ASERNIP-S

Audit of
Endoluminal Repair of
Abdominal Aortic Aneurysms

– Long term follow up-

Final Report to Cook Australia
Prepared March 2009

Australian Safety and Efficacy Register
of New Interventional Procedures – Surgical

The Royal Australasian College of Surgeons

ASERNIP S

Audit of Endoluminal Repair of Abdominal Aortic Aneurysms

Final report on Zenith graft patients

Prepared for

Cook Australia

March 2009

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Introduction

In May 1999 the Medical (formerly Medicare) Services Advisory Committee (MSAC) assessed and reported on the procedure of endovascular aneurysm repair (EVAR). Their results showed that although the procedure appeared effective in the short-term, there was insufficient evidence concerning the long-term safety and efficacy.[1] The procedure involves the elective repair of abdominal aortic aneurysms (AAA) using an endovascular graft. The graft is inserted through an incision in the femoral artery and positioned within the aorta at the site of wall weakening (the aneurysm) in order to prevent rupture.

As a consequence, the Australian Government Department of Health and Ageing commissioned the Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP-S) to manage a national collection of data for the evaluation of endovascular aneurysm repair (EVAR). ASERNIP-S is part of the Research, Audit and Academic Surgery Division of the Royal Australasian College of Surgeons (the College) and the project is managed from the office in Adelaide, South Australia.

As a result of consideration of the audit's final progress report to the Government showing the five-year outcomes of patients treated by EVAR, the Minister for Health and Ageing, the Hon. Tony Abbott endorsed MSAC's recommendation of permanent funding for two item numbers allocated to the procedure on the Medical Benefits Schedule:

Item 33116: Infrarenal abdominal aortic aneurysm, replacement by tube graft using endovascular repair procedure, excluding associated radiological services (Ministerial Determination) (Anaes.) (Assist.)

Item 33119: Infrarenal abdominal aortic aneurysm, replacement by bifurcation graft to one or both iliac arteries using endovascular repair procedure, excluding associated radiological services (Ministerial Determination) (Anaes.) (Assist.)

In 2006, Cook Australia agreed to fund the audit to continue follow-up data collection for a further two years. This report presents the results obtained for information submitted on patients who had a Zenith graft repair for abdominal aortic aneurysm between 1 November 1999 and 16 May 2001. This information is a subset (82%) of that submitted to the audit of endoluminal (endovascular) repair of abdominal aortic aneurysms. This report represents the mid to long term outcomes of patients undergoing endovascular repair of abdominal aortic aneurysms using the Zenith graft. Vascular surgeons throughout Australia registered a total of 787 patients in the Zenith data subset.

Audit Overview

The Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP-S), has established and managed the audit. A project officer is responsible for managing the audit, with supervision from the ASERNIP-S' Morbidity Audit Manager, the Director of the Research, Audit and Academic Surgery Division of the College and ASERNIP-S Surgical Director, Professor Guy Maddern.

An independent reference group of senior vascular surgeons with a high level of expertise in the procedure provided advice on clinical aspects of the audit. The group comprises the following members:

- Professor Guy Maddern (Chair) (Adelaide, South Australia)
- Mr John Anderson (Adelaide, South Australia)
- Mr Michael Denton (Melbourne, Victoria)
- Associate Professor Robert Fitridge (Adelaide, South Australia)
- Professor John Harris (Sydney, New South Wales)
- Mr Michael Lawrence-Brown* (Perth, Western Australia)
- Professor James May (Sydney, New South Wales)
- Professor Kenneth Myers (Melbourne, Victoria)

* Mr Lawrence-Brown has recently retired and has subsequently resigned from this group.

Confidentiality and privacy

The audit contains sensitive health information. Advice was sought regarding its handling and housing to ensure that the information was handled appropriately. In 2000, amendments were made to the Privacy Act 1988 (Cwth): The Privacy Amendment (Private Sector) Act 2000 (Cwth), which came into effect 21 December 2001. In order to ensure that the rights of patients were respected by ASERNIP-S, guidance was obtained from the College Ethics Committee, and the lawyer acting for the College. Recommendations were made that ASERNIP-S provide information for patients about the audit and that patients provide consent for the release of their health information. As a result of these recommendations information brochures and consent forms were provided to surgeons to use at patient follow-up.

The patient information brochure, patient consent forms and a privacy statement (which includes information about the EVAR audit) are available for download from the ASERNIP-S web site:
http://www.surgeons.org/Content/NavigationMenu/Research/ASERNIPS/ASERNIPSAudits/Audits.htm

The EVAR audit has been declared a quality assurance activity by the Minister for Health and Ageing, the Hon. Tony Abbott under Part VC of the Health Insurance Act 1973 (QAA No. 2/2004).

Data collection

This section describes the methods used to facilitate accurate and complete data collection.

Participating surgeons

During the period of initial data collection around 80 surgeons were performing the EVAR procedure and have continued to submit their data.

Data input

Most data have been submitted using paper-based forms (Appendix 1). Other methods, such as encrypted internet submission or Access databases, were provided earlier in the audit period but were not widely used.

The information was entered into a password-protected Access 2003 database. Most of the data was double-checked to ensure data integrity. The date of data entry and checking was logged.

Surgeons were asked to provide information using three separate forms:

- Operative form – information obtained in the period immediately prior to and during the procedure
- Discharge form – including information obtained postoperatively, up to 30 days from the time of the procedure
- Follow-up form – aimed to collect information at regular follow-up intervals of 3 months, 6 months, 12 months and then on an annual basis.

Copies of each form are included in Appendix 1. The forms do not include any universal identifiers such as the Medicare or Veterans Affairs Numbers as stipulated by the Privacy Amendment (Private Sector) Act 2000, in National Privacy Principle 7.1. Changes were made to the forms in 2004 to identify Type III and Type IV endoleaks.

Data received

ASERNIP-S was required to collect procedures performed privately in Australia between November 1999 and May 2001. An estimate of the number of private procedures performed was obtained from the Health Insurance Commission (HIC), and a comparison with ASERNIP-S data indicates that around 90% of these cases were submitted.

A proportion of patients are considered lost to follow-up by surgeons. Advanced age and/or increasing frailty of patients may have necessitated their movement to nursing home care; the patient may move to be closer to family members and becomes lost to follow-up. Additionally, with advancing age and frailty some of these patients are lost to follow-up when they refuse further monitoring. A number of patients were also lost when, for instance, their surgeon retired and we have not been able to establish the new surgeon or GP responsible for these patients. In summary, the barriers to follow-up include worsening health, distance, cost and movement between service providers.

National Death Index

The National Death Index (NDI) is a database which lists all deaths that have occurred in Australia since 1980. It is maintained by the Australian Institute of Health and Welfare (AIHW) in Canberra. An application to use the database to track patients enrolled in the audit was first made in 2004. The project received clearance from the AIHW Ethics Committee, which has continued to monitor the project every 12 months. The last application to use NDI data was made in July 2008. Frequently, patients who have been listed as lost to follow-up were subsequently identified through the NDI.

