called the dependent variable, and the variables that significantly affect the outcome are called the independent variables. These variables are accepted if the P value is < 0.05. An acceptable model is then produced that aims to provide good predictive qualities (called "discrimination") and this predictive ability should persist for cases with both low and high risk of an adverse outcome (called "calibration"). We have been able to produce good models for mortality following open aortic, open aneurysm, EVAR, stroke/death after carotid endarterectomy, occlusion after lower limb bypass and occlusion after AVF creation. The link test was run after each logistic regression to confirm that the model was correctly specified.

Once a model has been established, it will provide an expected risk of an adverse outcome for each patient in the population studied, based on the presence or absence of the statistically significant variables identified by the logistic regression procedure. This is then applied in the methods chosen to display the data. Statistical analysis was performed using Stata version 13.1 (Statacorp. 4905 Lakeway Drive College Station, Texas 77845 USA) and StatsDirect statistical software (England: StatsDirect Ltd. 2008)

Data display

Funnel plots have been adapted from a technique used to establish publication bias in meta-analyses. The adverse event rate is plotted on the Y axis, with the total number of cases on the X axis and Poisson 95% and 99% confidence intervals using the pooled adverse event rate for the whole group superimposed on the scatter plot. The data is risk adjusted (where a robust predictive model has been obtained) by plotting the adverse event rate as a standardised mortality/event ratio (Observed/ Expected rate x overall event rate expressed as a percentage). The expected rate for each patient is derived from the logistic regression analysis. Non risk-adjusted funnel plots are displayed using the percent adverse event on the Y-axis and using a binomial distribution. These plots were obtained by using the funnelcompar module in Stata. The graph is easily interpreted because any consultant falling outside the upper 95% confidence interval should be scrutinised to see if there is a problem in processes, using careful clinical appraisal. Conversely, consultants falling below the lower 95% confidence interval are performing much better than the majority.

Variables used in models:

1. Open aortic surgery

OP SITE:
Thoracoabdominal
Mesenteric
A-Iliac Open an
Aortic Tube
Aorta Not AAA
AI-AF Open Occlusive
Prev Prosthetic
Aorta-AxFem
Aorta-Rupture no bypass
Iliac
Thoracic An
Thoracic Non an
Emergency
INDICATION:
Claudication
Acute Ischemia
Rest Pain
An Ruptured
Bypass Sepsis
Aortoenteric fistula
Dissection
An Mycotic
Endoleak
Neoplasm malignant
Ulc Gangrene
Trauma
An Occluded
Asymptomatic
An elective
Mesenteric Isch
An Pain
RISK FACTORS:
Creat > 150mMol/L
Current Smoker
Hypertension
Diabetes
IHD
Age80+
Age70-79
Female

2. Open AAA:

AAA diam 60-69mm
diam70-79mm
diam80-89mm
diam90+mm
2-3L blood loss
3-4L
>4L
Suprarenal Clamp
Suprarenal AAA
Pain
Ruptured
Mycotic
Occluded
ASA3
ASA4
ASA5
Current Smoker
Creat > 150mMol/L
IHD
Diabetes
Hypertension
Age70-79
Age80+
Female

3. Carotid endarterectomy

>4weeks since symptoms
2-4weeks
<2weeks
70-79% stenosis
80-99%
String sign
Contralat occlusion
Carotid Eversion
Carotid Shunted
Emergency
Patched
Asymptomatic
TIA
Stroke
Amaurosis
ASA2
ASA3
ASA4
GA
Creat > 150mMol/L
Current Smoker
Hypertension
Diabetes
IHD
Age90+
80-89
70-79

Female

4. Infrainguinal bypass (some variables were combined to allow valid logistic regression):

1 Vessel runoff
2vessel
Blind pop
PROXIMAL TAKEOFF:
AK pop
SFA
BK pop
Profunda
Vein graft
Abdo Dacron
Tibial
Iliac
Emergency
Unplanned Return
OPERATIVE SITE:
Pedal bypass
BK pop
PT bypass
Tibio-peroneal
Peroneal
Ant Tibial
Ilio popliteal
CONDUIT:
Arm V
GSV rev
GSV in Situ
Synthetic w cuff
GSV non rev
Synthetic
Vein other
Composite v
Composite vein/prosth
Homograft
Omniflow
SFV
SSV
INDICATION:
an occluded
Trauma occl nonIatrogenic
Ulc Gangrene
Acute Ischemia
Trauma haem nonIatrogenic
Infection
Trauma occlusion Iatrogenic
Neoplasm Malignant
Asymptomatic
Trauma Haem Iatrogenic
An ruptured
An false Iatrogenic
An pain

