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VASCULAR SOCIETY
OF GREAT BRITAIN AND IRELAND

HQIP
Healthcare Quality Improvement Partnership

NATIONAL VASCULAR REGISTRY

2014 Progress report

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RCS ADVANCING SURGICAL STANDARDS	**The Royal College of Surgeons of England** is an independent professional body committed to enabling surgeons to achieve and maintain the highest standards of surgical practice and patient care. As part of this it supports Audit and the evaluation of clinical effectiveness for surgery. The RCS managed the publication of the 2014 progress report.
VASCULAR SOCIETY OF GREAT BRITAIN AND IRELAND	**The Vascular Society of Great Britain and Ireland** is the specialist society that represents vascular surgeons. It is one of the key partners leading the audit.

Commissioned By

HQIP Healthcare Quality Improvement Partnership

The Healthcare Quality Improvement Partnership (HQIP) promotes quality in healthcare. HQIP holds commissioning and funding responsibility for the National Vascular Registry and other national clinical Audits as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP).

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Executive Summary

The National Vascular Registry is commissioned by the Healthcare Quality Improvement Partnership (HQIP) to measure the quality and outcomes of care for patients who undergo major vascular surgery in NHS hospitals in England and Wales. It aims to provide comparative information on the performance of NHS hospitals and thereby support local quality improvement as well as inform patients about the care delivered in the NHS. As such, all NHS hospitals in England, Wales, Scotland and Northern Ireland are encouraged to participate in the Registry.

The measures used to describe the patterns and outcomes of care are drawn from various national guidelines including: the "2014 The Provision of Services for Patients with Vascular Disease" and the Quality Improvement Frameworks published by the Vascular Society, and the National Institute for Health and Care Excellence (NICE) guidelines on stroke and peripheral arterial disease.

In 2014, the Registry published NHS trust and surgeon-level information for elective infra-renal Abdominal Aortic Aneurysm (AAA) repair and carotid endarterectomy on the Registry website. From 28 October, information on both procedures has been available on the www.vsqip.org.uk website for all UK NHS trusts that currently perform them. For English NHS trusts, the same information was published for individual consultants, as part of NHS England's "Everyone Counts: Planning for Patients 2013/4" initiative. Consultant-level information was also published for NHS hospitals in Wales, Scotland and Northern Ireland for consenting surgeons.

This progress report aims to complement that information by (1) providing an overview of care delivered by the NHS at a national level, and (2) describing various developments within the National Vascular Registry. The Registry will publish its next annual report on major vascular surgery in November 2015.

Elective repair of infra-renal AAA

The information on elective AAA repair published on the VSqip website described the care received by patients who had their surgery between 2009 and 2013. Over this five year period, there had been a major shift in the provision of vascular services in England. In 2009, infra-renal elective AAA repairs were performed in 102 NHS trusts, and 48 (47%) of these had performed fewer than 30 operations. By 2013, 21 of the NHS trusts had stopped performing this procedure, and in the remaining 81, the number of NHS trusts performing fewer than 30 operations had fallen to 29. The median number of procedures performed at the NHS trusts performing surgery each year rose from 31 in 2009 to 40 in 2013.

Carotid endarterectomy

The NHS trust and consultant level information on carotid endarterectomy published in October 2014 described patients who had this procedure between 1 October 2010 and 30 September 2013. Over 5000 patients undergo this procedure annually, typically being referred to vascular surgeons by stroke physicians after experiencing symptoms. NICE recommend that patients should receive surgery within 14 days of experiencing their symptoms, and NHS trusts are increasingly meeting this standard of care. The median time to surgery has fallen over the last three years and, for procedures performed between October 2012 and September 2013, the median was 14 days or less at 74 of 111 NHS organisations. The risk of complications following carotid endarterectomy remains low, with the national rate of death or stroke within 30 days being 2.1% (95% CI 1.9-2.4).

Interventions for the treatment of peripheral arterial disease

Surgeons were able to enter information on lower-limb bypass and amputation procedures for peripheral arterial occlusive disease (PAD) into the National Vascular Database (NVD) - the precursor of the Registry. However, this element of the NVD had not promoted to the same degree as the components for AAA repair and carotid interventions, and the case-ascertainment of these lower-limb procedures is comparatively low. An aim of the National Vascular Registry is to ensure that case-ascertainment improves. Consequently, we used routine hospital data from English NHS trusts to provide a baseline description of surgery and outcomes for lower- limb PAD between January 2009 and December 2013 for English NHS trusts.

The number of endovascular lower-limb procedures performed between 2009 and 2013 rose by approximately 5% from 16,345 to 17,179 operations. Bilateral procedures accounted for just under 10% of all operations and three-quarters were elective. Over the same period, the annual number of lower-limb bypass operations was fairly stable with an average of around 4,400 procedures per year. The proportion of bilateral procedures was slightly lower than among the endovascular operations (approx. 7%), and roughly two-thirds were elective.

The number of major amputations fell over the five years by 13% from 4,794 in 2009 to 4,185 in 2013, with both above and below knee amputations falling by an equivalent amount. Bilateral amputations were uncommon, accounting for 2.1% and 1.4% of above and below knee amputations, respectively.

Geographically, there was considerable variation in the procedure rates per 100,000 population across the 10 English Strategic Health Authorities for both lower-limb revascularisation and amputation. The revascularisation rates were highest for Yorkshire & the Humber, the North West and North East regions, while the rates were lowest in the

South East of England. There was some variation in the ratio of endovascular to bypass procedures. The same regions had the highest rates of major amputation. This variation is likely to reflect differences in the incidence of lower-limb PAD across the regions.

The outcomes for lower-limb endovascular procedures have remained stable over the five year period and have the lowest 90-day postoperative mortality rates (approximately 5%). In comparison, there has been an improvement in outcomes after bypass procedures, with 90-day mortality rates decreasing over the five year period from 7.6% to 6.3%. For above-knee and below-knee amputation, there has been a small improvement in the 90-day mortality rates, with the figures for 2013 being 21.9% and 10.0%, respectively, compared to the baseline rates in 2009 of 24.6% and 11.1%, respectively.

Developments to National Vascular Registry

In January 2014, the National Vascular Registry swapped from the old NVD to the new IT system developed in collaboration with Northgate Information Systems. The new IT system embodied a lot of improvements, updating the datasets for the four procedures in the NVD (AAA repair, carotid endarterectomy, lower-limb bypass and amputation) and adding a new dataset for lower-limb angioplasty/stent procedures. In addition, several online reports were introduced to support data entry and the monitoring of activity and outcomes locally.