Reportage

Surgeons participating in the audit received an updated list of their audit information every three months. This ensured that surgeons remained informed if follow-up information was due.

The progress of the audit was reported at each ASERNIP-S Management Committee meeting. An update of audit activities has been provided to the Council of the College monthly. During the initial funding period for the audit, reports were submitted to the Australian Government Department of Health and Ageing at six-monthly intervals. For the final phase of the audit's initial funding (November 2005 – October 2006) a report was submitted in February 2006 and the final report was submitted in October 2006.

Accreditation of the ASERNIP-S audit

The College Board of Professional Development and Standards approved the EVAR audit for the purposes of their Continuing Professional Development Program. The audit has been listed on the College website under approved audit activities: http://www.surgeons.org/Content/NavigationMenu/FellowshipandStandards/ProfessionalStandards/FAQS/surgical_audit_peer_review_2005.pdf

Publications and presentations related to the audit are shown below:

Conference presentations

2007

- **Boult M** - on behalf of the RACS Research & Audit Division. *Pilot Audit of peripheral stenting procedures.* Vascular Interventions 2007. Newcastle, NSW Australia. February 2007.

- **Boult M**, Fitridge R, Barnes M, Maddern G. *Using audit data to develop a predictive model of success for endovascular repair of abdominal aortic aneurysms.* 5th Australsian Conference on Safety and Quality in Health Care. Brisbane, QLD Australia. August 2007.

- **Fitridge**, Boult, Barnes, Maddern. *Mid term results of EVAR based on asernip-s audit.* Vascular 2007. Melbourne, VIC Australia. August 2007.

2006

- Golledge J, **Parr A,** Boult M, Maddern G, Fitridge R. *The outcome of endovascular repair of small abdominal aortic aneurysms.* "Vascular 2006". The Australian and New Zealand Society for Vascular Surgery. Cairns, QLD Australia. September 2006.

- **Fitridge R**, Boult M, Babidge W, Maddern G on behalf of the ASERNIP-S EVAR reference group. *Effect of pre-operative variables on the mid-term outcomes for patients treated in Australia for endovascular repair.* Annual Scientific Congress of the Royal Australasian College of Surgeons. Sydney, NSW Australia. May 2006.

2005

- **Fitridge R**, Boult M, Babidge W, Maddern G. *ASERNIP-S audit of endoluminal repair of abdominal aortic aneurysms in Australia.* Annual Scientific Congress of the Royal Australasian College of Surgeons. Perth, WA Australia. May 2005.

2004

- **Fitridge R**, Boult M, Babidge W, Maddern G. *Endoluminal repair of abdominal aortic aneurysms – contemporary Australian experience.* Annual Scientific Congress of the Royal Australasian College of Surgeons. Melbourne, VIC Australia. May 2004.

- **Fitridge R**, Boult M, Babidge W, Maddern G. *Endoluminal repair of abdominal aortic aneurysms – Australian audit.* ISCVS World Congress, Hawaii USA. April 2004.

2003

- **Fitridge R**, Boult M, Babidge W, Maddern G (for the ASERNIP-S Reference Group for endoluminal graft repair). *The Australian Audit of the Safety and Efficacy of Endoluminal Grafts for the Repair of Abdominal Aortic Aneurysms.* Annual Scientific Congress of the Royal Australasian College of Surgeons. Brisbane, QLD Australia. May 2003.

2002

- **Harris J.** *Australian audit of endoluminal and open repair of abdominal aortic aneurysms.* 15th Annual International Congress for Endovascular Interventions. Phoenix, Arizona USA. February 2002.
- **Fitridge R**. *ASERNIP-S follow-up data.* Annual Scientific Congress of the Royal Australasian College of Surgeons. Adelaide, SA Australia. May 2002.
- Boult M, **Babidge W**, Coburn D, Maddern G. *Data collection on a new technology to inform funding decision making by the Australian Government*. (Poster). 18th Annual Meeting for the International Society of Technology Assessment in Health Care (ISTAHC). Berlin, Germany, June 9-12, 2002.
- **Boult M**, Babidge W, Maddern G. *The role of audit in improving health outcomes*. Australasian Health Research Data Managers Association, Brisbane, Australia, 21-22nd August 2002.**M Denton,** R Fitridge, M Boult, W Babidge & G Maddern (for the Endoluminal Reference Group). *Highlights from the ASERNIP-S Registry; What are the important findings for clinical practice?* International Endovascular Symposium. Sydney, NSW Australia, December 5-7, 2002.

2001

- **Maddern G and Fitridge R.** Annual Scientific Congress of the Royal Australasian College of Surgeons. Canberra, ACT Australia. May 2001.
- **Boult M**, *Ethics and the Law - Some Issues involved in Data Collection*, Australasian Health Research Data Managers Association, Melbourne, VIC Australia, 13-14th September 2001.

Publications

2006

- Golledge J, Parr A, Boult M, Maddern G, Fitridge R. The outcome of endovascular repair of small abdominal aortic aneurysms. *Annals of Surgery.* 2007; 245(2): 326-333.

- Boult M, Babidge W, Maddern G, Barnes M, Fitridge R. Predictors of success following endovascular aneurysm repair: mid-term results *European Journal of Vascular and Endovascular Surgery* 2006; 31(2):123-129.

2004

- Boult M, Babidge W, Maddern G, Fitridge R, on behalf of the Reference Group. Endoluminal repair of abdominal aortic aneurysm – contemporary Australian experience. *European Journal of Vascular and Endovascular Surgery.* 2004; 28(1): 36-40.

2002

- Boult M, Babidge W, Anderson J, Denton M, Fitridge R, Harris J, Lawrence-Brown M, May J, Myers K, Maddern G. Australian audit for the endoluminal repair of abdominal aortic aneurysm - the first 12-months. *Australian and New Zealand Journal of Surgery.* 2002; 72(3):190-195.
- Boult M, Babidge W, Roder D, Maddern G. Issues of consent and privacy affecting the functioning of ASERNIP-S. *Australian and New Zealand Journal of Surgery.* 2002; 72(8):580-582.

2001

- Fitridge R. Evaluation of aortic stent grafting – the Australian experience. In: Whittemore A (Ed). *Advances in Vascular Surgery.* 2001;9:55–65.

Results of Zenith Graft Patients

This section summarises the patient demographics, procedures and follow-up results of patients whose AAA was treated with a Zenith graft. All data used for calculating the results in this section were received prior to 16 August 2008.

Pre-operative patient demographics

Of the 787 Zenith graft patients enrolled in the audit the majority were male (85.1%, 670/787). The average age for Zenith graft patients was 75 years (SD± 6.9, ranging from 35-92 years, mode= 77 years). Patient fitness was measured using the American Society of Anaesthesiology (ASA) Rating. Table 1 below shows 32.6% (257/787) of Zenith patients were listed as healthy or only had mild systemic conditions (i.e. ASA I or II). The majority of patients were rated ASA III (59%, 464/787), i.e. as having severe systemic condition limiting lifestyle, e.g. angina.

