Australasian Vascular Audit Public Report – 2019

Contents

Foreword

It is with great pleasure that I present this AVA report. The AVA remains strong and is one of the cornerstones of our Society.

The Healthcare Quality Improvement Partnership (HQIP) defines audit as “a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change”. I believe that we have built a strong platform to achieve these goals while still looking to build further. The identification of adverse events is important as well as the safe-guarding of our data. The Audit Monitoring committee independently oversees these functions. Refinements to allow easier data entry and the ability to use handheld and mobile devices is underway.

Our Data Administrator, Barry Beiles, provides us with a wealth of expertise, skill and dedication, whilst overseeing its evolution.

A Hill

President ANZSVS

Introduction

The Australasian Vascular Audit (AVA) has just completed its 10th year of data collection. It 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 43,387 operations entered in 2019; 38,521 from Australia and 4,866 from New Zealand (Fig 1). Although the demographic data applies to all operations, the outcome analyses are based on the 46,578 discharged patients (98.7%).

Fig 1. Volume of vascular surgery by country 2019

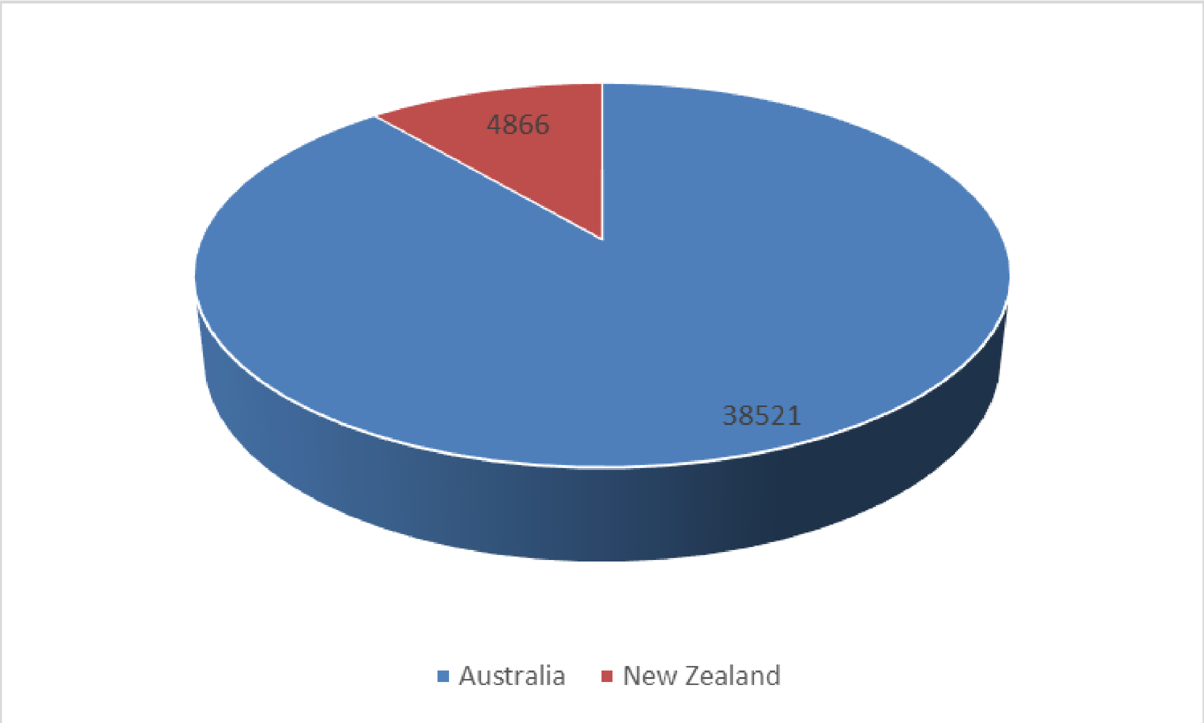
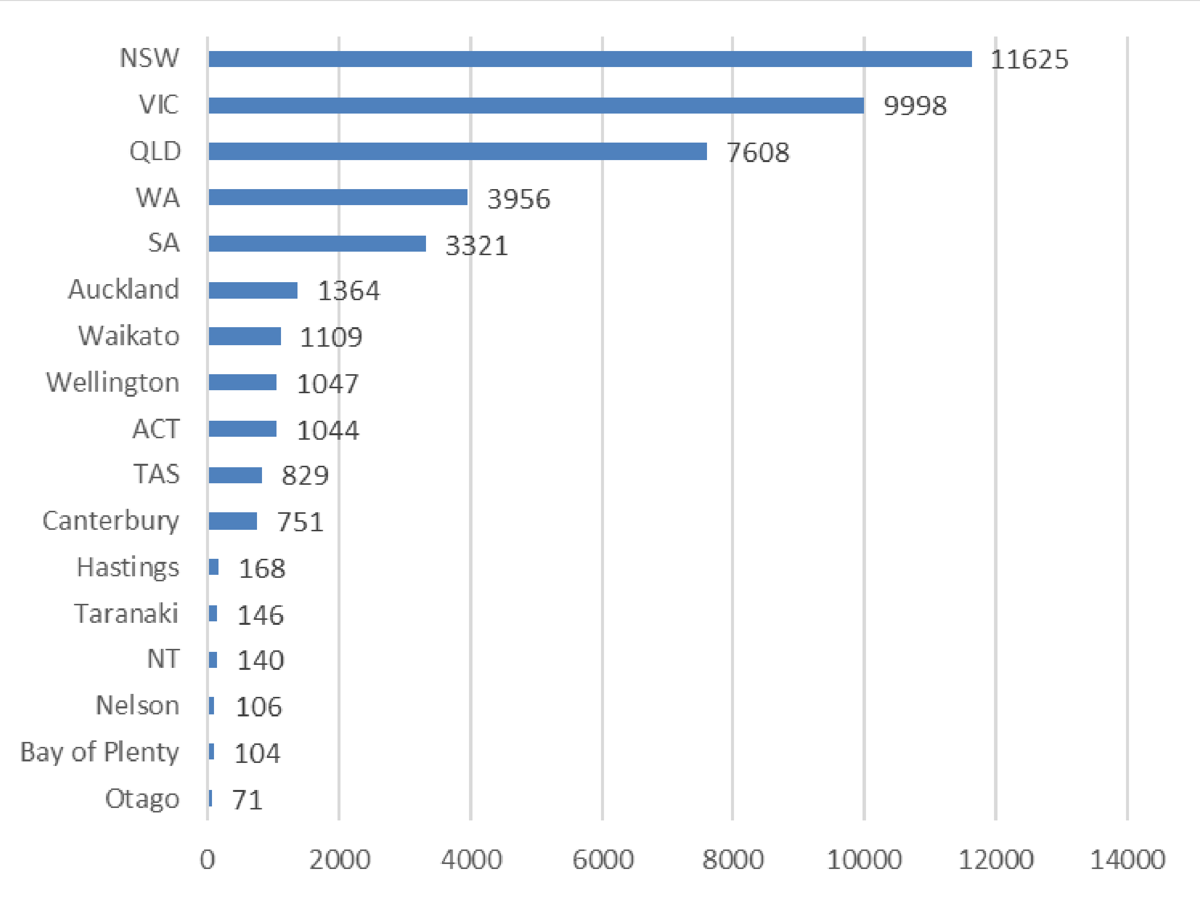


Fig 2. Operations by Australian State and New Zealand Region 2019



246 consultants entered data from 201 hospitals/clinics which are shown alphabetically in the following table.

Albany Day Hospital-Mira Mar
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
Baringa Private Hospital-Coff's Harbour
Bentley Health Service-Bentley
Blacktown Hospital-Blacktown
Blue Mountains Hospital-Katoomba
Box Hill Hospital-Box Hill

Brisbane Waters Private Hospital-Woy Woy
Buderim Private Hospital-Buderim
Cabrini Hospital-Brighton
Cabrini Hospital-Malvern
Cairns Base Hospital-Cairns
Cairns Private Hospital-Cairns
Calvary Hospital-Lenah Valley
Calvary Hospital-North Adelaide
Calvary John James Hospital-Deakin
Calvary Private Hospital-Bruce
Calvary Public Hospital-Bruce
Calvary Wakefield Hospital-Adelaide
Canberra Hospital-Garran
Casey Hospital-Berwick
Christchurch Public Hospital-Addington
Coffs Harbour Health campus-Coffs Harbour
Concord Repatriation Hospital-Concord
Dandenong Hospital-Dandenong
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
Fiona Stanley Hospital-Murdoch
Flinders Medical Centre-Bedford Park
Flinders Private Hospital-Bedford Park
Frankston Hospital-Frankston
Freemasons Hospital-East Melbourne
Fremantle Hospital-Fremantle
Friendly Society Private Hospital-Bundaberg West
Geelong Private Hospital-Geelong
Geelong Public Hospital-Geelong
Gold Coast Hospital Robina-Robina
Gold Coast Private Hospital-Parklands
Gold Coast Public Hospital-Southport
Gosford District Hospital-Gosford
Grace Hospital-Tauranga
Greenslopes Private Hospital-Greenslopes
Gretta Volum Day Surgery Centre-Geelong
Hastings Memorial Hospital-Camberley
Hawke's Bay Hospital-Camberley
Hobart Private Hospital-Hobart
Hollywood Private Hospital-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
La Trobe Regional Hospital-Traralgon
Lake Macquarie Private Hospital-Gateshead
Launceston General Hospital-Launceston
Lingard Private Hospital-Merewether
Lismore Base Hospital-Lismore
Liverpool Hospital-Liverpool
Lyell McEwin Hospital-Elizabeth Vale
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
Middlemore Hospital-Otahuhu
Monash Medical Centre-Clayton
Moorabbin Hospital-East Bentleigh
Mount Barker Hospital-Mt Barker
Mulgrave Private Hospital-Mulgrave
Nambour Selangor Private Hospital-Nambour
National Capital Private Hospital-Garran
Nelson Hospital-Nelson
New Bendigo Hospital-Bendigo
Newcastle Private Hospital-New Lambton Heights
Noarlunga Hospital-Noarlunga
Noosa Hospital-Noosaville
North Gosford Private Hospital-North Gosford
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

Norwest Private Hospital-Baulkham Hills
Norwest Private Hospital-Bella Vista
Ormiston Hospital-Botany Junction
Peninsula Private Hospital-Frankston
Perth Childrens Hospital-Nedlands
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
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 North Shore Hospital-St Leonards
Royal Perth Hospital-Perth
Royal Prince Alfred Hospital-Camperdown
Royal Womens Hospital-Parkville
Sir Charles Gairdner Hospital-Nedlands
Southern Cross Hospital-Christchurch
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-Bunbury
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