In 2015, we expect the National Vascular Registry to start reaching its potential as the national source for comparative information on these five major vascular procedures. There have been high levels of case-ascertainment for elective AAA repair and carotid endarterectomy during the previous five years, and over the coming year, it is our aim for the NVR to start approaching similar levels of case-ascertainment for the lower-limb procedures. Achieving this will enable the 2015 Annual Report to provide a richer description of the process and outcomes of specialist vascular services.

KEY FINDINGS

Elective repair of infra-renal AAA

- The median number of procedures performed at NHS trusts performing AAA repair rose from 31 in 2009 to 40 in 2013 as vascular services were centralised.
- In 2009, infra-renal elective AAA repairs were performed in 102 NHS trusts, and 48 (47%) of these had performed fewer than 30 operations. By 2013, 21 of the NHS trusts had stopped performing this procedure, and in the remaining 81, there were 29 NHS trusts performing fewer than 30 operations.

Carotid endarterectomy

- The median time to surgery has fallen over the last three years and an increasing number of NHS trusts are ensuring patients receive surgery within 14 days of experiencing their symptoms, as recommended by NICE.
- Between October 2012 and September 2013, the median delay from symptom to surgery was 14 days or less at 74 of 111 NHS organisations.
- The risk of complications following carotid endarterectomy remains low, with the national rate of death or stroke within 30 days being 2.1% (95% CI 1.9-2.4).

Interventions for the treatment of peripheral arterial disease (PAD)

- Between January 2009 and December 2013, in English NHS trusts, the number of endovascular lower-limb procedures rose from 16,345 to 17,179; the annual number of lower-limb bypass operations was stable at around 4,400 procedures per year; and the number of major amputations fell from 4,794 to 4,185.
- There was variation in the procedure rates per 100,000 population across the 10 English Strategic Health Authorities for both lower-limb revascularisation and amputation. This variation is likely to reflect differences in the incidence of lower-limb PAD across the regions.
- Lower-limb endovascular procedures had the lowest 90-day postoperative mortality rates (approximately 5%). There has been an improvement in outcomes after lower-limb bypass procedures, with 90-day mortality rates decreasing over the five year period from 7.6% to 6.3%.
- For above-knee and below-knee amputation, there was a small improvement in the 90-day mortality rates over the 5 years, with the figures for 2013 being 21.9% and 10.0%, respectively.

1. Introduction

The National Vascular Registry (NVR) was established in 2013 to measure the quality and outcomes of care for patients who undergo major vascular surgery in NHS hospitals. It covers five main procedures: repair of abdominal aortic aneurysm (AAA), carotid endarterectomy, and three procedures performed for peripheral arterial disease: lower-limb angioplasty, lower-limb bypass and lower-limb amputation.

Last year, the NVR published reports on the patterns of care and outcomes for patients undergoing carotid endarterectomy (October 2013) and elective infra-renal AAA repair (November 2013). This provided information by NHS acute trust to support local benchmarking and quality improvement. Earlier in 2013, the NVR published information on these two procedures by vascular consultant to provide further transparency on the specialist vascular services in the NHS.

In 2014, the Registry published NHS trust and surgeon-level information for elective infra-renal AAA repair and carotid endarterectomy together on the Registry website (www.VSqip.org.uk). Publishing this information on the Registry website is a change from our previous approach of publishing results only as downloadable (.pdf) reports. This approach has various advantages, not least in making the information more accessible and allowing for it to be updated more easily. The Registry will continue to publish an annual report to provide an overall "State of the Nation" picture of major vascular surgery. However, this approach was not followed in 2014 because there were delays in the provision of Hospital Episode Statistics to the NVR, and this had a knock-on effect of delaying the publication of the organisational and consultant outcome information on the Registry website. Consequently, the Registry has produced this progress report:

- to provide information on the care delivered by the NHS at a national level that complements the information already published on the VSqip website, and
- to give an update on the various developments within the National Vascular Registry.

The Registry will publish its next annual report on the overall "State of the Nation" picture for major vascular surgery in November 2015.

1.1 Overview of the National Vascular Registry

The National Vascular Registry was formed in 2013 by the amalgamation of the National Vascular Database and UK Carotid Interventions Audit projects. These projects had been used by vascular surgical services in the UK to monitor their practice and outcomes since 2005, and were part of a broad quality improvement programme undertaken by the Vascular Society in collaboration with other organisations. The Vascular Society will continue its quality improvement activities using the NVR, which it is running in partnership with the Clinical Effectiveness Unit of the Royal College of Surgeons of England.

The Registry was commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP) to examine care within England and Wales. However, all NHS hospitals in England, Wales, Scotland and Northern Ireland are encouraged to participate in the Registry, so that it continues to support the work of the Vascular Society to improve the care provided by vascular services within the UK.

The primary purpose of the Registry is to provide comparative figures on the performance of hospital vascular services to support local benchmarking and quality improvement. The NVR captures data on adult patients undergoing emergency and elective procedures in England and Wales for following patient groups:

1. patients with peripheral arterial disease (PAD) who undergo either (a) lower-limb angioplasty/stent, (b) lower-limb bypass surgery, and (c) lower-limb amputation
2. patients who have a repair procedure for abdominal aortic aneurysm (AAA), both open and endovascular (EVAR).
3. patients who undergo carotid endarterectomy or carotid stenting.

The NVR uses a combination of process and outcome measures to describe the care received by these patients. Being a procedure-based clinical audit, the primary focus is on outcomes rather than the process of care. Short-term survival after surgery is the principal outcome measure for all vascular procedures, but this is complemented by measures on the clinical complications associated with individual procedures, eg, stroke after carotid endarterectomy. The provision of comparative benchmark information on outcomes supports vascular specialists to reduce the risk of complications/postoperative death.

Additional contextual information is provided by the process measures (such as the time from symptom to intervention for symptomatic carotid arterial disease requiring intervention). These are linked to standards of care that are drawn from various national guidelines. The “2014 Provision of Services for Patients with Vascular Disease” document produced by the Vascular Society [VSGBI 2014] provides an overall framework for the

organisation of vascular services, while a number of other sources describe standards of care for the individual procedures, including:

For elective AAA repair

- The Vascular Society of GB&I "Quality Improvement Framework for AAA" [VSGBI 2012]
- Standards and outcome measures for the National AAA Screening Programme (NAAASP) [NAAASP 2009]

For carotid endarterectomy

- National Institute for Health and Clinical Excellence (NICE). Stroke: The diagnosis and acute management of stroke and transient ischaemic attacks [NICE 2009]
- National Stroke Strategy [DH 2007] and its associated publication "Implementing the National Stroke Strategy – an imaging guide".