Almost half of Zenith graft patients (44.7%, 352/787) were considered unsuitable for open repair. For these patients the main reason for unsuitability was co-existent morbidity (76.2%, 269/352), other reasons that affected suitability were 'hostile abdomen' (21.3%) and 'unfit for general anaesthetic' (21.8%). Some patients were unsuitable for open repair for more than one reason.

Table 1. Pre-operative ASA in patients treated with Zenith graft*

	ASA I	ASA II	ASA III	ASA IV
% Zenith Patients	2.5%	30.1%	59.0%	6.6%

* For patients where this was recorded adequately

Table 2 shows the survival and lost status of the EVAR audit cohort and the original enrolment. The 787 Zenith patients represent 82% of the original cohort captured by the audit (n=961). At seven years follow-up, about half of the Zenith patients are now deceased.

Table 2. Enrolments, follow-up and mortality

Data		Total	Percentage
Operative data set		787	100%
	Public	215	27.3%
	Private	572	72.7%
Patients lost to follow-up[1]		89	11.3%
Deceased		391	49.6%
	Early*	12	1.5%
	Late	379	48.1%

[1] Patients lost due to age, frailty, refusal or following retirement or relocation of surgeon

* Early death occurs within 30 days of the procedure, and is sometimes referred to as perioperative death. Late death implies death occurring more than 30 days post procedure.

30-day technical success

Technical success rates were calculated according to reporting standards established by the Ad Hoc Committee for standardized reporting practices in vascular surgery.[2] The definition of primary technical success within the first 30 days after the operation includes:

- Successful access to the arterial system using a remote site
- Successful deployment of the endovascular graft with secure proximal and distal fixation
- Absence of the following: death, conversion to open repair, Type I or III endoleaks, or graft limb obstruction
- Use of the following: additional planned components, stents, angioplasty or adjunctive surgical procedures constitutes success*.

* The Australian audit data does not distinguish between planned and unplanned procedures undertaken during the peri-procedural (24h) period.

Technical success for Zenith graft patients enrolled in the audit was 93.4% (735/787)

Mortality

Perioperative mortality

ASERNIP-S has received notification that half of the original cohort of patients has died (Table 2). ASERNIP-S has regularly linked the EVAR Audit database with the National Death Index data held by the AIHW. This information was last updated in July 2008. Table 3 shows the causes of death for the 12 patients who died within 30 days of their EVAR procedure, as shown by ICD-10 codes obtained from the National Death Index, and the number of days to death.

Table 3. Cause of early mortality and days to death

Cause of early death	ICD-10 code	Days to death
Retroperitoneal haemorrhage and Myocardial Infarction	I21.9	0
Cardiac and acidosis and AAA w/o rupture	I71.4	1
Acute Myocardial Infarction	I21.9	2
Acute Myocardial Infarction	I21.9	3
Chronic IHD and renal failure	I25.9	3
Right cerebro-vascular infarct and renal failure	N19	7
Pulmonary embolism and AAA w/o rupture	I71.4	7
Acute bowel rupture and AAA w/o rupture	I71.4	10
Cerebral haemorrhage	I61.9	14
Brain stem haemorrhage	I61.3	18
Acute Myocardial Infarction	I21.9	21
Ischaemic gut	K559	21

Of the 12 patients who died early, all were male and nine were described as ASA III or ASA IV. Patients who died early were aged 71-85 years and most were considered unsuitable for open repair. All except one patient had a pre-operative aneurysm diameter of more than 50mm.

Mid-term and long-term mortality

Table 4 shows mortality in the mid-term and long-term intervals following the 30 day postoperative period.

Table 4. Cumulative mid to long term mortality

	Up to 3yrs*	Up to 5yrs	Up to 7yrs	>7yrs
Total (N=787)	145 (18%)	250 (32%)	347 (44%)	379 (48%)
Age at EVAR				
<60 (N=17)	2 (12%)	4 (24%)	4 (24%)	4 (24%)
61-70 (N=143)	12 (8%)	29 (20%)	38 (27%)	42 (29%)
>70 (N=622)	131 (21%)	217 (35%)	305 (49%)	333 (54%)
Gender				
Male (N=670)	121 (18%)	215 (32%)	299 (45%)	324 (48%)
Female (N=117)	24 (20%)	35 (30%)	48 (41%)	55 (47%)
Aneurysm size at EVAR				
≤50mm (N=199)	23 (12%)	38 (19%)	64 (32%)	70 (35%)
>50mm (N=559)	119 (21%)	203 (36%)	269 (48%)	293 (52%)
ASA				
I (N=20)	0 (0%)	2 (10%)	5 (25%)	5 (25%)
II (N=237)	26 (11%)	45 (19%)	67 (28%)	75 (32%)
III (N= 464)	102 (22%)	169 (36%)	234 (50%)	255 (55%)
IV(N=52)	16 (31%)	29 (56%)	33 (63%)	35 (67%)

* From 30 days to 3 years

Table 5 shows the all cause mortality for the mid-term and long-term intervals following the 30 day postoperative period. Cardiac problems were the most common cause of death amongst the cohort, with cancer the second most common cause of death in the mid to long term.

Table 5. Cause of mid to long term mortality in Zenith patients[1]

	Up to 3yrs*	**Up to 5yrs**	**Up to 7yrs**	**>7yrs (Total %)**
Unknown/Not Yet Known	1	3	37	66 (17.4%)
Cardiac	42	75	88	90 (23.7%)
Cancer	30	52	65	66 (17.4%)
Respiratory	14	31	43	43 (11.3%)
Stroke	14	21	26	26 (6.9%)
Rupture/Dissection[2]	6	10	12	12 (3%)
Aneurysm without rupture	7	9	11	11 (2.9%)
Hepatic/Biliary/Renal	8	13	16	16 (4.2%)
Diabetes	3	6	9	9 (2.3%)
Digestive/Gastric	2	5	7	7 (1.8%)
Miscellaneous	13	16	29	30 (7.9%)

* From 30 days to 3 years.[1] for cases with both date and cause of death data. See Appendix 2 for definitions of cause of death categories. [2]Includes I71.00 Dissection of aorta unspecified site, not included in aneurysm-related death below.

Aneurysm-related mortality and rupture

For the purposes of these results, aneurysm-related death refers to death that occurs within 30 days of the original EVAR procedure (i.e. all early death), death within 30 days of a secondary procedure for the patient's aneurysm and death assigned the following ICD-10 codes for cause of death.

- I71.00 Dissection of aorta unspecified site
- I71.2 Thoracic aortic aneurysm without rupture
- I71.3 Abdominal aortic aneurysm ruptured
- I71.4 Abdominal aortic aneurysm without rupture
- I71.8 Aortic aneurysm unspecified site ruptured
- I71.9 Aortic aneurysm unspecified site without rupture
- I72.3 Aneurysm of iliac artery

Currently, around seven years after EVAR, the total aneurysm-related death for Zenith graft patients enrolled in the audit is 4.4% (35/787), of these, 10 deaths were due to ruptured aneurysms (1.5%). The total of aneurysm-related deaths after the initial 30-day postoperative period is 2.9% (23/787).