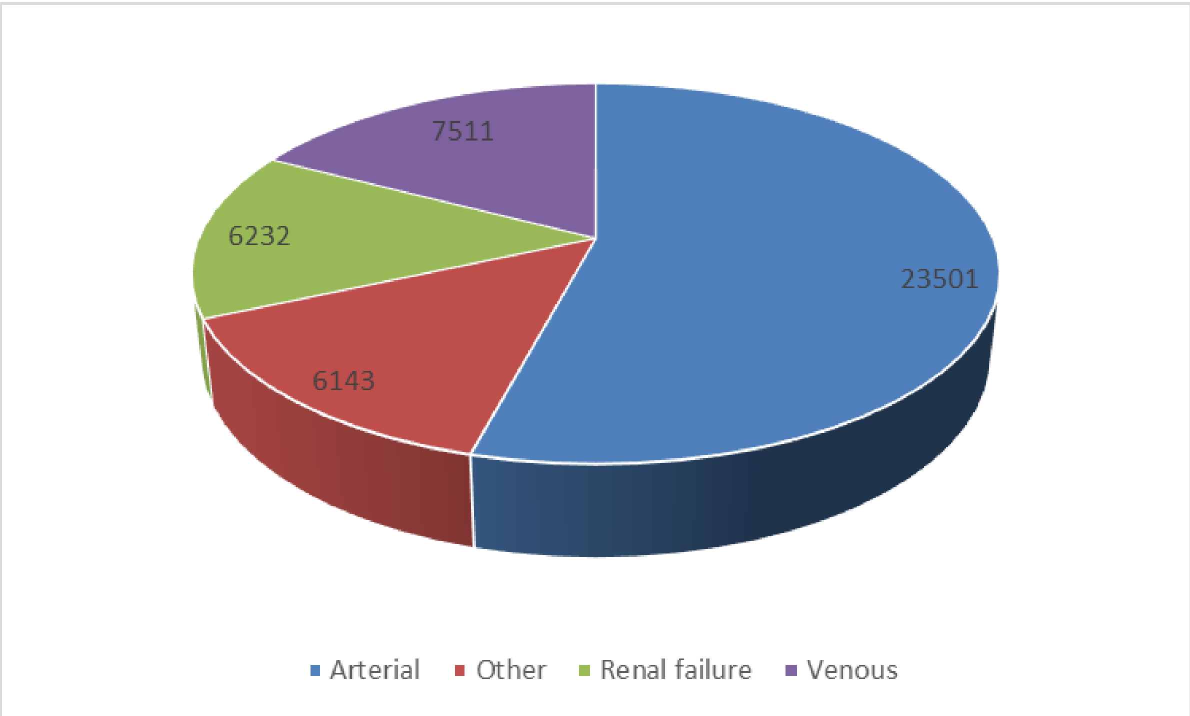
St Vincents Private Hospital-Launceston
St Vincents Private Hospital-Northside
St Vincents Private Hospital-Werribee
St Vincents Public Hospital-Darlinghurst
St Vincents Public Hospital-Fitzroy
Steele Street Clinic-Devonport
Stirling Hospital-Stirling
Strathfield Private Hospital-Strathfield
Sunshine Coast Private Hospital-Buderim
Sunshine Coast University Private Hospital-Birtinya
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 Vein Centre-Richmond
The Wesley Hospital-Auchenflower
Toowoomba Base Hospital-Toowoomba
Townsville Hospital-Townsville
Varsity Lakes Day Hospital-Varsity Lakes
Vascular Solutions-Subiaco
VCCC-Parkville
WA Vascular Centre-Bassendean
Wagga Wagga Base Hospital-Wagga Wagga
Wagner rooms-Melbourne
Waikato Hospital-Hamilton
Warringal Private Hospital-Heidelberg
Wauchope District Hospital-Wauchope
Waverly Private Hospital-Mt Waverly
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 216 with a range of 1-1,491

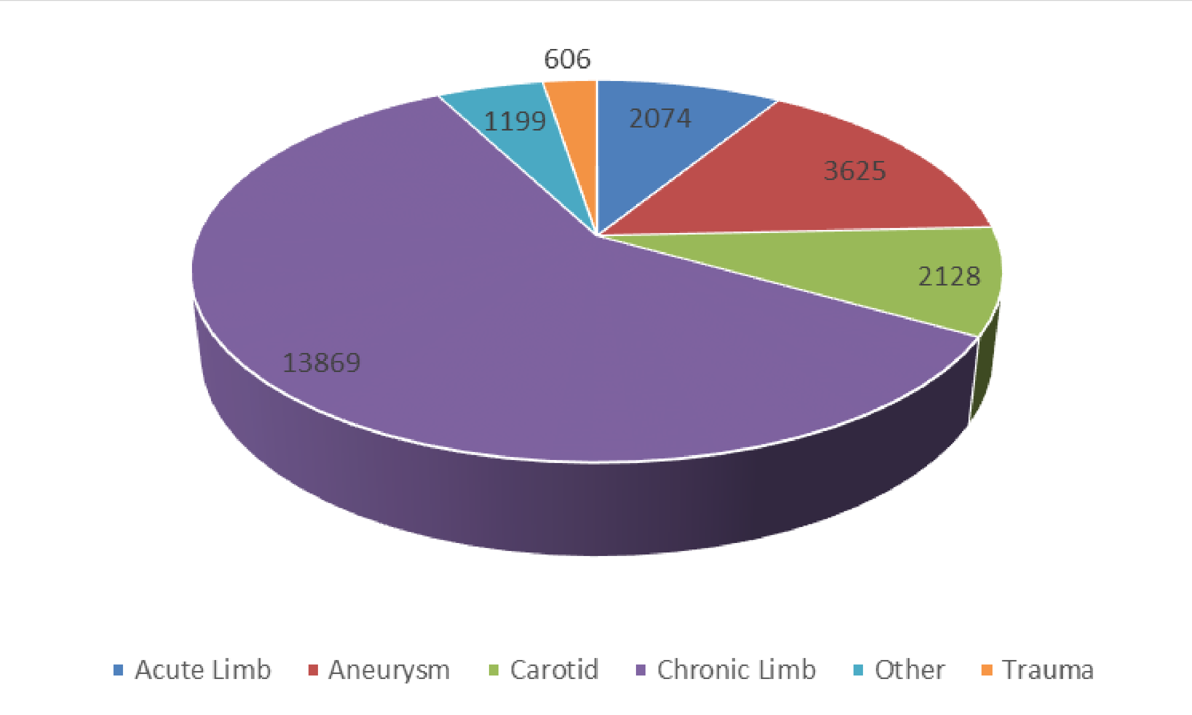
The distribution of procedures by patient type is shown in Fig. 3. The majority were arterial patients followed by venous disease then renal disease.

Fig 3. Patient type 2019



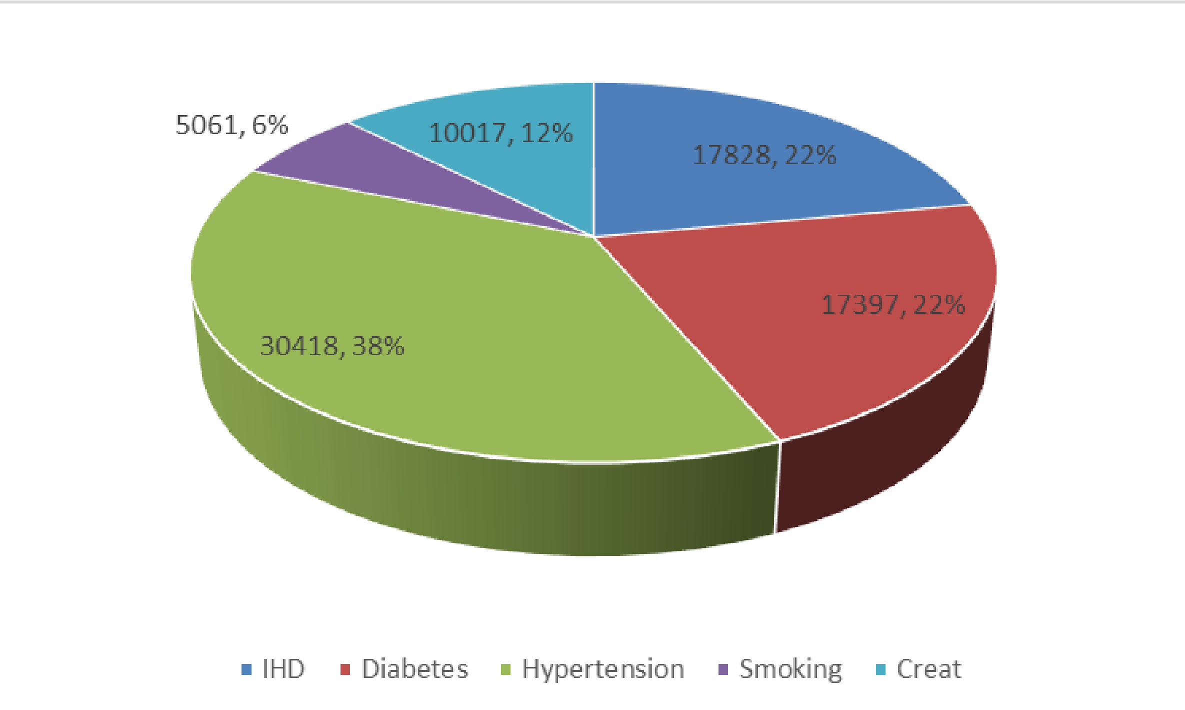
The distributions of procedures in the arterial category are shown in Fig. 4. The majority were for chronic limb operations followed by aneurysms then acute limb procedures.

Fig 4. Arterial categories 2019 (n=23,501)



In the 23,501 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.