For peripheral arterial disease

- The Vascular Society of GB&I "Quality Improvement Framework for Major Amputation Surgery" [VSBGI 2012]
- National Institute for Health and Clinical Excellence (NICE). Guidance for peripheral arterial disease (CG147) [NICE 2012]

1.2 Aim of the Progress Report

This report aims to provide an update on the following elements of the National Vascular Registry:

- Changes in the delivery of care for patients having AAA repair or carotid endarterectomy
- Historical patterns of care for patients having vascular procedures for peripheral arterial disease (PAD), and description of data captured on vascular procedures for PAD
- Changes to the NVR IT data system to support clinicians monitor their participation in the NVR and their local activities

The report is primarily aimed at vascular specialists working within hospital vascular units. Nonetheless, the information contained in the report on patterns of care is relevant to other health care professionals, patients and the public who are interested in having an overall picture of the organisation of services within the NHS.

2. Elective repair of infra-renal abdominal aortic aneurysm

2.1 Information on the outcomes of elective infra-renal AAA repair

In November 2013, the NVR published its first report on the outcomes of patients who had elective surgery for an infra-renal abdominal aortic aneurysm (AAA) in NHS hospitals within the UK. The report continued the tradition begun by the Vascular Society of releasing information on AAA repair outcomes to the public and profession. The last report by the Vascular Society [VSGBI 2012] was published in March 2012 and described the care of patients whose procedures were performed between 1 October 2008 and 30 September 2010. It examined the outcomes of 8380 procedures and found that the overall in-hospital mortality after surgery for that period had been 2.4%.

The first NVR report covered the three-year period between 1 January 2010 and 31 December 2012, and found that the in-hospital mortality after elective infra-renal AAA repair had reduced to 1.8% over this period. The case-ascertainment of the NVR had also increased, with NHS hospitals within the UK submitting 13,413 procedures. This corresponded to 88% of all elective AAA repairs performed in the UK.

In October 2014, the Registry changed how it published the results of elective AAA repair for NHS trusts in the UK. From 28 October, information has been available on the www.vsqip.org.uk website for all UK NHS trusts that currently perform elective AAA repairs. For each organisation, the website gives the number of operations, the typical length of stay, and the adjusted in-hospital mortality rate for operations performed between 1 January 2009 and 31 December 2013. For English NHS trusts, the same information was also published for individual consultants currently working at the organisation, as part of NHS England's "Everyone Counts: Planning for Patients 2013/4" initiative. Consultant-level information was also published for NHS hospitals in Wales, Scotland and Northern Ireland for those surgeons who gave consent to the publication of this information.

The website contains information on 21,603 patients who had surgery in 92 NHS organisations: 76 in England, 5 in Wales, 10 in Scotland, and 1 in Northern Ireland. The methods used to produce this information are described in Appendix 2.

Box 1: The repair of abdominal aortic aneurysm (AAA)

An abdominal aortic aneurysm is the local expansion of the abdominal aorta, a large artery that takes blood from the heart to the abdomen and lower parts of the body. It is a condition that tends not to produce symptoms until the aneurysm ruptures. A rupture can occur without warning, causing sudden collapse or death of the patient. Most abdominal aortic aneurysms occur below the kidneys (i.e., are infra-renal).

A ruptured AAA requires emergency surgery. Screening and intervening to treat larger AAAs reduces the risk of rupture, and the National Abdominal Aortic Aneurysm Screening Programme (NAAASP) was introduced in 2010 to identify and treat at risk aneurysms prior to rupture. Once detected, treatment to repair the aorta before it ruptures can be planned with the patient, and surgery is typically performed as an elective procedure.

Aneurysms may be treated by either open surgery, or by an endovascular repair (EVAR). In open surgery, the AAA is repaired through an incision in the abdomen. An EVAR procedure involves the insertion of a stent graft through the groin. Both are major operations. The decision on whether EVAR is preferred over an open repair is made jointly by the patient and the clinical team, taking into account characteristics of the aneurysm as well as the patient's age and fitness.

More information about abdominal aortic aneurysms and their treatment can be found on the Circulation Foundation website at:

http://www.circulationfoundation.org.uk/help-advice/abdominal-aortic-aneurysm/

2.2 Patterns of care for infra-renal AAA repair between 2009 and 2013

The VSqip website provides a simple way for patients and the profession to find detailed information on organisational activity and outcomes. However, it has proven less suited to giving an overview of overall trends in activity. We therefore provide some additional information on these procedures in the remaining sections of this chapter.

Over the five years between 2009 and 2013, there have been several notable changes in the organisation and delivery of vascular services for elective AAA repair. The first is the increasing trend in the proportion of repairs performed as endovascular (EVAR) procedures, increasing from 54% in 2009 to 66% in 2013. There were small differences in the characteristics of patients who had EVAR and open procedures (Table 1), with those

undergoing EVAR procedures being, on average, slightly older and having a greater burden of comorbid disease. EVAR procedures were used more often than open repairs for smaller aneurysms, accounting for 64.2% of procedures for aneurysms with a diameter less than 6.5 cm and 57.0% of procedures for aneurysms of 6.5 cm or greater. The average length of stay (LOS) for patients undergoing EVAR procedures was shorter than for open repairs, with the median (IQR) LOS being 4 (3-6) and 9 (7-13) days, respectively. In-hospital mortality for EVAR procedures was 0.8% compared to 3.6% for open repairs over the five years.