Rupture

To date 16 Zenith graft patients have experienced a rupture of their aneurysm (2%). As mentioned above, ten of these patients died as a result of the rupture. The results of patients experiencing rupture can be seen in Table 6.

Table 6. Zenith Graft Patient Experiencing Aneurysm Rupture

Age at EVAR (years)	Max diameter before rupture* (mm)	Time to rupture (months)	Result of rupture	Current status	Other cause of death
65	60	30	Deceased		
78	60	60	Deceased		
79	60	30	Deceased		
72	48	71	Deceased		
67	68	59	Deceased		
76	45	12	Deceased		
73	75	58	Deceased		
81	81	69	Deceased		
82	60	22	Deceased		
85	53	43	Deceased		
78	110	<1	Converted to open early	Alive	
78	70	<1	Converted to open early	Deceased at 5 years	COPD
75	106	21	Converted to open late	Deceased at 6 years	Pneumonitis
66	52	87	Converted to open late	Alive	
64	77	55	Converted to open late	Alive	
77	42	11	Occlusion of right limb	Deceased at 4 years	Cancer

*As recorded at last follow-up before rupture or if early rupture as recorded at EVAR

Endoleaks and other complications

White and colleagues define an endoleak as "the persistence of blood flow outside of the lumen of the endoluminal graft but within the aneurysm sac", as detected by an imaging study[3]. The various types of endoleak measured in the audit were identified by White and colleagues[3] and classified by Chaikof and colleagues[2] for reporting purposes as:

Type I

- An inadequate seal at the proximal or distal ends of the graft or an inadequate seal around an iliac occluder plug

Type II

- Retrograde flow from the lumbar arteries, inferior mesenteric artery or other collateral vessel

Type III

- Flow caused by fabric tears or disruption, component disconnection or graft disintegration

Type IV

- Flow through porous fabric (observed <30 days after the graft is placed)

During the perioperative period 21 Zenith graft patients (2.7%) were recorded with Type I endoleaks, three patients (0.4%) with both Type I and II endoleaks, 60 patients (7.6%) with Type II endoleaks only, and one with both Type II and Type IV endoleaks. Table 7 indicates the prognosis of those patients recorded with Type I endoleaks.

Table 7. Endoleaks recorded < 30 days (n=21)

		Comments
Normal at first follow-up	10 (47.6%)	1 patient had a Type I endoleak at 2nd follow-up
Type II endoleaks at first follow-up	6 (28.6%)	
Converted to open	1 (4.8%)	following rupture at 6 days
Unknown	1 (4.2%)	

Of the three patients who had Type I **and** Type II endoleaks recorded in the perioperative period, one was clear until two years when the Type II leak was observed again, and two reported continuing Type II endoleaks (but not Type I) throughout all follow-ups.

Table 8 shows the number of endoleaks and other complications reported in the mid to long-term follow-up. The table shows the number of visits where a complication was recorded, and in brackets the number of patients affected. The number of visits higher than the number of patients shows there were some patients who experienced the complication during more than one follow up visit.

Table 8. Mid to long term follow-up visits where endoleak and other complications were reported

Complication	Up to 3yrs[1] N= 1818* visits	Up to 5yrs N=2448 visits*	Up to 7yrs N= 2852 visits*	>7yrs N= 3404 visits*
Type I	31 (26)	43 (31)	49 (33)	51 (34)
Type II	172 (94)	219 (104)	245 (111)	254 (114)
Type III	0	2 (2)	5 (5)	7 (6)
Type IV	0	1 (1)	1 (1)	1 (1)
Kinking	11 (9)	13 (10)	13 (10)	13 (10)
Stenosis	13 (11)	15 (13)	16 (14)	16 (14)
Migration	9 (8)	15 (14)	17 (15)	18 (16)
Thrombosis	15 (11)	15 (11)	16 (12)	20 (14)
Graft Infection	1 (1)	1 (1)	3 (3)	3 (3)

*number of patients shown in brackets

[1] 30 days to 3 years

Additional Procedures and Conversion to Open Repair

Twenty eight (3.6%) Zenith graft patients have had their EVAR converted to open repair. Of these, 7 were converted to open early (<30 days postoperative) (Table 9) and 21 were late conversions (Table 10).

Table 9. Zenith graft patients converted to open repair early (<30 days)

Age at EVAR	Max diameter in mm before conversion	Cause for conversion	Current status
75	unknown	Type I leak during operation	Deceased at 4 months, sepsis
79	59	R limb occluded following congestive cardiac failure, 9 days post EVAR	Deceased at 29 months, cancer
78	110	Endoleak during operation	Lost to follow up
78	70	Rupture, 5 days post EVAR	Deceased at 5 years, COPD
74	58	Migration causing occluded limb	Deceased at 6 years
81	63	Conversion during procedure	Deceased at 5 years, renal failure

78	45	Occluded limb and ischaemic leg, 8 days post EVAR	Has had additional EVAR, alive

Among the 21 patients who had late conversion to open repair the time between EVAR and conversion to open ranged from 1 month to 86 months (mean time to late conversion to open repair is 34 months [±21.9]). Reasons for late conversion to open repair can be seen in Table 9.

Table 10: Main Cause of late (>30 days postoperative) conversion to open repair

Cause	**Patients**
Occluded limb	3
Type II endoleak	6
Enlarged aneurysm	3
Type I endoleak	2
Rupture	3
Thrombosis	2
Graft infection	2

At the time of the procedure 24.1% of patients had an additional endovascular procedure (n=190), and 3.6% of patients had an additional surgical procedure (n=28). Seventeen patients required a secondary intervention during the procedure (2.2%).

During the follow-up period from 30 days postoperative up to 16 August 2008, 89 Zenith patients (12.1%) enrolled in the audit have had 125 additional procedures for their aneurysm including open, endovascular or other procedures (see follow-up form).

Most patients requiring an additional procedure during mid to long term follow-up received endovascular procedures, with a total of 74 patients (9.4% of patients) receiving 92 additional EVAR interventions (73.6% of interventions after 30 days post EVAR). Twenty one patients received open repair as noted above, and 11 patients received an intervention described as other; other procedures included thrombin injection, embolectomy, extension of graft, CT-guided sacogram and angiogram.

During the same period 29 patients required two or more additional procedures (3.7%). Of these, there were 7 patients (0.9%) who had an additional EVAR procedure but later also required an open procedure. Table 11 shows the number of open and endovascular interventions reported at different follow-up intervals. Most patients requiring an additional procedure during follow-up had endovascular procedures.