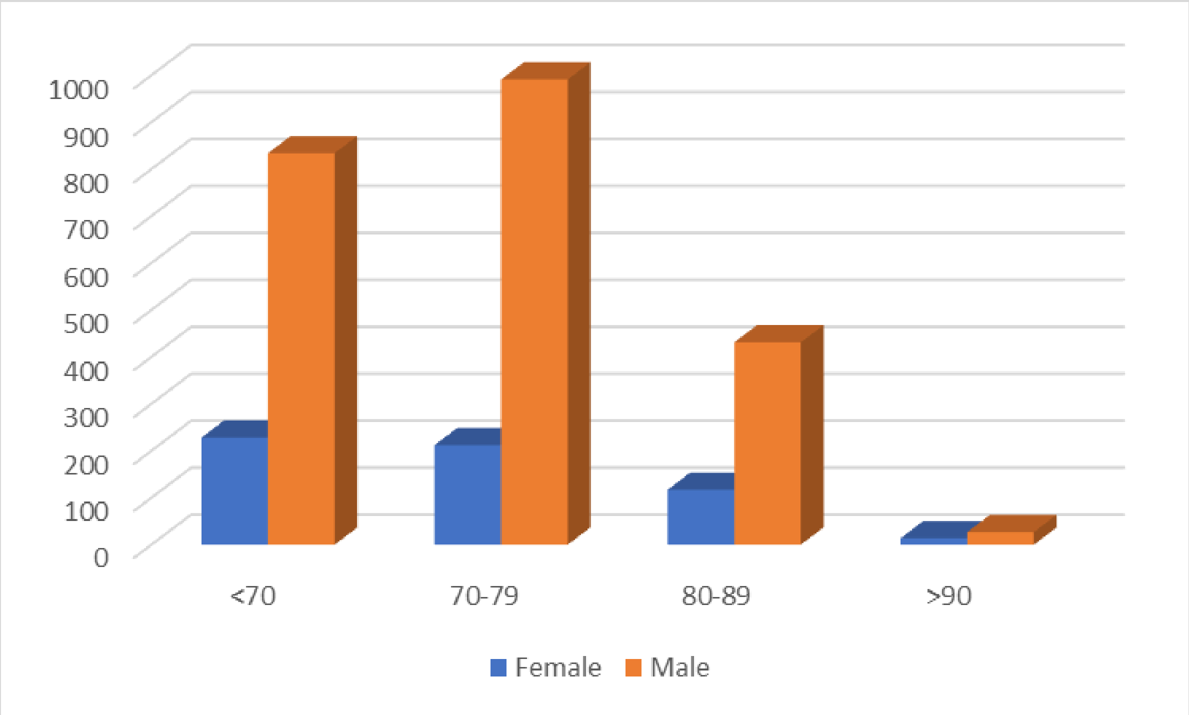
Fig 5. Risk factors in arterial operations 2019 (Creatinine = >150mMol/L, Smoking = current)



Aortic Surgery

There were 2,855 Aortic (discharged) procedures performed in 2019. 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	Mortality (%)
All Aortic procedures	2853	5.2
Open Aortic surgery	999	10.9
Open AAA	628	9.9
Open AAA-elective	396	4.0
Open AAA-ruptured	137	29.2
AAA-EVAR-elective	1352	0.7
AAA-EVAR-ruptured	80	18.8
Non-aneurysm abdominal aortic surgery	349	12
Thoracic ELG	254	4.7
Open Thoracoabdominal	10	30

i) Open aortic surgery

This includes all aneurysm and non-aneurysm surgery. 193 surgeons performed an average of 5 procedures. The indications for the 349 non-AAA procedures are shown in Table 2.

Table 2. Non-aneurysm open aortic surgery

Indication	Total	Died
Claudication	96	4
Mesenteric ischemia	55	19
Rest pain	55	1
Acute ischemia	50	10
Ulcer/gangrene(arterial)	24	0
Trauma(iatrogenic)-haemorrhage	19	0
Neoplasm-malignant	9	0
Aortoenteric fistula-secondary	7	3
Dissection	7	1
Trauma(non iatrogenic)-haemorrhage	6	2
Bypass / Stent graft / Patch sepsis	4	1
Endoleak	4	0
Infection	3	0
Retrieval device/FB	3	0
Renal a stenosis/refractory hypertension	2	0
Trauma(non iatrogenic)-occlusion	2	1
Aortoenteric fistula-primary	1	0
AV Fistula closure	1	0

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.

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 0.83.

Fig 7. ROC for mortality after open aortic surgery model.

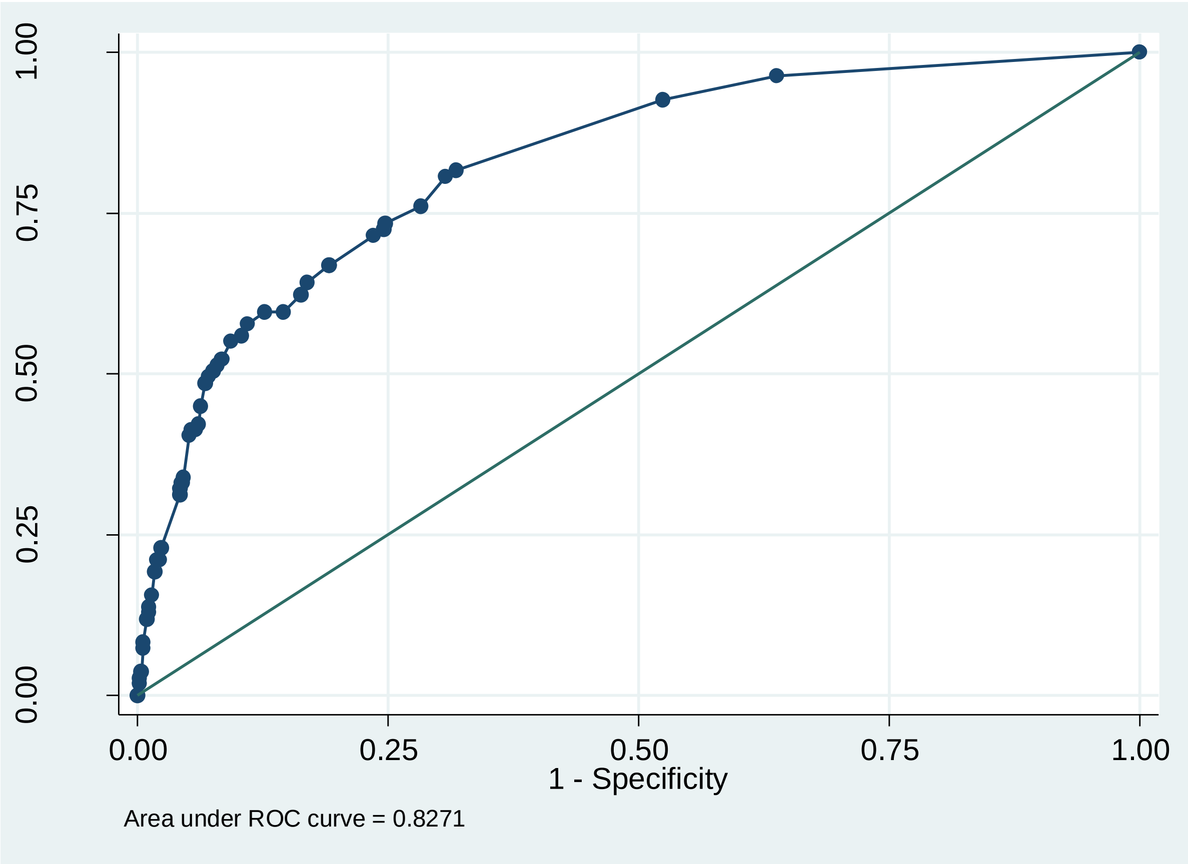


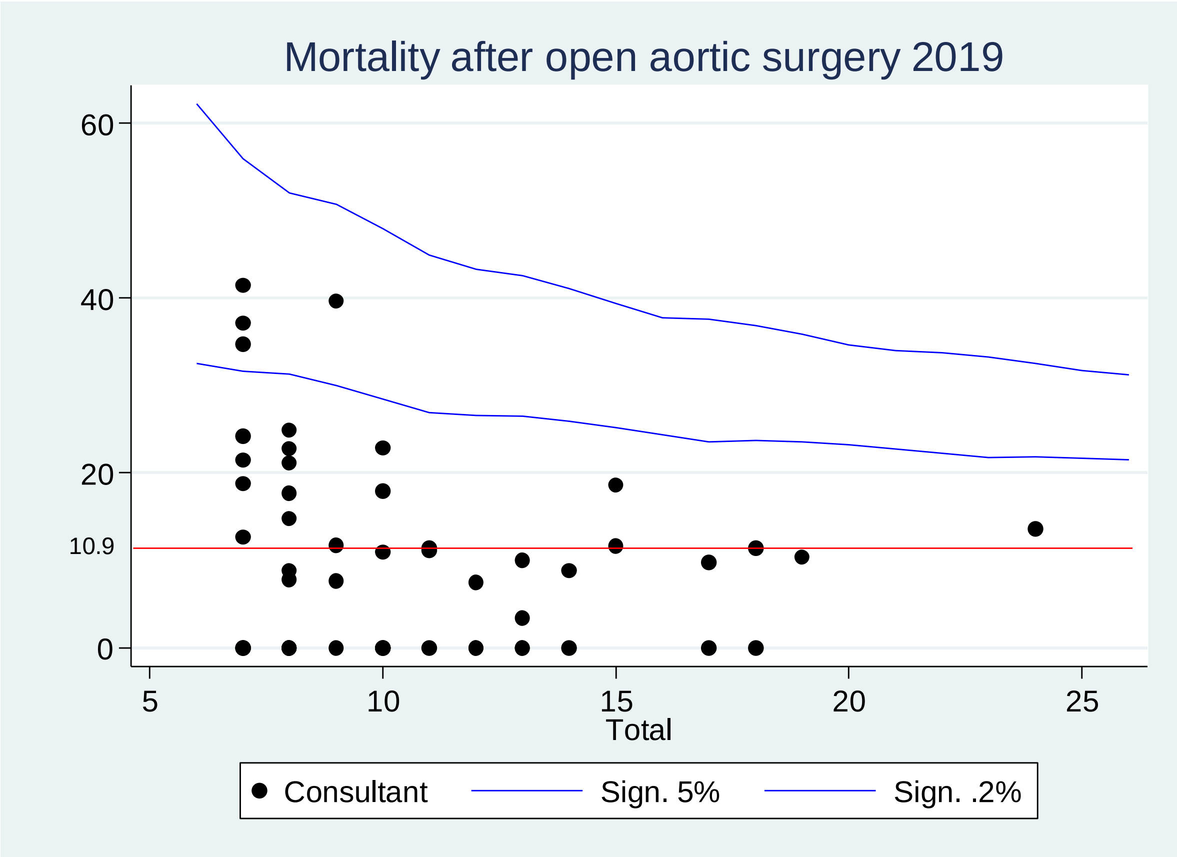
Table 3 shows the significant variables used in the model for all open aortic surgery 2019.