Table 1: Description of patients undergoing elective open and EVAR repairs of infra-renal AAA between 2009 and 2013

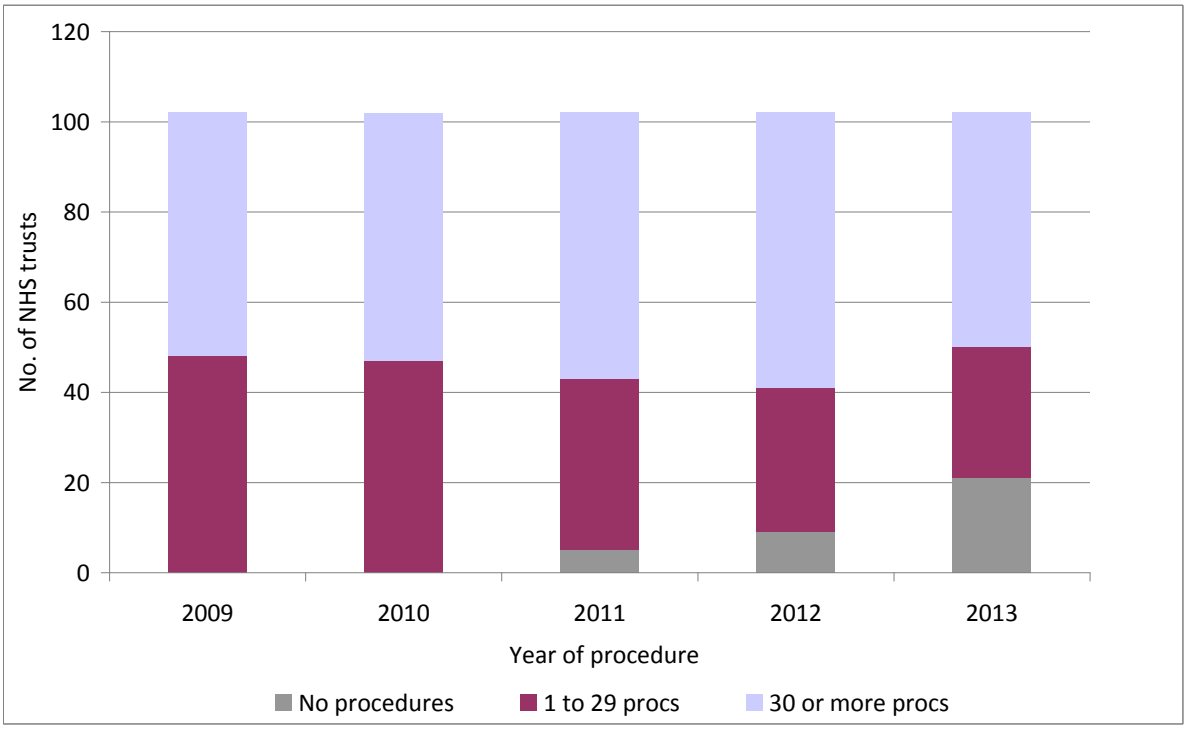
Patient characteristic		Open repairs		EVAR procedures	
		No. of patients	(%)	No. of patients	(%)
No. of procedures		8,270		13,345	
Age (years)	65 or less	1,849	22.4	1,257	9.4
	66 to 75	3,769	45.6	4,901	36.7
	76 to 85	2,507	30.3	6,201	46.5
	Over 85	145	1.8	986	7.4
Male		7,040	85.1	11,851	88.8
Female		1,230	14.9	1,494	11.2
Cardiac disease	No	5,089	61.5	7,076	53.0
	Yes	3,181	38.5	6,269	47.0
Abnormal ECG	No	6,051	73.2	8,773	65.7
	Yes	2,219	26.8	4,572	34.3
Previous aortic surgery	No	7,900	95.5	12,746	95.5
	Yes	370	4.5	599	4.5
AAA diameter	less than 6.5cm	5,121	61.9	9,177	68.8
	6.5cm or more	3,149	38.1	4,168	31.2
ASA fitness grade	1, 2	3,793	45.9	5,120	38.4
	3	4,236	51.2	7,625	57.1
	4,5	241	2.9	600	4.5

A second change has been driven by a growing body of evidence on the relationship between postoperative mortality and the volume of surgery in vascular units. Numerous studies have concluded that vascular units with high caseloads typically have lower postoperative mortality after elective AAA repair compared to units with lower volumes [Holt et al 2007]. The VSGBI has issued guidance on the provision of emergency and elective vascular surgery services and recommends that vascular units need to be of sufficient size to enable consultant surgeons undertake a reasonable number of procedures (alongside an emergency on call rota). In England, this has been supported by guidance on the commissioning of vascular services.

The changes in the provision of vascular services in England summarised in Figure 1. In 2009, infra-renal elective AAA repairs were performed in 102 NHS trusts, and 48 (47%) of these had performed fewer than 30 operations. By 2013, 21 of the NHS trusts had stopped performing this procedure, and in the remaining 81, the number of NHS trusts performing fewer than 30 operations had fallen to 29. The median number of procedures performed at the NHS trusts performing surgery each year rose from 31 in 2009 to 40 in 2013.

This process of centralisation in England is likely to continue. In 2014, a further six vascular units have transferred their services to another NHS trust. A similar centralisation process has occurred in Northern Ireland, with all AAA repairs being performed in Belfast. The number of NHS trusts / Health Boards in Wales and Scotland performing surgery has not changed significantly since 2009.

Figure 1: Number of English NHS trusts performing elective infra-renal AAA surgery



2.3 Case ascertainment among NHS trusts and Health Boards

Between 1 January 2009 and 31 December 2013, the NHS trusts / Health Boards submitted 21,615 procedures to the NVR. The number of elective infra-renal AAA procedures identified in the routine hospitals datasets over the same period was 25,358, which gives an overall case-ascertainment of 85%. The estimated case-ascertainment figures for the four nations were: 88% for England, 80% for Northern Ireland, 53% for Scotland and 81% for Wales. As shown in table 2 below, the overall case-ascertainment has remained fairly stable over this period.

The estimated case-ascertainment figures for individual NHS trusts still performing elective AAA repairs were published on www.VSqip.org.uk website. These NHS trusts have slightly better case-ascertainment figures compared to those who no longer perform this surgery. This may reflect their on-going work to enter data into the Registry and to review the coding of AAA procedures in the routine hospital datasets.

Table 2: Estimated case-ascertainment of elective infra-renal AAA repairs

	2009	2010	2011	2012	2013	Total
Audit procedures	4,332	4,283	4,451	4,428	4,121	21,615
Expected procedures	5,179	4,970	5,213	5,119	4,877	25,358
Estimated Case-ascertainment	84%	86%	86%	87%	84%	85%

3. Carotid Endarterectomy

3.1 Background to audit of patients having surgery for carotid stenosis

An audit of the care received by patients who undergo interventions (either surgery or endovascular stenting) for carotid stenosis was initiated in 2005 as a collaboration between the Vascular Society of Great Britain & Ireland and the Royal College of Physicians. The Carotid Interventions Audit regularly published information on surgical carotid endarterectomy (CEA), evaluating care against clinical standards from two principal sources:

1. National Clinical Guidelines 2009 Stroke: The diagnosis and acute management of stroke and transient ischaemic attacks [NICE 2009]

2. National Stroke Strategy [DH 2007] and its associated publication "Implementing the National Stroke Strategy – an imaging guide".