Table 11. Time to additional open and endovascular procedures in mid to long term

	Open		*Endovascular*	
	Procedures	Patients	Procedures	Patients
Up to 3 years[1]	11	11 (1.4%)*	59	50 (6.5%)*
Up to 5 years	18	18 (2.8%)*	73	60 (9.3%)*
Up to 7 years	20	19 (3.5%)*	92	73 (13.6%)*
>7 years	21	20 (4.5%)*	92	74 (16.8)*
Total	21	20 (4.5%)*	92	74 (16.8)*

* Proportion of patients alive entering this time period; N=775 at 1 month, N=642 at 3 years, N=537 at 5 years, N=440 at 7 years.

[1]. 130 days to 3 years

Discussion

The audit of endoluminal (endovascular) repair of abdominal aortic aneurysms was initiated in 1999 to assess the mid-long term effectiveness of EVAR in the Australian setting. ASERNIP-S was commissioned by the Australian Government to manage the audit until 2006, when Cook Australia funded an additional two years of follow-up data collection. The audit followed a cohort of 961 patients treated with EVAR using various brands of graft between 1 November 1999 and 16 May 2001. This report represents a subset of the cohort treated with Zenith grafts distributed by Cook Australia. Overall, 82% of all cases in the audit were treated with Zenith grafts suggesting that Zenith was the most widely used graft at the time, considering that previous data has shown the audit represents 90% of all privately performed EVAR procedures at the time.

The immediate results of this group of 787 Zenith patients showed this procedure to be safe and efficacious in the short-term, with a 30 day technical success rate of 93.4% and early death (within 30 days) 1.5%. About half of the cohort has survived to 7-8 years of long-term follow-up, if not longer. It can be expected that the remaining proportion is not higher as patients who undergo EVAR are generally elderly patients with some degree of co-morbidities. A similar survival rate was found by van Herwaaden *et al* in 2007 after 9 years follow up[4]; AAAs are often only discovered upon investigation of another health concern. Mid to long term mortality rates were higher at each follow-up interval among patients with large aneurysms, greater co-morbidities and patients over 70 years of age at the time of their initial EVAR.

The vast majority of patients treated with EVAR had a successful recovery for the term of their follow-up. Some patients experienced complications and further interventions, highlighting the importance of vigilant monitoring. The most influential complication noted in this audit was Type II endoleak. Eight percent of patients experienced Type II endoleak within the 30 day postoperative period and this increased to 12% of patients in the period from 30 days to 3 years post EVAR. There continued to be new patients experiencing not only Type II but also Type I endoleak (and other complications, but to lesser extent) throughout the follow up period, although after 3 years the increase slowed to less than 1% per 2 year interval. Only 6 patients in total experienced Type III endoleak, as may be logically expected Type III endoleak occurred late in the follow up, after 5 years post EVAR. Perhaps this represents degradation of the graft that could occur over time; however this shows that degradation of grafts resulted in problems for only a very small percentage of patients. The presence of the late onset endoleaks and other complications, while a small percentage, were noted with all types of complications collected by this audit and add weight to the argument for ongoing surveillance.

While other researchers agree on the importance of long-term follow-up of EVAR patients[5,7] there may be considerable barriers to comprehensive follow-up of the success of EVAR. The main barriers being advancing age, frailty and co-morbidities. Elderly patients may be less inclined to comply with follow-up, (and physicians less inclined to urge them) may become too frail to do so or may become lost to follow-up as they move into aged care. A sick patient's AAA may become a low priority compared to other health concerns experienced by people of that age or undergoing EVAR due to unsuitability for open repair.

While likelihood of rupture remains low after EVAR, the audit shows that the risk of rupture can still be present after a long follow-up, as late as 87 months post EVAR for one audit patient. Rupture resulted in death for 1.3% of patients. The Australian ASERNIP-S EVAR audit had a similar rate of rupture of 2% (resulting in death or not) to other long-term studies of EVAR (Massachusetts General Hospital 1.5%[5], EUROSTAR at 6 years 2.2%[8]). Overall, aneurysm-related death was also comparable: ASERNIP-S 4.4%, Massachusetts General Hospital 3.9%[5].

The EVAR audit had a slightly higher overall rate of reintervention (12%) over 7-8 years follow-up than Massachusetts General Hospital found over 12 years (10%)[5], however significantly lower rates than a small sample single institution study in Finland (81%)[6]. Around an eighth of EVAR patients required an additional procedure, although the majority of these were additional EVAR procedures (a relatively small percentage of patients require more than one additional procedure). The likelihood of needing another procedure increases by around 3% every two years following the 30 day postoperative period. Less than one percent of patients had attempted repairs of their problematic EVARs with a second EVAR only to have it fail and require open repair. Brewster *et al* explained in 2006, there were no late conversions to open in the last four years of follow up in their study due to newer low profile devices and more stringent patient selection[5]. This may explain some of the variance between the Massachusetts General Hospital figures and the ASERNIP-S EVAR audit as those patients were all treated between 1999 and 2001 when the procedure was very new to this country and important patient factors may not have been as well defined.

Based on the results of the EVAR audit at 5 years follow up, a predictive model was prepared[9], which may better inform patient selection in Australia. The model is available as an interactive workbook available on the College website http://www.surgeons.org/Content/NavigationMenu/Research/ASERNIPS/ASERNIPSAudits/Audits.htm . Surgeons can enter pre-operative patient and aneurysm factors and calculate the likelihood of success of performing EVAR, based on data of the audit patients.

Conclusions

Notwithstanding the inconvenience of the requirement of continuous monitoring for longer than 7 years, EVAR provides patients and physicians with a possibility of AAA repair that is less invasive, provides fewer risks, faster recovery an option for patients unsuitable for open repair[10]. Appropriate patients selected for EVAR can largely expect an uneventful and successful follow-up period. A proportion of EVAR patients can expect to undergo an additional procedure for their aneurysm, although this is likely to be a secondary endovascular procedure so they can continue to avoid major surgery. Further consideration of issues around EVAR may include weighing up the potential risks of regular imaging against the benefits of EVAR and how significant this risk may be given the age and co-morbid characteristics of EVAR recipients[11].

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Appendices

Appendix 1: Audit of Endoluminal Repair of Abdominal Aortic Aneurysms- Data Entry Paper Forms

ASERNIP-S

ENDOLUMINAL
Abdominal Aortic Aneurysm Repair
Operative Data Set

PO Box 553
Stepney
South Australia 5069
Telephone: (08) 8363 7513
Facsimile: (08) 8362 2077
Email: mboult.asernip@surgeons.org
Form updated 3 May 04

Baseline details

Identifying data or place a name label

1 Patient's name

Family name

Given name

2 Address

City/Town

State Postcode

3 Telephone numbers

Home

Work

4 Date of birth

Day Month Year

5 Gender

Male ☐ Female ☐

6 Hospital

7 Medical record number

8 Patient Type

Private ☐ Public ☐

9 Admission date

Day Month Year

Question 10: no longer required

11 Smoking status (tick one)

Current ☐ Ever ☐ Never ☐

12 Creatinine

μmol/L

Baseline details (continued)

13 Physical condition: ASA (tick one)

ASA I ☐
Normal healthy patient with localized condition requiring surgery

ASA II ☐
Patient with mild or well controlled systemic condition, e.g. mild hypertension