Parameter	Odds Ratio	P (>|Z|)
Aortoenteric Fistula	7.760912	P = 0.008
Ruptured AAA	2.695719	P = 0.0016
Mesenteric ischemia	6.027512	P < 0.0001
ASA Status(4)	3.897836	P < 0.0001
ASA Status(5)	4.774147	P = 0.0001
71-80 years	2.629658	P = 0.0002
81-90 years	4.191389	P < 0.0001
Male	0.433385	P = 0.0007

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 2019. 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. The mortality rate was 10.9% for open aortic surgery.

Fig 8. Risk-adjusted funnel plot for open aortic surgery for consultants with 6 or more cases (52)



Outliers

No outliers were identified.

Open AAA

628 patients underwent surgery for open AAA in 2019. This dataset was restricted to patients with abdominal aneurysm repair, excluding thoraco-abdominal aneurysms. This allowed comparison of postoperative complications between 491 intact (elective, mycotic, painful, occluded) aneurysms and 137 ruptured AAA (Table 4). Mean aneurysm diameter was 66mm.

Table 4. Complications after intact and ruptured AAA repair

Complication	Intact AAA (491)	Ruptured AAA (137)
AMI	9(1.8%)	7(5.1%)
Gut ischaemia	11(2.2%)	9(6.6%)
Renal failure/impairment	34(6.9%)	31(22.6%)
Died	22(4.5%)	40(29.2%)

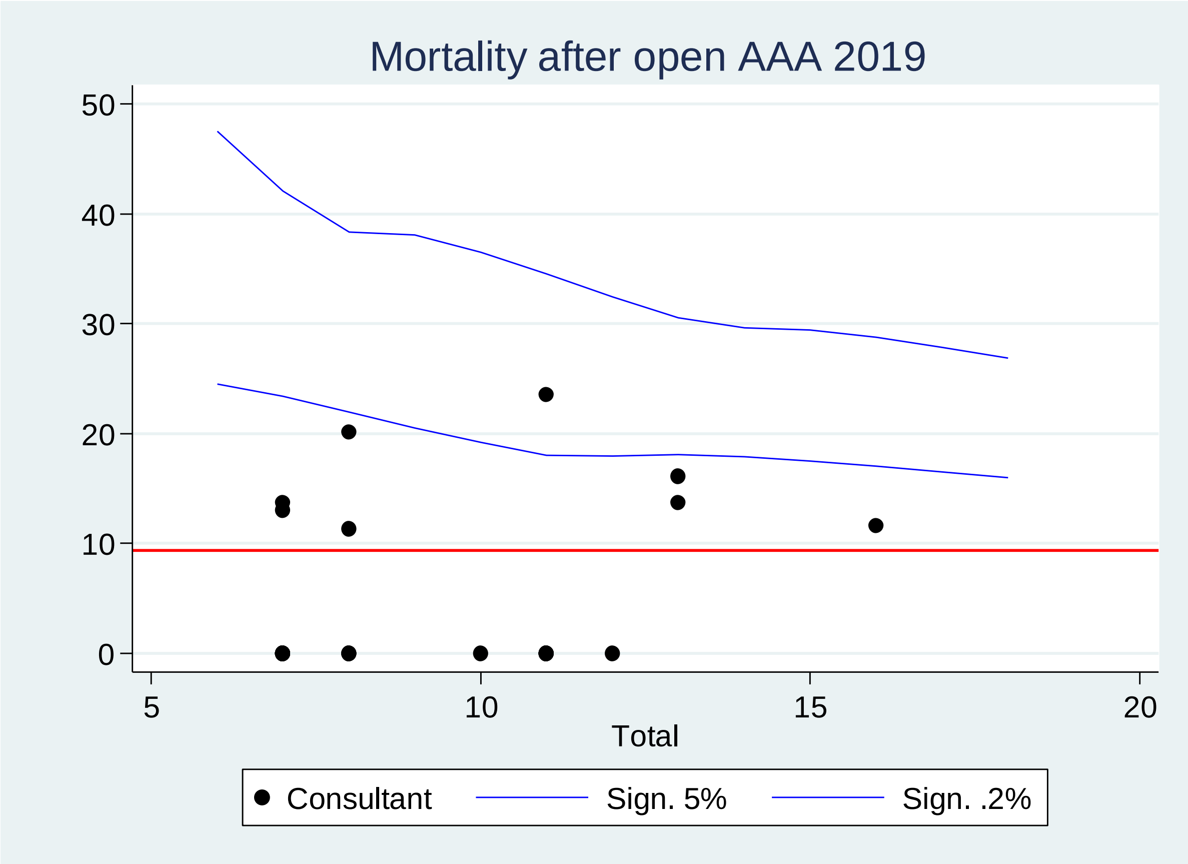
Outcomes

Predictive variables for the model are shown in table 5. Excellent discrimination was obtained with a c-statistic of 0.84. A multilevel model was not used as it was not significantly different from the binary logistic regression model.

Table 5. Significant variables in the Open AAA model 2019.

Parameter	Odds Ratio	P (>|Z|)
>4 L bloodloss	3.18536	P = 0.004
Ruptured	8.121692	P < 0.0001
IHD	2.211692	P = 0.0093
Age>80	2.611594	P = 0.0082
Male	0.32061	P = 0.0007

Fig 9. Risk-adjusted funnel plot for open AAA repair where surgeons performed >6 cases (25)



Outliers: There were no outliers for open AAA surgery. Raw mortality was 9.9%

iii) Endoluminal abdominal aortic surgery

Abdominal aortic aneurysm

1,614 non-thoracic ELG were inserted during 2019. 87% patients had percutaneous access with closure device. Mean aneurysm diameter was 58mm. There were 31 type 1, 43 type 2 and 7 type 3 endoleaks. There were 13 occluded limbs and 2 conversions to an open repair. GA was used in 94.5%.

The indication for EVAR was not confined to AAA as shown in Table 6.

Table 6. Indications for EVAR 2019

Indication	Total
Aneurysm-elective	1352
Aneurysm-pain	115
Aneurysm-ruptured	80
Aneurysm-mycotic	18
Endoleak	17
Aneurysm-occluded	10
Dissection	10
Aortoenteric fistula-secondary	4
Aortoenteric fistula-primary	3
Claudication	3
Acute ischemia	1
Aneurysm-false(non iatrogenic trauma)	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 7. Complications after intraabdominal ELG (n = 1,614)

Complication	Intact Aorta (1,534)	Ruptured AAA (80)
Conversion	2	0
AMI	11	1
Gut ischaemia	2	1
Renal failure/impairment	24	8
Endoleak type 1	30	1
Endoleak type 2	42	1
Endoleak type 3	6	1
Died	12(0.8%)	15(18.8%)

The types of device used for ELG is shown in table 8.

Device
Endurant
Zenith Alpha
Excluder
Cook low profile
Zenith Fenestrated
Cook low profile with spiral limb(s)
Cook with side branches
Endologix
Zenith Flex(non-fenestrated)
Other hybrid combination
Cordis Incraft
Anaconda(non-fenestrated)
Zenith T Branch
Zenith body with Gore limb(s)
Trivascular Ovation (Prime)
Aorfix
Zenith body with Anaconda limb(s)
Zenith body with Endurant limb(s)
Ancure
Cook low profile, Zenith Alpha
Cook with side branches, Cook low profile
Cook with side branches, Endurant
Cordis Incraft, Anaconda(non-fenestrated)
Endologix, Excluder
Endologix, Other hybrid combination
Excluder, Zenith Fenestrated
Excluder, Zenith Alpha
Nellix
Zenith Fenestrated, Cook with side branches

iv) Fenestrated and branched ELG

The configuration of all ELG is shown in Table 9. The subsets of branched and fenestrated grafts are evident; 11.7% were fenestrated with a mortality of 7/190 (3.7%) vs non-fenestrated 20/1,424 (1.4%) P=0.03. Endoleaks occurred in 5.2% of non-fenestrated vs 3.7% in fenestrated ELG (ns).

Table 9. Configuration of ELG 2019

Configuration	Total
Bifurcated	**1268**
Fenestrated Renal(s)-SMA-Coeliac	92
Tube	**71**
Fenestrated Renal(s)-SMA	45
Bifurcated-bifurcated(+/- IBD)	**36**
Fenestrated + Branched endograft	24
Aorto-uni-Iliac and Fem fem bypass	**22**
Fenestrated both Renals	21
Branched endograft R Iliac	**12**
Branched endograft L Iliac	9
Aorto-uni-iliac-no x-over	**8**
Fenestrated L Renal	3
Fenestrated R Renal	**2**
Fenestrated SMA-Coeliac	1

Outcomes

Mean mortality for all EVAR (for AAA only) was 1.6%. The c-statistic was 0.86. Significant variables in the model were gender, Fenestrated graft and ruptured AAA.

Table 10. Significant variables for mortality after EVAR 2019

Parameter	Odds Ratio	P (>|Z|)
Fenestrated	9.062313	P = 0.0006
Ruptured	63.751574	P < 0.0001
Male	0.381449	P = 0.0515

iv) Thoracic and thoraco-abdominal procedures

Endoluminal. Of the thoracic and thoracoabdominal ELG (n=254), the group consisted of dissecting aneurysms (23), non-dissecting aneurysms (86), acute dissection (44), chronic dissection (39), traumatic aortic tear (34) and penetrating ulcer (28). There were 12 deaths (4.7%), not considered significant for this procedure. 111 surgeons inserted a mean of 2 ELG with a range from 1-12. Configuration is shown in Table 11.

Configuration	Total
Overlapping Stent grafts	126
Single Stent graft	120
Stent graft(s) with distal bare stent	7
Stent graft(s) with intra-abdominal fenestration(s)	1

The following devices were inserted in patients having stents/stent grafts in the thoracic aorta (Table 12).

Device
Zenith Alpha
Medtronic
Gore C-TAG
Zenith TX2
Endospan Nexus

There were 9 patients with paraplegia (3.5%) and 6 strokes (2.4%) following TEVAR. 8 patients had renal failure or impairment and 1 developed intestinal infarction. There was 1 type 1, and 1 type 3 endoleaks. No patients required conversion to open. Breakdown of complications by aetiology is shown in Table 12.

Table 13. Complications according to the main pathology types (n=254)

Pathology	Total	Mortality	Stroke	Paraplegia
Aneurysm(dissecting)	23	1		1
Aneurysm(non-dissecting)	86	3	3	4
Dissection-acute	44	3		2
Dissection-chronic	39	1		1
Traumatic tear	34	2	1	
Penetrating ulcer	28	2	2	1

Outcomes

No predictive model was produced. Because of low numbers no outlier detection could be run for TEVAR in 2019. A cumulative report will be produced in 2021 to correct this, as was the case in the 2015-2017 report.