The National Vascular Registry continued this sequence of reports, publishing the results for Round 5 of the Carotid Interventions Audit in October 2013 [Waton et al 2013]. The 2013 report summarised the patterns of care for 16,774 CEA procedures performed between 1 October 2009 and 30 September 2012 in 117 NHS trusts and Health Boards in the UK, and reported on the current speed of delivery of carotid endarterectomy in the UK, and the 30-day postoperative outcomes.

Box 2: Carotid endarterectomy for patients at increased risk of stroke

As people age, they can suffer from the narrowing of the carotid arteries. These are the major arteries which supply blood to the brain, head and neck. The narrowing of the arteries is caused by a build-up of plaque on the arterial wall. The plaque may cause turbulent blood flow and material breaking off can lodge in the blood vessels of the brain causing either transient symptoms or a stroke. Those with transient symptoms have the highest risk of stroke in the period immediately following the onset of symptoms.

The risk of stroke can be reduced if surgery is performed quickly following onset of symptoms. For patients with a narrowing of a carotid artery between 50% and 99%, it is recommended that surgery to remove the plaque, a carotid endarterectomy, is performed within two weeks.

In October 2014, the Registry published information on the time from symptom onset to carotid endarterectomy and the postoperative outcomes by NHS trust and Health Board on the www.vsqip.org.uk website, alongside the information on elective AAA repairs. When seen as a continuation of the Carotid Interventions Audit, the figures correspond to the completion of Round 6, with previous information updated to include procedures performed between 1 October 2012 and 30 September 2013. During this period, data were submitted by 466 surgeons, who were working at 112 NHS trusts and Health Boards in England, Wales, Scotland and Northern Ireland. Data were submitted to the Registry on a total of 5,553 interventions, which covered:

- 4,677 symptomatic patients
- 5,316 cases with complete 30 day survival information
- 4,068 cases for whom information was submitted on a follow-up appointment

The information published on the website broadly followed the structure of the previous reports. Figures of the median time from symptom onset to carotid surgery focused on the most recent year, being derived for symptomatic patients operated on between 1 October 2012 and 30 September 2013. Information on the outcomes of care was derived from three years of data, covering Rounds 4, 5 and 6 (1 October 2010 to 30 September 2013).

The information was provided for both organisations and individual consultants. It covered all consultants currently working in English NHS trusts and as well as consultants in NHS hospitals in Wales, Scotland and Northern Ireland who gave consent to the publication of this information.

3.2 Characteristics of patients and treatment pathways

Table 3 summarises the characteristics of patients who underwent carotid endarterectomy during Round 6. The procedure was more common among men than women, with 68% of patients undergoing these procedures being male. The mean age of patients was 72 years.

Nearly three-quarters of the patients had at least 70% stenosis in their ipsilateral artery at the time of operation, and 88% were symptomatic. Among the 4,677 patients with symptomatic disease, TIA was the most common symptom (47%) followed by stroke (32%).

Table 3: Patient characteristics of patients who underwent carotid endarterectomy between 1 October 2012 and 30 September 2013

Patient characteristics	No. of patients		%
No. of procedures	5,316		
Age (years), mean (SD) (n=5311)	72.1	(9.7)	
Male	3,618		68.1
Female	1,698		31.9
Co-morbidities			
Diagnosed diabetic	1,087		20.5
Current symptoms/ treatment ischaemic heart disease	1,392		26.2
Rankin score prior to surgery (n=5307)			
0-2	4,821		90.8
3	427		8.0
4-5	59		1.1
Patients symptomatic for carotid disease			
Index symptom if symptomatic: (n=4677)			
TIA	2,219		47.4
Amaurosis fugax	803		17.2
Stroke	1,480		31.6
None of the three above	175		3.7
Grade of ipsilateral carotid stenosis* (n=5270)			
<50%	44		0.8
50-69%	1,328		25.2
70-89%	2,349		44.6
90-99%	1,522		28.9
Occluded	27		0.5
Grade of contralateral carotid stenosis* (n=4982)			
<50%	3,142		63.1
50-69%	745		15.0
70-89%	427		8.6
90-99%	197		4.0
Occluded	309		6.2
Not examined	162		3.3
Pre-op drugs prior to surgery			
Antiplatelet / antithrombotic treatment	5,014		94.3
Statin therapy	4,598		86.5

* level of stenosis recorded at the time of initial imaging.

Patients may be referred for carotid endarterectomy from various medical practitioners. The stroke physician is the increasingly common source of referral, increasing from 68% in Round 4 to 75% in Round 6. The next most common referral sources in Round 6 were: neurologists (4.7%), general practitioners (4.3%) and care of elderly consultants (4.3%)

A limitation of the web-based tables is the lack of a graph showing the summary symptom to procedure time figures for all NHS trusts. This graph was a common feature of previous audit reports, and we have included the graph for Round 6 overleaf (Figure 2). As in previous reports, the graph contains figures for all NHS organisations that had 10 or more symptomatic cases with exact symptom and procedure dates, and is presented in the same way. The median time is represented by a black dot. The inter-quartile ranges (IQRs) are shown by horizontal green lines. Any upper quartile line that is red indicates that the upper quartile value is above 100 days. This typically occurs when the number of patients with exact symptom and procedure dates for the NHS trust was relatively small. The vertical red line in the graph represents the current NICE Guideline of 14 days from symptom to procedure.