ASA III ☐
Patient with severe systemic condition limiting lifestyle, e.g. angina

ASA IV ☐
Patient with severe systemic condition threatening life, e.g. advanced cancer

ASA V ☐
Moribund patient not expected to survive 24 hours with or without operation

14 Has the patient ever been diagnosed with, or experienced, any of the following:

	Yes	No
Hypertension	☐	☐
Angina	☐	☐
Myocardial infarction	☐	☐
Heart failure (CCF)	☐	☐
Arrhythmia	☐	☐
Stroke	☐	☐
Transient ischaemic attack	☐	☐
Peripheral vascular disease	☐	☐
Diabetes	☐	☐
Cancer (non-skin)	☐	☐
Asthma	☐	☐
COAD	☐	☐
Renal failure	☐	☐
If **yes**, requiring dialysis?	☐	☐
Hepatic disease	☐	☐
Haematologic disease	☐	☐
Specify		
Previous abdominal surgery	☐	☐
Other	☐	☐
Specify		

Aneurysm morphology

15 Imaging technique (tick all that apply)

- Spiral CT ☐
- Other CT ☐
- Abdominal x-ray ☐
- MRI ☐
- Angiography ☐
- Ultrasound ☐
- Other ☐

Specify

16 Maximum aneurysm diameter

mm

17 Length of infrarenal neck

mm

18 Diameter of infrarenal neck

mm

19 External iliac artery diameter

mm

20 Is there thrombus in the neck?

Yes ☐ No ☐

21 Saccular aneurysm

Yes ☐ No ☐

22 Iliac aneurysm

Yes ☐ No ☐

23 Is there occlusive aorto-iliac disease?

Yes ☐ No ☐

24 Iliac tortuosity *(tick one)*

- None ☐
- Mild ☐
- Moderate ☐
- Severe ☐

25 Iliac calcification *(tick one)*

- None ☐
- Mild ☐
- Moderate ☐
- Severe ☐

26 Artery affected by aneurysm *(tick one)*

- Aorta ☐
- Aorto-iliac ☐
- Iliac ☐
- Other ☐

Specify

Aneurysm morphology (continued)

27 Length of common iliac artery

Left

mm

Right

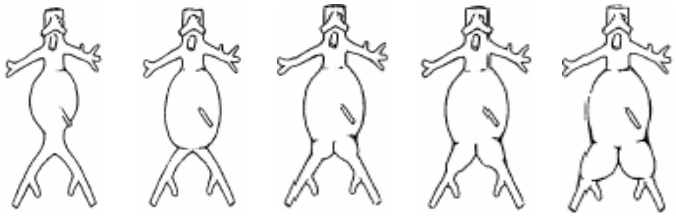
mm

28 Significant angulation *(sharpest angle in AP or side projection*

	Significant angulation? Yes	No	If YES, specify angle (°)
Aortic neck	☐	☐	
Aneurysm	☐	☐	
Right iliac	☐	☐	
Left iliac	☐	☐	

29 Classification AAA *(If iliac involvement is asymmetric: check two boxes A-E)*

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐



30 Patency of IMA

- Patent ☐
- Occluded ☐
- Unknown ☐

Comments

Suitability for treatment

31 Is the patient suitable for open surgical repair?

Yes ☐ No ☐

If No, specify reasons *(tick all that apply)*

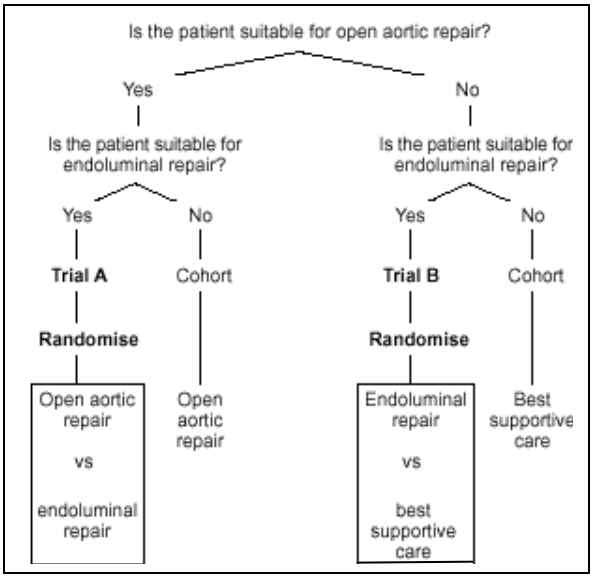
- Coexistent morbidities that preclude open surgical repair ☐
- Hostile abdomen ☐
- Unit for general anaesthesia ☐
- The risk of rupture does not exceed the risk of operating ☐
- Other ☐

Specify

Procedure Details

32 Could this patient theoretically be randomised?

Randomised trials comparing treatments for abdominal aortic aneurysm are being considered. One model is presented in the diagram below.



Yes, could be randomized **Trial A** ☐

Yes, could be randomized **Trial B** ☐

No, could not be randomised ☐

33 Surgeon

34 Date of procedure

Day | Month | Year

35 Site of procedure *(tick those that apply)*

Angiography suite ☐

Surgical theatre ☐

Endovascular suite ☐

36 Type of anaesthesia used *(tick one)*

Local ☐

Epidural/spinal ☐

General ☐

37 Main Access Vessel *(tick one)*

Femoral ☐

Iliac ☐

Other ☐

Specify

Procedure details (continued)

38 Contralateral Access Vessel *(tick one)*

None ☐

Femoral ☐

Iliac ☐

Other ☐

Specify

39 Access technique for body of graft (endoluminal)

Open ☐

Percutaneous ☐

Other ☐

Specify

40 Access technique for second limb (endoluminal)

Open ☐

Percutaneous ☐

Other ☐

Specify

41 Name of device (and manufacturer) *(tick one)*

Ancure (Guidant) ☐

AneuRx (Medtronic) ☐

Lifepath (Baxter) ☐

Talent (World Medical) ☐

Vanguard (Boston Scientific) ☐

Zenith (Cook) ☐

Excluder (W L Gore) ☐

Other ☐

Specify

42 Type of graft *(please attach graft label to page 4 Q.47)*

Aorto-aortic tube ☐

Aorto-bi-iliac-bifurcated ☐

Aorto-uni-iliac + crossover ☐

Other ☐

Specify

43 Duration of procedure

Hours : Minutes

44 Immediate outcome

Was the aneurysm successfully excluded?