Open. There were 10 open thoracoabdominal procedures with 3 deaths They were performed by 9 surgeons and one surgeon had performed 2 cases. There was a single stroke and no paraplegia was recorded in this cohort. There were 2 aneurysm ruptures with one death and 5 intact aneurysms with a single mortality in a complex type 4 on bypass, with uncontrollable bleeding after flow restoration. This was not considered significant by the audit monitoring committee for this procedure.There were 3 dissections with a single mortality. Mean diameter of the aneurysms was 64mm.

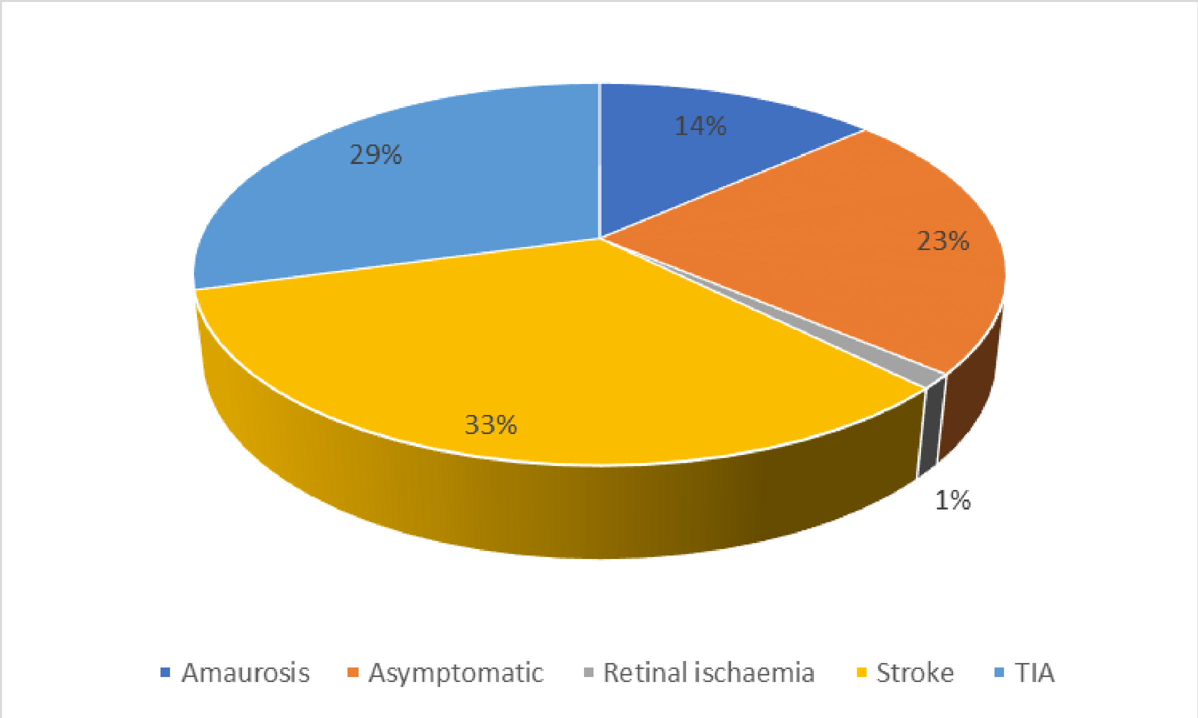
Carotid Surgery

There were 2,061 carotid interventions, 1,905 carotid endarterectomies (CEA) and 156 carotid stents (CAS).

i) Carotid Endarterectomy

The indications for CEA are shown in Fig.12 with 23% having no symptoms.

Fig 12. Indication for CEA



The time from onset of symptoms to surgery in symptomatic patients was < 48 hours in 1%, < 2 weeks in 59%, 2-4 weeks in 20% and > 4 weeks in 20%. 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 13.4% of patients and 43% were shunted. Patches were used in 87% of CEA (Table 14).

Table 14. Patches after CEA.

Patch	Total
Polyurethane	745
Pericardium	537
Dacron	211
No patch/conduit	167
PTFE	76
Prosthetic (Other)	55
GSV-reversed	19
Neck vein	8
Homograft	4
Ext carotid	2
GSV-non reversed	1
Vein (Other)	1

Complications after CEA are shown in table 15.

Table 15. Complications after CEA (n= 1,905)

Complication	Percent
Haemorrhage requiring exploration	2.6
Cranial nerve trauma	0.7
Myocardial infarction	0.6
Major/minor stroke	0.9
TIA	0.4
Hyperperfusion	0.3
Death	0.3
Stroke or death	1.1

Outcomes

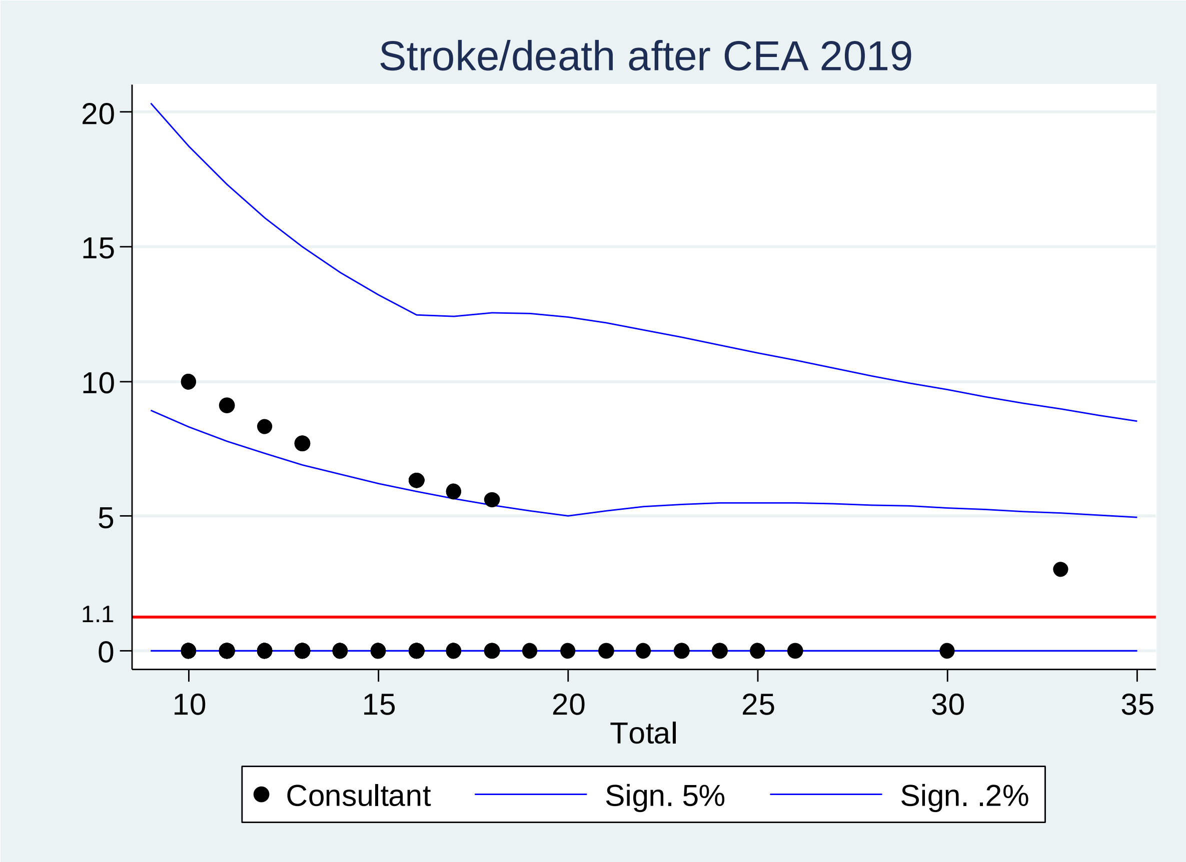
Only 1 variable was significant in the model for stroke/death (Table 16). Thus a non-risk-adjusted funnel plot was constructed.

Table 16. Significant variables for S/D after CEA 2019

Parameter	Odds Ratio	P value
ASA4	4.863636	P = 0.0133

Because the numbers were low, only those surgeons (85) who performed 10 or more CEA were assessed by a funnel plot. The mean stroke/death(S/D) rate was 1.1% and no outliers were apparent. Symptomatic S/D rate was 1.1% and Asymptomatic S/D was 0.9%. postop S/D rate for stroke as the indication for operation was 1.6%.

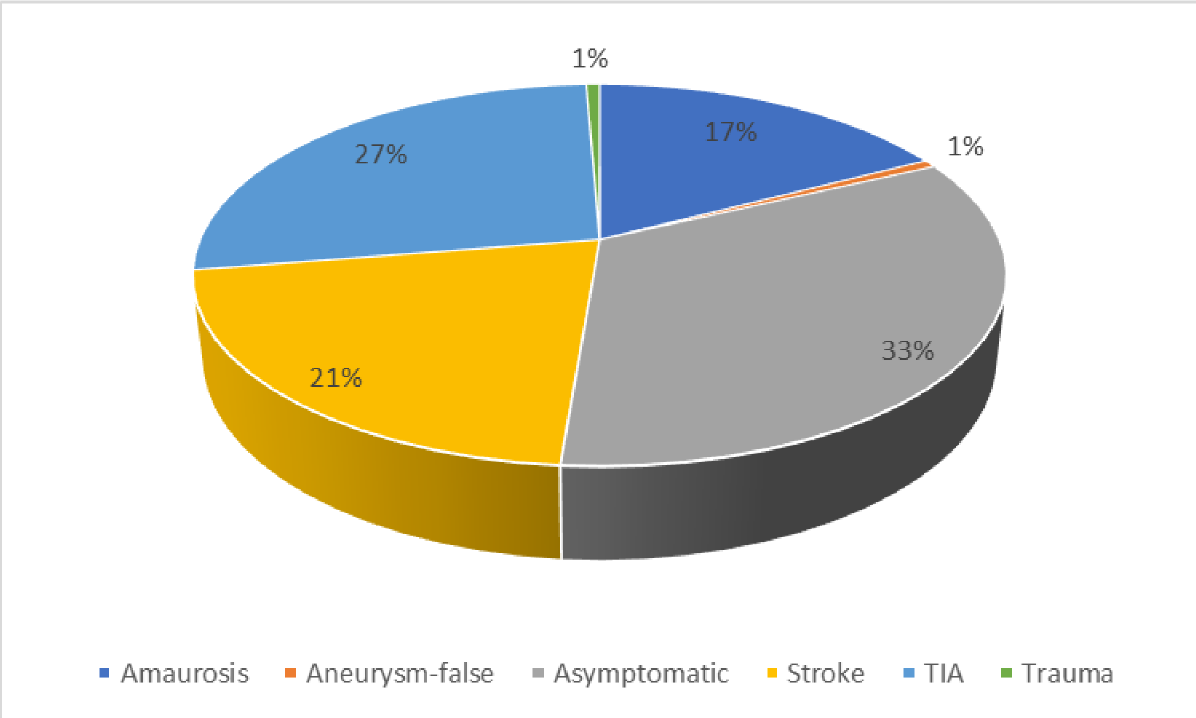
Fig 13. Non risk-adjusted Funnel plot for stroke and death after CEA 2019



ii) Carotid Stents

156 carotid stents were performed in 2019.