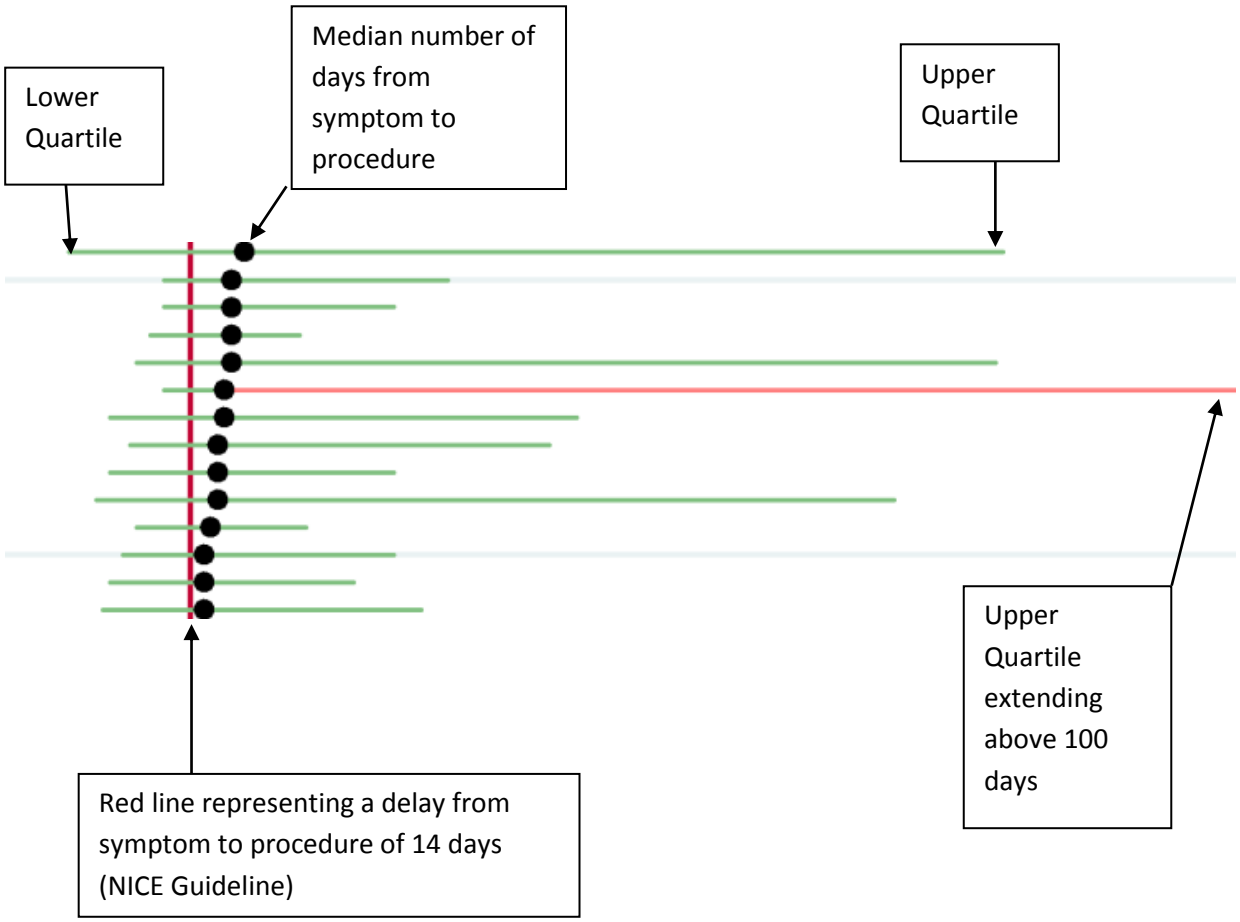
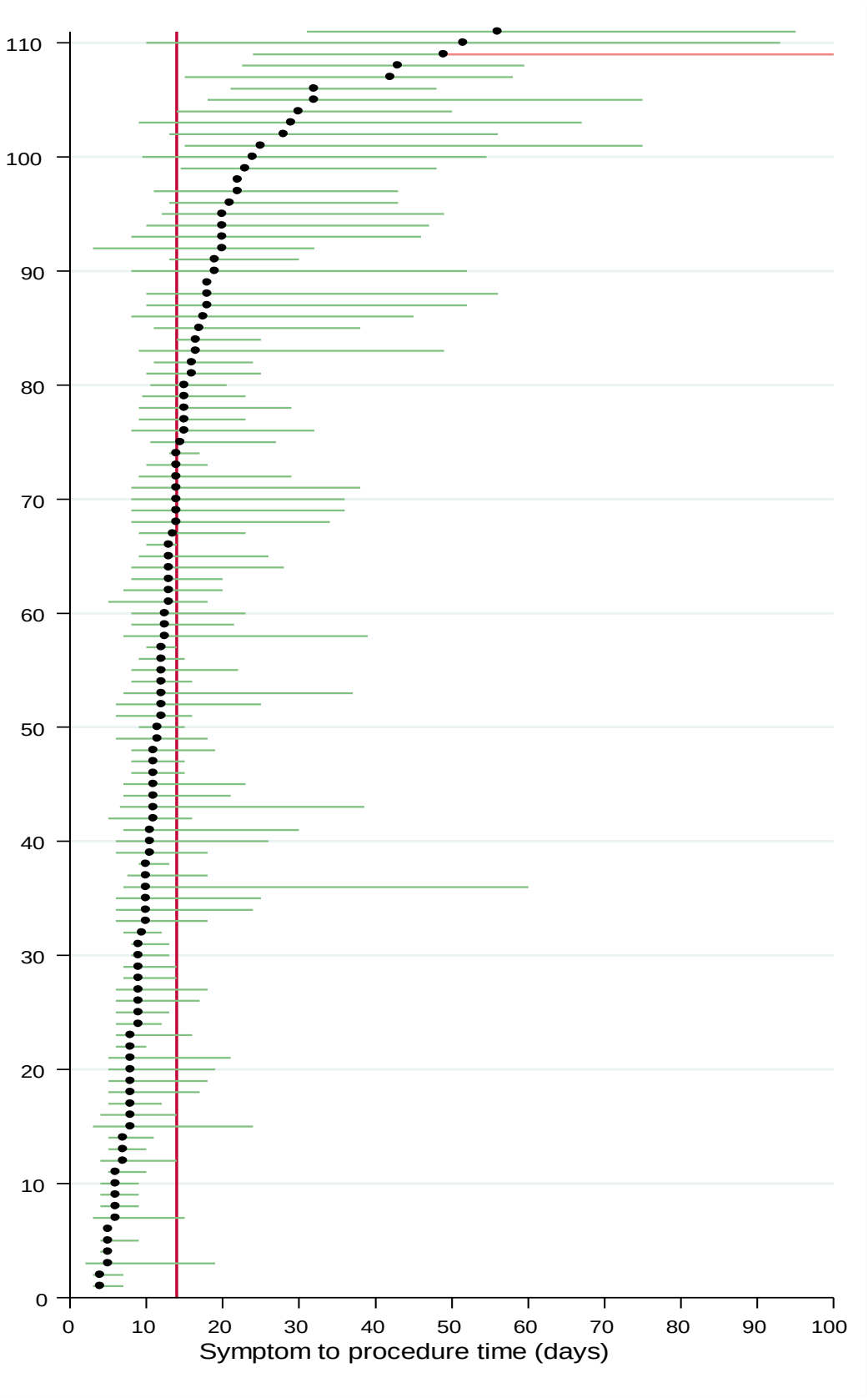