Yes ☐ No ☐

Procedure details (continued)

45 Complications at the time of the procedure

(tick all that apply)

- Failed access ☐
- Access vessel complications ☐
- Failed deployment ☐
- Misplaced deployment ☐
- Imperfect seal ☐
- Twist/kink/obstruction ☐
- Embolisation ☐
- Death ☐
- Other ☐

Specify

Procedure details (continued)

46 Additional procedure/s *(tick those that apply)*

- No additional procedures ☐

or

- Conversion to open repair ☐
- Secondary intervention during the procedure (e.g. twist corrected) ☐
- Additional endovascular procedure ☐

Specify

- Additional surgical procedure ☐

Specify

Comments

47 Graft Label *(Attachment or Description)*

ASERNIP-S

ENDOLUMINAL
Abdominal Aortic Aneurysm Repair
Discharge/30-Day Follow-up

***BLOCK LETTERS TO BE USED FOR HAND WRITTEN FORMS**

PO Box 553
Stepney
South Australia 5069
Telephone: (08) 8363 7513
Facsimile : (08) 8362 2077
Email: mboult.asernip@surgeons.org

Last update 3 May 2004

Discharge Evaluation

Identifying data

Surgeon:

1 Patient's name

Family name

Given name

2 Medical record number

3 Patient status

Alive ☐ - Go to Q6

Deceased ☐

4 If deceased, date of death

Day Month Year

5 If deceased, cause of death

6 Creatinine

µmol/L

7 Discharge date

Day Month Year

8 Admitted to ICU

Yes ☐ No ☐

9 If admitted to ICU specify

a) Date and time admitted

Day Month Year Time (24 hour Clock)

a) Date and time discharged

Day Month Year Time (24 hour clock)

10 Transfused blood products within 48 hours of procedure

mls

Discharge Evaluation (continued)

11 Complications prior to discharge *(tick all that apply)*

a) Procedures and device related complications

Graft migration ☐
Graft thrombosis ☐
Endoleak – Type 1 ☐
Endoleak – Type 2 ☐
Endoleak – Type 3 (fabric tear / module separation) ☐
Endoleak – Type 4 (graft porosity) ☐

Details

b) Systemic complications (*tick box then specify details*)

Cardiac ☐
Cerebral ☐
Pulmonary ☐
Renal ☐
Hepatobiliary ☐
Bowel ☐
Sepsis ☐
Pyrexia ☐
Graft infection ☐
Other ☐

Details

c) Access site and lower limb complications

Bleeding, haematoma, false aneurysm ☐
Arterial thrombosis ☐
Peripheral emboli ☐
Limb loss ☐
Other ☐

Specify

Discharge Evaluation (continued)

12 Were there any interventions following the procedure

Yes ☐ No ☐

13 If Yes, specify details of procedure

a) Open procedure

Yes ☐ No ☐

If **yes**, give date and details — Day | Month | Year

Details

b) Endovascular procedure

Yes ☐ No ☐

If **yes**, give date and details — Day | Month | Year

Details

c) Other procedure

Yes ☐ No ☐

If **yes**, give date and details — Day | Month | Year

Details

Aneurysm Evaluation

14 Imaging technique *(tick all that apply)*

- Spiral CT ☐
- Other CT ☐
- MRI ☐
- Angiography ☐
- Ultrasound ☐
- Abdominal x-ray ☐
- Other ☐

Specify

15 Result of Imaging *(tick all that apply)*

- Normal findings ☐
- Endoleak – Type 1 ☐
- Endoleak – Type 2 ☐
- Endoleak – Type 3 (fabric tear / module separation) ☐
- Endoleak – Type 4 (graft porosity) ☐
- Kinking ☐
- Stenosis ☐
- Migration ☐
- Thrombosis ☐
- Graft infection ☐
- Other ☐

Specify

16 Position of stent

- Same ☐
- Migrated ☐
- Broken wires ☐

17 Maximum aneurysm diameter

mm

ASERNIP-S

ENDOLUMINAL
Abdominal Aortic Aneurysm Repair
Follow-up

*BLOCK LETTERS TO BE USED FOR HAND WRITTEN FORMS

PO Box 553
Stepney
South Australia 5069
Telephone: (08) 8363 7513
Facsimile : (08) 8362 2077
Email: mboult.asernip@surgeons.org

Form updated 8 March 2005

Identifying details

1 Patient's name

Family name

Given name

2 Medical record number

3 Date of procedure

Day Month Year

4 Surgeon

5 Current follow-up

<12 months ☐ 50-60 months ☐
12-20 months ☐ 60-70 months ☐
20-30 months ☐ 70-80 months ☐
30-40 months ☐ >80 months ☐
40-50 months ☐

Patient details

6 Patient status

Alive ☐ - Go to Q8

Deceased ☐

7 If deceased,

a) Date of death

Day Month Year

b) Cause of death

8 If alive, date of examination

Day Month Year

9 Readmission to hospital

Day Month Year

Patient details (continued)

10 Cause for readmission

11 Creatinine

µmol/L

Aneurysm Evaluation

12 Imaging technique *(tick all that apply)*

Spiral CT ☐
Other CT ☐
MRI ☐
Angiography ☐
Ultrasound ☐
Abdominal x-ray ☐
Other ☐

Specify

13 Result of Imaging *(tick all that apply)*

Normal findings ☐
Endoleak – Type 1 ☐
Endoleak – Type 2 ☐
Endoleak – Type 3 (fabric tear / module separation) ☐
Endoleak – Type 4 (graft porosity) ☐
Kinking ☐
Stenosis ☐
Migration ☐
Thrombosis ☐
Graft infection ☐
Other ☐

Specify

14 Position of endoluminal graft

Same ☐
Migrated ☐
Broken wires ☐

15 Maximum aneurysm diameter

mm

Interventions

16 Have there been any interventions for the aneurysm since the last follow-up?

Yes ☐ No ☐

17 If Yes, specify details

a) Open procedure

Yes ☐ No ☐

If **yes**, give date and details Day Month Year

Details

b) Endovascular procedure

Yes ☐ No ☐

If **yes**, give date and details Day Month Year

Details

c) Other procedure

Yes ☐ No ☐

If **yes**, give date and details Day Month Year

Details

Interventions (continued)

18 Comments

Appendix 2: ICD-10 codes used to categorise cause of death for mid-long term mortality.