Indications for CAS are shown in Fig 15, with the most frequent being asymptomatic, then TIA.



Technical details. n=156

Access was via a long sheath in 111 and via a short sheath with guiding catheter in 45. There was a type 1 arch in 93, type 2 in 58 and type 3 in 5 patients.

Cerebral protection devices used are shown in table 17. No protection device was employed in 17 patients.

Filter
Emboshield
Nav 6
None
Filterwire EX
Angioguard
SpiderFX
Accunet
Neuroshield

Stent types are shown in table 18.

Stent
Xact
Covered stent
Precise
Wallstent
Casper
CGuard
Angioplasty only
Tapered
ProtegeRX
Medtronic Cristallo
Smart

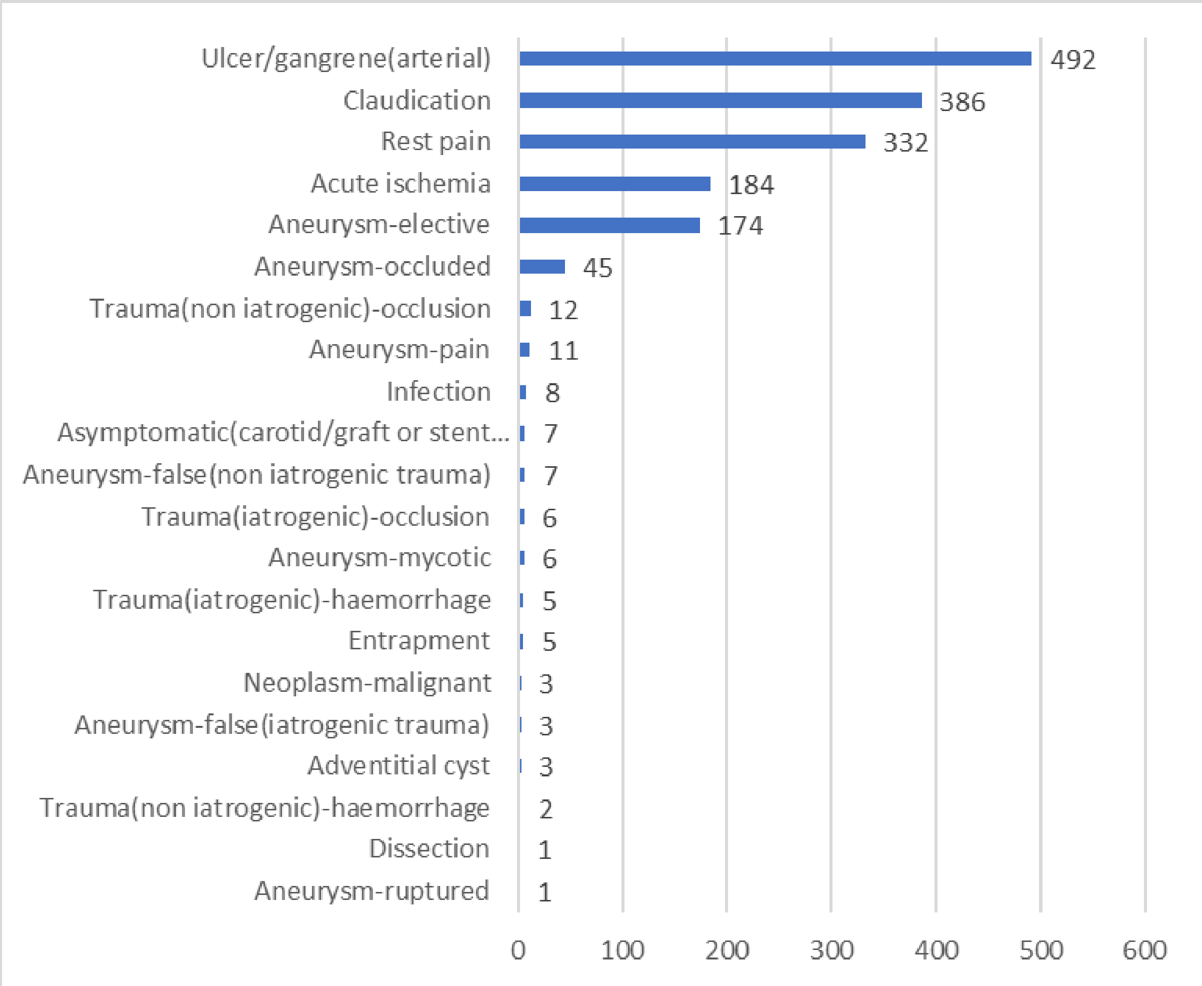
Outcomes

There was a single post op stroke and 1 death giving a stroke and death rate of 2/156(1.3%). Both patients were symptomatic. There were no AMIs and 1 had renal impairment.

Infrainguinal bypass

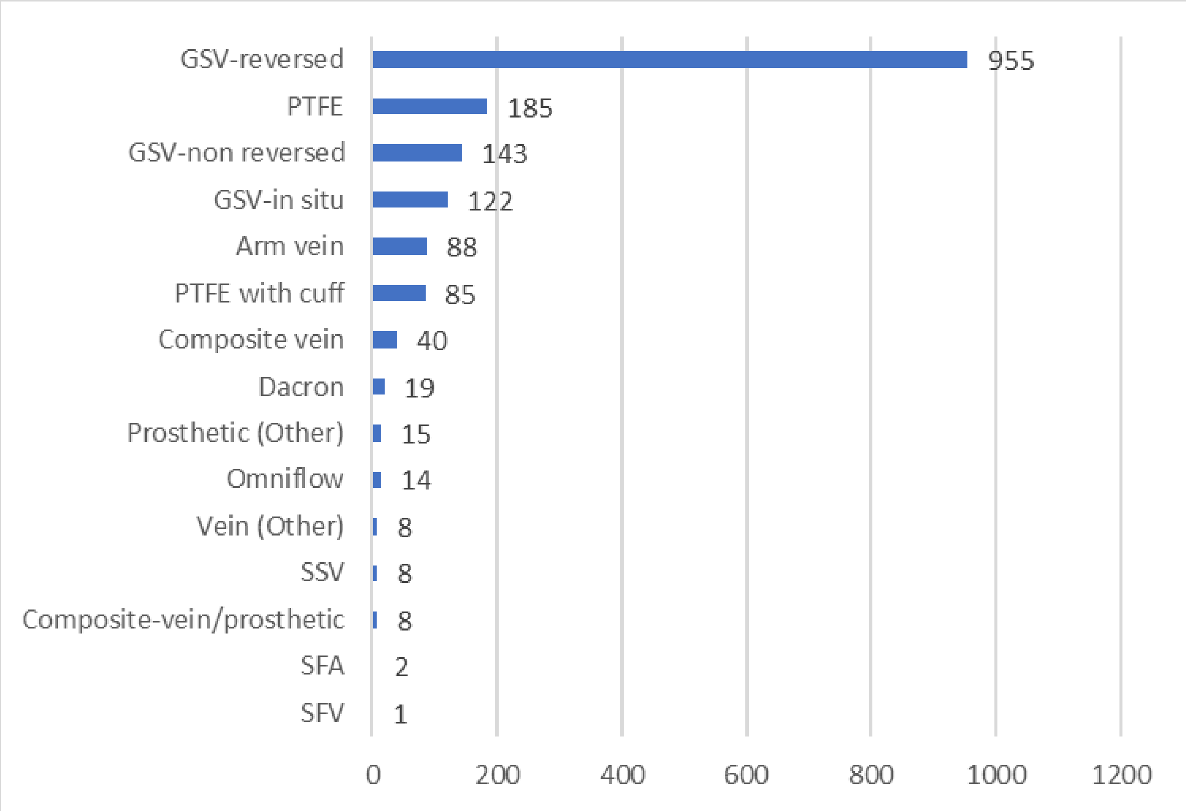
1,693 Infrainguinal bypasses (IIB) were performed in 2019. The average age of patients was 68 with the M: F ratio of 3.8:1. General anaesthetic was used in 96%.

Indications for surgery are shown in Fig 16 with tissue loss being the most frequent.