Figure 2: Median time (and inter-quartile range) from symptom to procedure by NHS trust for procedures done between October 2012 and September 2013

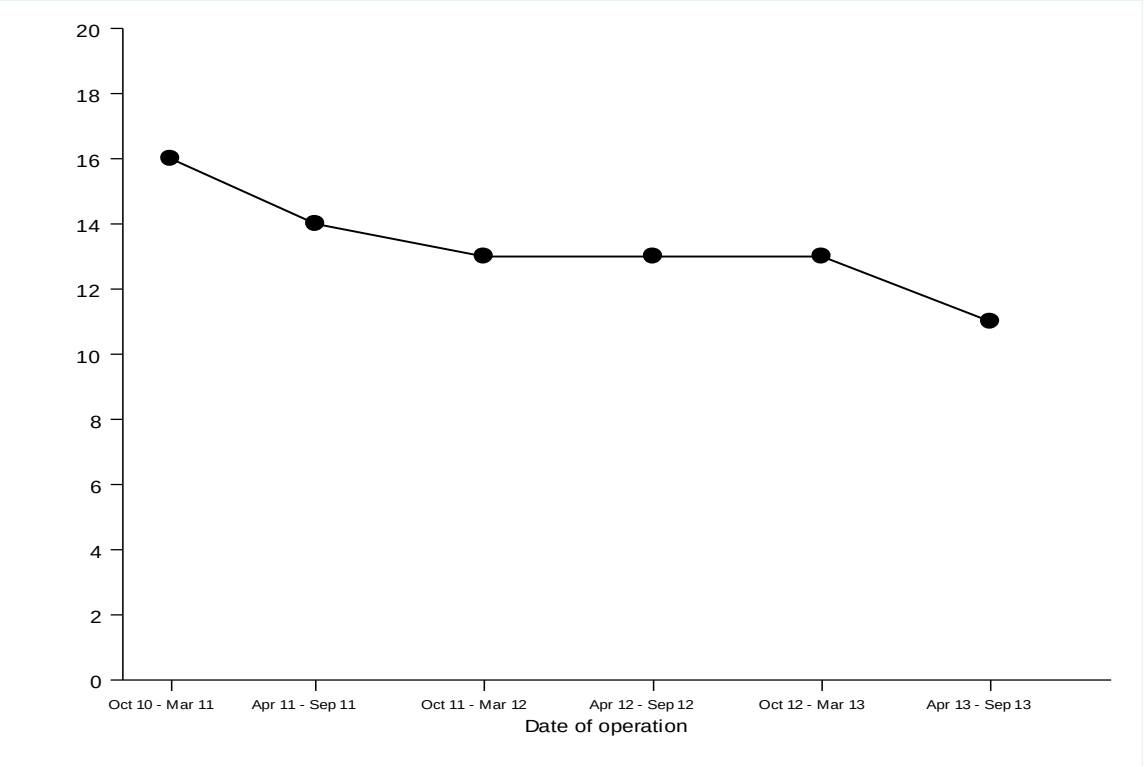


The graph (figure 2) shows that there was considerable variation among NHS trusts in the median time to surgery. The median was 14 days or less for 74 organisations, but the median exceeded 20 days for a minority of vascular units. The values for the individual organisations can be found in Appendix 3.

Despite this, there has been an improvement from Rounds 4 to 6 in the time from referral to surgery for symptomatic cases, as can be seen when the median delay for procedures grouped into six month periods are plotted (figure 3) for the whole 3 year period.

In Round 6, the median times along the care pathway were similar for patients with symptoms of stroke or TIA. However, patients with amaurosis fugax took comparatively longer to progress from symptom onset to surgery, with the median delay being 17 days (IQR 8 to 40 days).

Figure 3: Index symptom to operation (number of days) for symptomatic patients between October 2010 and September 2013.



3.3 Follow-up care and postoperative surgical outcomes

Among the cohort, 77.4% were offered an appointment, and 98.8% of those offered an appointment attended. The median time from hospital discharge to follow-up was 49 days.

The Audit has collected data on various complications following carotid endarterectomy since its inception. The risk of a complication has remained low; Table 4 summarises rates of specific complications (and 95% confidence intervals (CI)) across Rounds 4 to 6.

Table 4: Complication rates following carotid endarterectomy for procedures between October 2010 and September 2013

Complication	Procedures in Rounds 4-6	Complication rate (%)	95% CI
Myocardial Infarct within admission	16,985	0.8	0.7-1.0
Bleeding within admission	16,985	3.2	2.9-3.5
Death and/or stroke within 30 days	17,032	2.1	1.9-2.4
Cranial Nerve Injury within admission	17,031	1.8	1.6-2.0

3.4 Case ascertainment among NHS trusts and Health Boards

Over rounds 4 to 6, data were submitted to the NVR on 17,032 carotid endarterectomies. The number of procedures identified in the routine hospitals datasets over the same period was 18,810, giving an overall case-ascertainment of 91%. The estimated case-ascertainment figures for the four nations were: 92% for England, 95% for Northern Ireland, 77% for Scotland and 80% for Wales. The overall case-ascertainment has been consistently high over the previous three rounds (Table 5), but there was a slight drop in the most recent year.

The estimated case-ascertainment figures for individual NHS trusts still performing carotid endarterectomy were published on www.VSqip.org.uk website. These NHS trusts have slightly better case-ascertainment figures compared to those who no longer perform this surgery. This may reflect their on-going work to enter data into the Registry and to review the coding of these procedures in the routine hospital datasets.