An mycotic
An False Non Iatrogenic
Entrapment
Adv cyst
An elective
Rest pain
ASA2
ASA3
ASA4
GA
Trainee surgeon
Creat > 150mm/L
On dialysis
Current Smoker
IHD
Diabetes
Hypertension
age70-79
age80-89
age90+
Female

5. A V Fistulae:

Emergency
OPERATIVE SITE:
Brachiocephalic
Brachiobasilic
Axillary
Brachiobrachial
Thigh loop
CONDUIT:
Prosthetic
Omniflow
ASA2
ASA3
ASA4
Creat > 150mm/L
On Dialysis
Current Smoker
Hypertension
Diabetes
IHD
<40 years
41-60
61-80
>80
Female

Appendix 3

Features of the AVA application

This is a web-based database in SQL residing on a secure server and is compatible with all browser platforms. Data capture is exclusively via the web portal.

1. Security and performance:

a) Uptime – Application and database up-time is greater than 99%

b) Backup Services - Daily database and application backup

c) Security services - Enterprise Firewalls, Intrusion Prevention Systems, and Anti-Virus Protection

d) Disaster recovery - Daily backups featuring file recovery, data de-duplication, redundant block elimination, over the wire encryption and offsite storage of backup data

e) Logon is only permitted by Surgeon code and password

f) The ability to view reports is determined by the status of the user. Full members of the ANZSVS have the ability to view all reports, and there is the ability to view the user's outcomes in the 4 categories of audit in real time compared to the peer group. There is also a category of data manager for a unit or hospital (e.g. vascular trainee) that is granted access to enter data for the surgeons who work in their unit. They have no access to the private patient data for those surgeons.

2. Scalability:

The application is capable of handling 200 simultaneous users

3. Role based data updates:

Modification of data entered in the discharge/complication form fields after user logoff is only allowed by the administrator. Addition of data is allowed by all users. Deletion of records is only allowed by the administrator.

4. Privacy and confidentiality:

Compliance with privacy legislation is current and patient identifiers are encrypted and the database is securely stored by the Server. Confidentiality of patient details is thus assured. Ethics committee approval has been obtained for this activity. Confidentiality of member's identity is assured by the storage of the surgeon code with legal representatives of the ANZSVS. The only situation where the identity of a surgeon would be allowed is in the event of the examination of the member by the AMC after possible underperformance has been identified by the statistical analysis. Commonwealth legislation identifying the AVA as a privileged quality assurance activity has been obtained. Any identification of participating members outside of the strict algorithm of the audit process is punishable by a significant financial penalty and a maximum 2 year custodial sentence. An important feature of the AVA is the independence provided by total ownership of the data. This has been possible because the ANZSVS has self-funded the establishment and maintenance costs.

5. Data reliability:

Strict data validation criteria prevent erroneous data entry and there is no ability for free text data entry, except for 2 “comment” boxes in the operation and discharge forms. Drop down menus allow choices to appear that are based upon selections made in previous fields. This diminishes the ability to enter incorrect data.

6. Flexibility:

The application has been designed to allow alterations to the menu choices by the administrator. This has ensured that unusual operations can be entered. The application captures all endovascular procedures where appropriate and the vascular surgical trainees extract data from the AVA to submit their logbooks to the Board of Vascular Surgery.

7. Benefits for the user:

The ability to compare real time outcomes by surgeon and /or hospital with the membership as a whole is very attractive. Also, there is the ability to conduct unit or personal audit using the reports specifically designed for this purpose. There is the ability to export data extracts, which represent a spreadsheet containing every field for each patient. This allows filtering to manipulate data in any form the user requires for any purpose. Logbook reports are also available for trainees and members. Participation in the AVA has been approved as a recognised audit activity by the Royal Australasian College of Surgeons for the purpose of re-accreditation. Participation also allows the user access to de-identified data for the purpose of research or in the event of an inquiry into one’s performance by a hospital or medico legal proceeding. A certificate of participation is issued annually upon application. This certificate is mandatory for retention of membership of the Society since 2019.

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