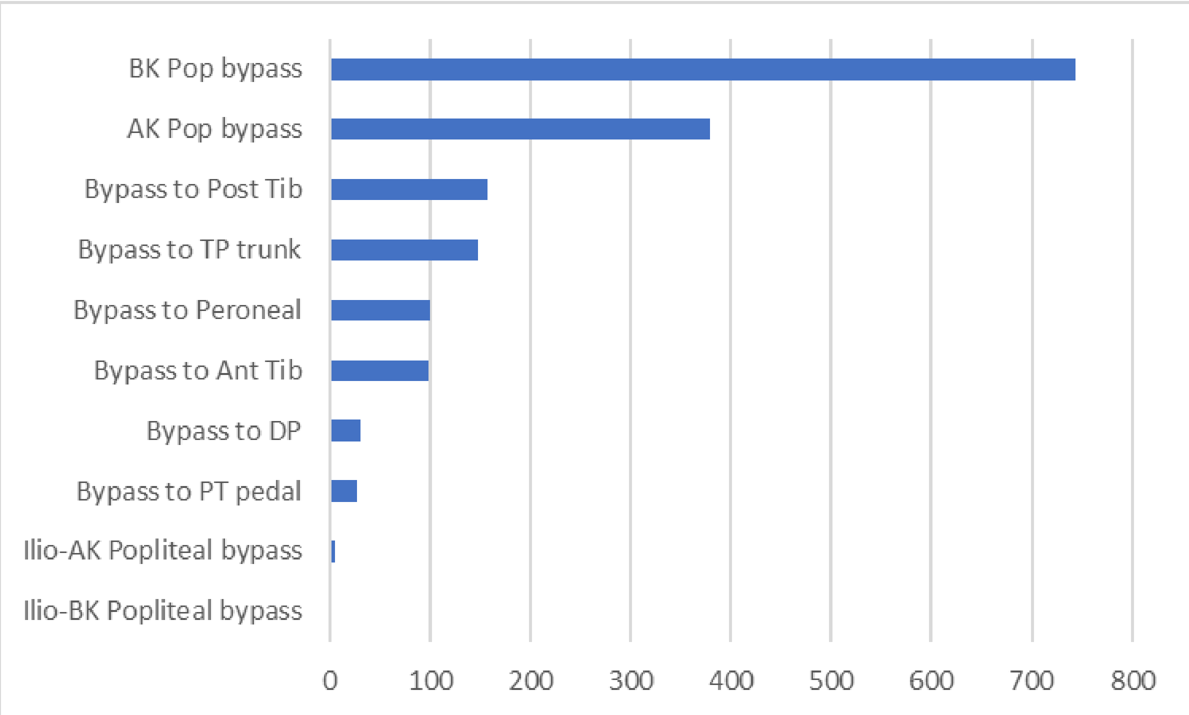


Ulcer/gangrene(arterial)
Claudication
Rest pain
Acute ischemia
Aneurysm-elective
Aneurysm-occluded
Trauma(non iatrogenic)-occlusion
Aneurysm-pain
Infection
Asymptomatic(carotid/graft or stent...
Aneurysm-false(non iatrogenic trauma)
Trauma(iatrogenic)-occlusion
Aneurysm-mycotic
Trauma(iatrogenic)-haemorrhage
Entrapment
Neoplasm-malignant
Aneurysm-false(iatrogenic trauma)
Adventitial cyst
Trauma(non iatrogenic)-haemorrhage
Dissection
Aneurysm-ruptured
492
386
332
184
174
45
12
11
8
7
7
6
6
5
5
3
3
3
2
1
1
0
100
200
300
400
500
600

Fig. 17 Conduits for infrainguinal bypass.



Bypass configuration is shown in Fig 18.



Post-operative complications are shown in table 19 (n = 1,693)

Complication	Percent
Myocardial infarction	1.4
Stroke	0.4
Renal impairment/ failure	1
Wound complications	6
Haemorrhage requiring reoperation	3.5
Death	0.8

Outcomes

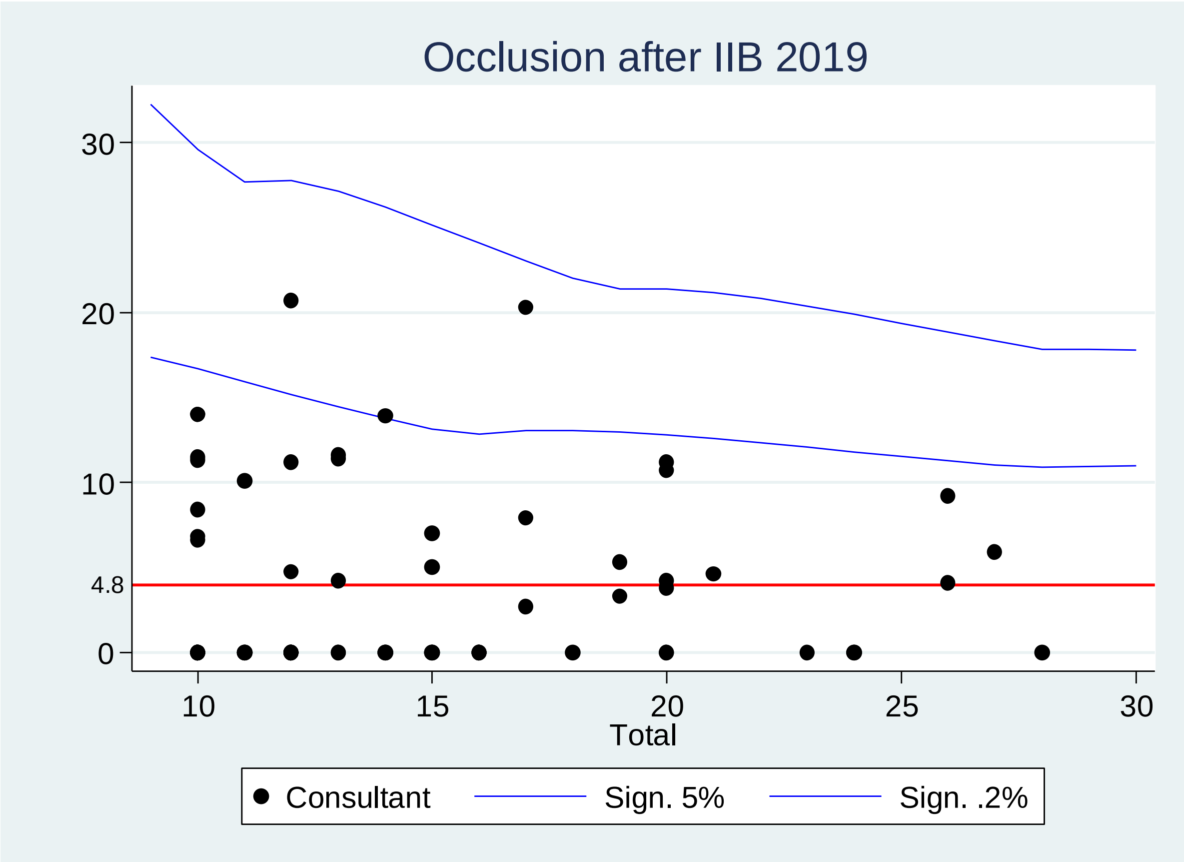
i) Occlusion

A multilevel logistic regression model for occlusion after IIB was obtained. Variables included are shown in table 20.

Parameter	Odds Ratio	P (>|Z|)
1Vessel	1.972003	P = 0.0037
Composite	3.980883	P = 0.0006
Male	0.455132	P = 0.0012

Occlusion rates were assessed using a risk adjusted funnel plot for those consultants that performed 10 or more bypasses (Fig 19). No outliers were detected for 2019. The mean occlusion rate was 4.8% and mortality was 0.8%.

Fig 19. Risk adjusted funnel plot for occlusion after IIB 2019 (> 9 cases)



Popliteal Aneurysm: There were 230 bypasses for aneurysm (elective, occluded, pain or rupture). The graft occlusion rate for these was 2.6% and the major amputation rate was 0%. In non-aneurysm patients the graft occlusion rate was 5.1% and the amputation rate was 1.3 %.

Claudicants *vs* tissue loss: In the 386 claudicants, the occlusion rate was 2.8% and there was 1 amputation. In 492 patients with tissue loss the occlusion rate was 5.5% and the amputation rate was 1.6%.

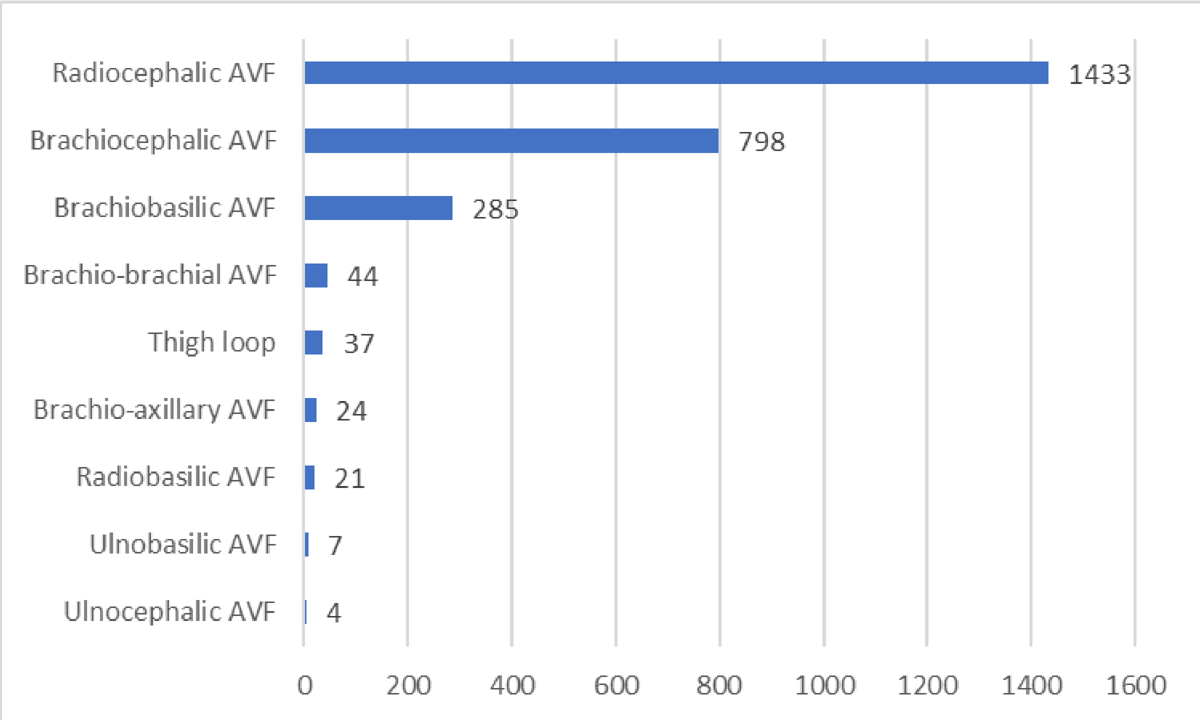
ii) Amputation

The limb salvage rate was 98.9%. 19 limbs were amputated and 5 of these occurred with a patent graft. 3 patients in this subgroup were diabetic.