Cardiac	
I21.9	ACUTE MYOCARDIAL INFARCTION UNSPECIFIED
I24.8	OTHER FORMS OF ACUTE IHD
I25.0	ATHEROSCLEROTIC C-V DISEASE SO DESCRIBED
I25.10	ATHEROSCLEROTIC HEART DIS UNSPEC VESSEL
I25.5	ISCHAEMIC CARDIOMYOPATHY
I25.8	OTHER FORMS OF CHRONIC IHD
I25.9	CHRONIC IHD UNSPECIFIED
I27.0	PRIMARY PULMONARY HYPERTENSION
I33.0	ACUTE & SUBACUTE INFECTIVE ENDOCARDITIS
I50.0	CONGESTIVE HEART FAILURE
I50.9	HEART FAILURE UNSPECIFIED
I059	Rheumatic aortic valve diseases, mitral valve unsp
I132	Pericarditis in diseases classified elsewhere
I340	Non rheumatic mitral valve disorders
I48	Atrial fibrillation and flutter
I420	Dilated cardiomyopathy
I312	Haemopericardium, not elsewhere classified
I516	Cardiovascular disease unspecified
I38	Endocarditis, valve unspecified
Cancer	
C16.0	MALIGNANT NEOPLASM OF CARDIA
C16.9	MALIGNANT NEOPLASM STOMACH UNSPECIFIED
C18.0	MALIGNANT NEOPLASM OF CAECUM
C18.5	MALIGNANT NEOPLASM OF SPLENIC FLEXURE
C18.9	MALGT NEOPLASM COLON UNSPECIFIED PART
C19	MALIGNANT NEOPLASM RECTOSIGMOID JUNCTION
C22.1	INTRAHEPATIC BILE DUCT CARCINOMA
C25.9	MALIGNANT NEOPLASM PANCREAS PART UNSPEC
C34.9	MALIGNANT NEOPLASM BRONCHUS OR LUNG NOS
C43.9	MALIGNANT MELANOMA OF SKIN UNSPECIFIED
C50.9	MALIGNANT NEOPLASM BREAST PART UNSPEC
C53.9	MALIGNANT NEOPLASM CERVIX UTERI NOS
C61	MALIGNANT NEOPLASM OF PROSTATE
C67.9	MALIGNANT NEOPLASM OF BLADDER NOS
C71.9	MALIGNANT NEOPLASM OF BRAIN UNSPECIFIED
C80	MALIGNANT NEOPLASM WO SITE SPECIFICATION
C85.1	B-CELL LYMPHOMA UNSPECIFIED
C90.00	MULTIPLE MYELOMA WITHOUT REMISSION
D43.2	NEOPLASM UNCRT/UNK BEH BRAIN NOS
D47.2	MONOCLONAL GAMMOPATHY
C119	Malignant neoplasm of nasopharynx
C321	Malignant neoplasm of larynx - supraglottis
C449	Other malignant neoplasm of skin, unspecified
C64	Malignant neoplasm of kidney, except renal pelvis
C269	Malignant neoplasm of other and ill-defined digestive organs -Ill defined sites within digestive system
C20	Malignant neoplasm of rectum
C459	Mesothelioma, unspecified
C329	Malignant neoplasm of larynx, unspecified

C260	Malignant neoplasm of other and ill-defined digestive organs – intestinal tract, part unspecified Malignant neoplasm of other and ill-defined digestive organs – intestinal tract, part unspecified
C48.2	malignant neoplasm: peritoneum unspecified
C92.0	Acute myeloid leukaemia
C76.0	Malignant neoplasm of head/face/neck
C22.0	Liver cell carcinoma
C97	Malignant neoplasms of independent (primary) multiple sites
C15.9	Malignant neoplasm of oesophagus, unspecified
Respiratory	
J15.2	PNEUMONIA DUE TO STAPHYLOCOCCUS
J18.9	PNEUMONIA UNSPECIFIED
J43.9	EMPHYSEMA UNSPECIFIED
J44.9	COPD UNSPECIFIED
J84.1	OTH INTERSTITIAL PULM DIS W FIBROSIS
J110	Influenza virus not identified; with pneumonia
J448	Other COPD
J449	Other COPD unspecified
J984	Other respiratory disorders, of lung
J690	Pneumonitis due to food and vomit
W79.5	Inhalation & ingestion of food causing obstruction of respiratory tract
G47.3	Sleep Apnoea
J18.1	Lobar pneumonia, unspecified
Stroke	
I60.9	SUBARACHNOID HAEMORRHAGE UNSPECIFIED
I61.3	INTRACEREBRAL HAEMORRHAGE IN BRAIN STEM
I61.9	INTRACEREBRAL HAEMORRHAGE UNSPECIFIED
I62.0	SUBDURAL HAEM (ACUTE)(NONTRAUMATIC)
I64	STROKE NOT SPEC HAEMORRHAGE OR INFARCT
I69.4	SEQUELAE OF STROKE NOT HAEM OR INFARCT
I698	Sequelae of other and unspecified cerebrovascular diseases
I693	Sequelae of cerebral infarction
I614	Intracerebral haemorrhage in cerebellum
J441	Chronic obstructive pulmonary disease with acute exacerbation, unspecified
I639	Cerebral infarction, unspecified
Aneurysm Rupture/Dissection	
I71.00	DISSECTION OF AORTA UNSPECIFIED SITE
I71.3	ABDOMINAL AORTIC ANEURYSM RUPTURED
I71.8	AORTIC ANEURYSM UNSPEC SITE RUPTURED
Aneurysm without rupture	
I71.2	THORACIC AORTIC ANEURYSM WO RUPTURE
I71.4	ABDO AORTIC ANEURYSM WO RUPTURE
I71.9	AORTIC ANEURYSM UNSPEC SITE WO RUPTURE
I72.3	ANEURYSM OF ILIAC ARTERY
Hepatic/Biliary/Renal	
K73.2	CHRONIC ACTIVE HEPATITIS NEC

K76.7	HEPATORENAL SYNDROME
K76.9	LIVER DISEASE UNSPECIFIED
K80.00	CALCULUS GALLB W AC CHOLECYSTITIS WO OBS
N03.9	CHRONIC NEPHRITIC SYNDROME UNSPECIFIED
N18.90	UNSPECIFIED CHRONIC RENAL FAILURE
N19	UNSPECIFIED RENAL FAILURE
K746	Fibrosis and cirrhosis of liver
K805	Calculus of bile duct without cholangitis or cholecystitis
N179	Acute renal failure, unspecified
K85.9	Acute pancreatitis, unspecified
Miscellaneous	
A41.2	Septicaemia due to staphylococcus nos
A41.9	SEPSIS
D46.4	REFRACTORY ANAEMIA UNSPECIFIED
I70.0	ATHEROSCLEROSIS OF AORTA
I70.1	ATHEROSCLEROSIS OF RENAL ARTERY
I73.9	PERIPHERAL VASCULAR DISEASE UNSPECIFIED
K66.1	HAEMOPERITONEUM
X59	EXPOSURE TO UNSPECIFIED FACTOR
A490	Staphylococcus inf, unspecified
F03	Unspecified dementia
G950	Other diseases of spinal cord
M464	Discitis unspecified
X599	Accidental exposure to other and unspecified cause
I99	Other and unspecified disorders of circulatory system
G20	Parkinson’s disease
L89	Decubitus (pressure) ulcer
D47.1	Chronic myeloproliferative disease
B029	Zoster w/o complication
E78.0	Pure Hypercholesterolaemia
G30.9	Alzheimer's disease, unspecified
W19.0	Unspecified fall in the home
Diabetes	
E14.9	UNSPEC DM WITHOUT COMPLICATION
E145	Unspecified diabetes mellitus (with circ.comp)
E147	Unspecified diabetes mellitus with multiple complications
E11.9	Non-insulin dependent diabetes mellitus w/o complication
E10.9	Insulin dependent diabetes mellitus w/o complication
Gastric/Digestive	
K274	Peptic ulcer, site unspecified, haemorrhage
K559	Vascular disorder of intestine unspecified
K922	Gastrointestinal haemorrhage, unspecified
K573	Diverticular disease of large intestine without perforation or abscess
K274	Peptic ulcer, site unspecified, haemorrhage