Arteriovenous Fistulae

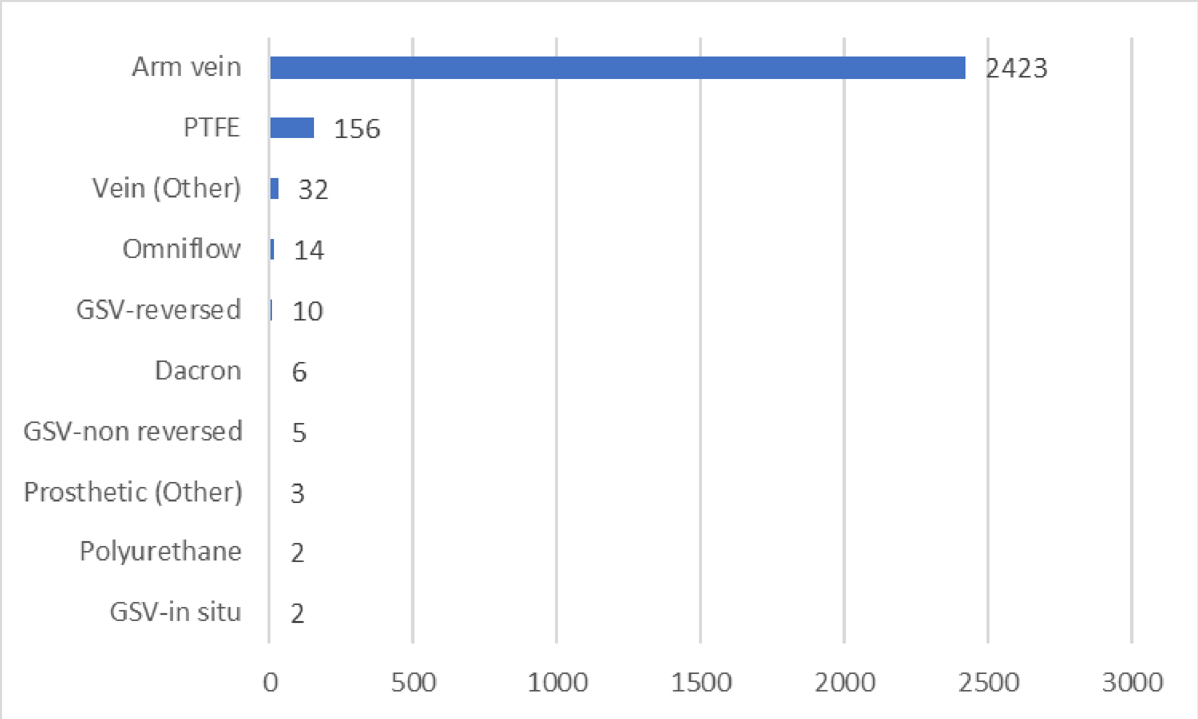
2,653 patients had an arteriovenous fistula (AVF) placed in 2019. The locations of AVF are shown in Fig 20.

Fig 20. AVF configuration



The majority of AVF were autogenous (2,481) and 6.5% were prosthetic. The conduits used are shown in Fig 21.

Fig 21. Conduits used



Outcomes

There were 37 occlusions (1.6%). Autogenous fistulae occluded in 34/2481(1.4%) and prosthetic fistulae occluded in 3/172(1.7%). 6 patients had a steal syndrome, 1 of these was a thigh loop and 2 occurred in a wrist fistula. The other 3 were in brachiocephalic AVF.

No model was obtained for occlusion after AV Fistula in 2019. The only significant variable was the use of an Omniflow graft with 2 occlusions out of 14 cases, both by different surgeons.

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% compared to AIHW data up to the 2017/8 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 2010-9 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

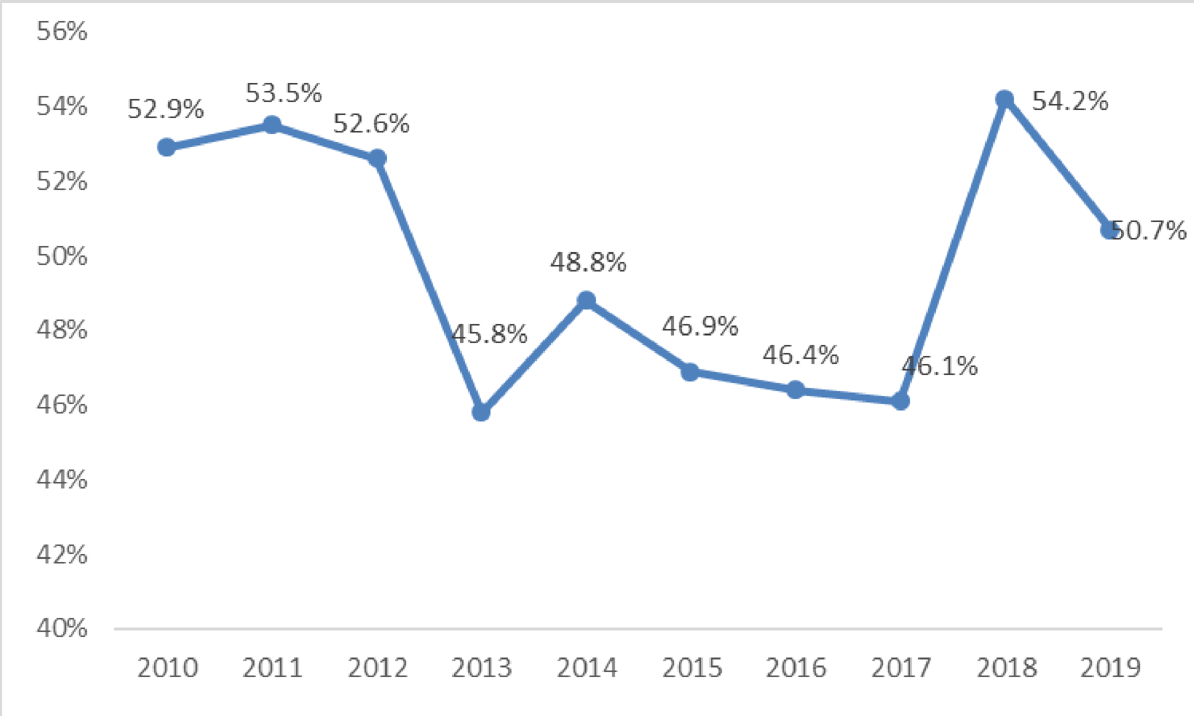
Item numbers 32739, 32742, 32745, 32748, 32751, 32754, 32757, 32763, 33050, 33055

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, but is just over 50% again but has dropped from last year. Further measures are required to increase this percentage.

Fig 23. Private practice participation in the AVA for Australia 2010-2019

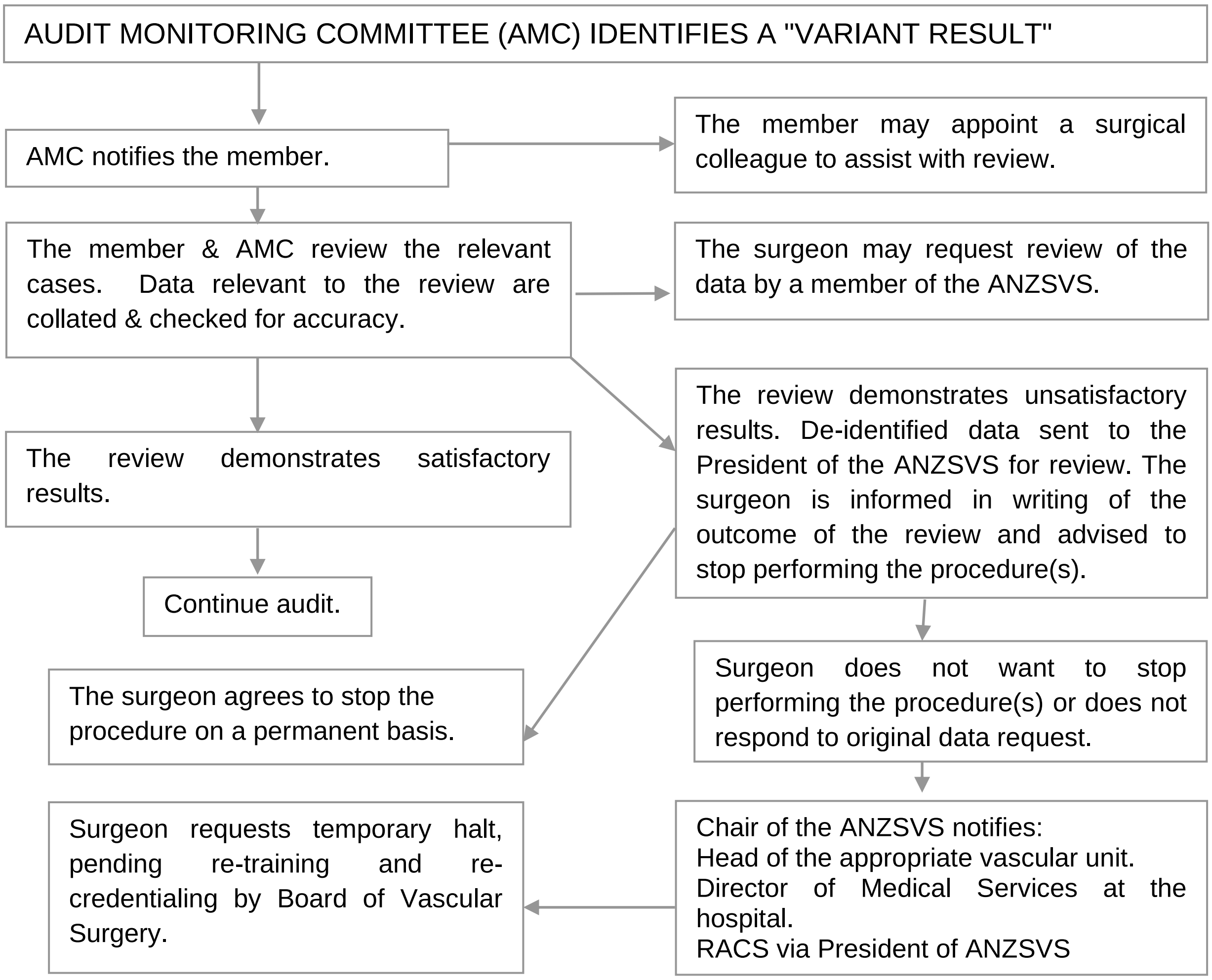


Internal validation was performed at the end of 2017 comparing a 5% sample of patients with the actual case notes by nominated members at each hospital. This showed that data entry was of high quality with only 2.7% having incorrect field data entered out of a total of 3,225 fields studied. This study 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.

Appendix 3

Features of the AVA application

This is a web-based database in SQL residing on a secure server (Microsoft Azure) within Australia and is compatible with all browser platforms. Data capture is exclusively via the web portal. A mobile-friendly modification has recently been designed.

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 in both Australia and New Zealand. 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.

References

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3) Bourke BM, Beiles CB, Thomson IA, Grigg MJ, Fitridge R. Development of the Australasian Vascular Surgical Audit. J Vasc Surg 2012; 55:164-70

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5) Sanagou M, Wolf R, Forbes A, Reid C. Hospital-level associations with 30-day patient mortality after cardiac surgery: a tutorial on the application and interpretation of marginal and multilevel logistic regression. BMC Medical Research Methodology 2012; 12:28. http://www.biomedcentral.com/1471-2288/12/28

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