Table 5: Estimated case-ascertainment of carotid endarterectomy

	Round 4	Round 5	Round 6	Total
Audit procedures	5,821	5,895	5,316	17,032
Expected procedures	6,394	6,351	6,065	18,810
Estimated case-ascertainment	91%	93%	88%	91%

4. Surgery for peripheral arterial disease

4.1 Background

The National Vascular Database (NVD) allowed surgeons to enter information on two major lower-limb bypass and amputation procedures for peripheral arterial occlusive disease (PAD). This facility was not promoted to the same degree as the components for AAA repair and carotid interventions, and the submission of data was not as complete. The NVD report published in 2009 [Vascular Society 2009] contained information on:

- 2899 lower-limb bypasses performed between January 2004 and December 2008, of which 2419 (83%) were bypass procedures of femoral artery to popliteal artery.
- 1777 amputations performed between January 2005 and December 2008, of which 784 (44%) were above-knee procedures and 792 (45%) were below knee procedures. Very few amputations below the ankle were submitted to the NVD, although previous studies had reported about 6000 minor amputations are performed annually in English NHS hospitals [Moxey et al 2010].

Since that publication, the case-ascertainment of these procedures within the NVD improved over time, particularly for lower-limb bypass procedures (Table 6). An aim of the National Vascular Registry is to ensure this improvement in case-ascertainment continues.

Table 6: Numbers of procedures submitted to the NVD for operations performed within England compared to HES data

	Year				
Data source	**2009**	**2010**	**2011**	**2012**	**2013**
Amputation					
NVR	1,512	1,948	2,293	2,270	2,590
HES	4,974	4,909	4,677	4,428	4,532
Case-ascertainment	30.4%	39.7%	49.0%	51.3%	57.1%
Bypass					
NVR	2,221	3,113	3,824	4,170	4,542
HES	4,915	5,273	5,158	5,028	5,139
Case-ascertainment	45.2%	59.0%	74.1%	82.9%	88.4%

Another aim of the National Vascular Registry is to improve the datasets on lower-limb procedures for PAD. We implemented revised datasets for bypass and amputation procedures, and have also added the capacity to capture lower-limb endovascular (angioplasty / stent) procedures. In this chapter, we provide information on endovascular and surgical treatment in national routine data to depict recent patterns of care. These can provide a baseline against which practice can be compared until results from the Vascular Registry become available.

Peripheral arterial disease is a restriction of the blood flow in the lower-limb arteries than can severely affect a patient's quality of life [Peach et al 2012]. The disease can affect various sites in the legs, notably the arteries between the femoral and popliteal, and produces symptoms that vary in their severity from pain in the legs during exercise, or persistent ulcers, or gangrene. There are an increasing number of treatment options for patients with PAD [Peach et al 2012]. Endovascular or open surgical interventions (such as bypass) become options when medical therapies have proved to be ineffective. The indication for either therapy depends upon the site(s) and length of the damaged arteries, as well as vessel size. Surgical bypass is recommended for patients with multi-site disease or severe claudication, but there is a degree of overlap between the two therapies, and they are increasingly used in combination. Despite these treatments, PAD can gradually progress in some patients to critical limb ischaemia for whom bypass is not an option. In these situations, patients will require an amputation of the lower limb. About half of all these amputation procedures are below the ankle. Nonetheless, around 5000 patients each year require a major amputation, either above or below the knee.

4.2 Historical patterns of endovascular or surgical interventions for PAD

In this section, we describe trends in the use of endovascular, bypass and amputation for lower limb PAD between January 2007 and 31 March 2014 for English NHS trusts. We extracted patient records from the national Hospital Episode Statistics dataset for patients who underwent one of these procedures during this period and examined patterns of care (see Appendix 4 for the methods).

The number of endovascular procedures performed between 2009 and 2013 rose by approximately 5% from 16,345 to 17,179 operations (Table 7). The proportion of bilateral procedures decreased slightly, but there was little change in the mode of admission, with three-quarters of endovascular procedures being elective. Over the same period, there was no trend in the number of bypass procedures with an average of around 4,400 procedures per year. The proportion of bilateral procedures was slightly lower than among the endovascular operations, and fewer were elective.

The number of major amputations fell over the five years by 13% from 4,794 in 2009 to 4,185 in 2013, with both above and below knee amputations falling by an equivalent amount (Table 7). Bilateral amputations were uncommon, accounting for 2.1% and 1.4% of above and below knee amputations, respectively. There was a small increase in the number of minor amputations.

Table 7: Number of lower-limb procedures for peripheral arterial disease performed in English NHS trusts between 2009 and 2013

Revascularisation

	Endovascular			Bypass		
Year	No. of procs	% bilateral	% elective	No. of procs	% bilateral	% elective
2009	16,345	9.7	76.6	4,337	6.7	65.0
2010	16,500	9.6	76.8	4,581	7.2	65.0
2011	16,988	9.4	77.0	4,396	6.4	66.8
2012	17,214	8.3	75.7	4,248	7.1	66.3
2013	17,179	7.8	74.0	4,314	6.6	64.7

Amputation

	Above knee amputations		Below knee amputations		Minor amputations	
Year	No. of procs	% elective	No. of procs	% elective	No. of procs	% elective
2009	2,512	22.9	2,282	27.6	4,448	35.9
2010	2,421	21.9	2,225	29.8	4,650	35.7
2011	2,282	23.7	2,088	29.5	4,742	38.0
2012	2,203	23.5	1,952	32.2	4,700	39.2
2013	2,192	24.0	1,993	30.4	5,122	39.7

Table 8 summarises the characteristics of patients in the last two years of data (2012 and 2013). The average age was similar across all procedures (66-72 years) and around two-thirds of patients were male. For endovascular and bypass procedures, intermittent claudication and tissue loss were coded for around 50% of cases. Other common diagnoses were hypertension, ischaemic heart disease and diabetes. The patient characteristics were similar among patients undergoing major amputations. However, diabetes was far more prevalent among patients having amputation than revascularisation.

Table 8: Characteristics of patient at the time of their index procedure, for operations performed in 2012 and 2013

Revascularisation

		Endovascular		Bypass	
		No. of procs	(%)	No. of procs	(%)
No. of procedures		34,393		8,562	
Mean age (years)		70.5		68.9	
Men		22,255	64.7	6,174	72.1
Intermittent claudication	(ICD-10 I73.9)	7,229	21.0	2,041	23.8
Tissue loss	(ICD-10 I70.2)	10,654	31.0	2,783	32.5
Hypertension	(ICD-10 I10–I15)	17,663	51.4	4,951	57.8
Ischaemic heart disease	(ICD-10 I20–I25)	8,586	25.0	2,309	27.0
Diabetes mellitus	(ICD-10 E10–E14)	10,744	31.2	2,485	29.0
Cerebrovascular disease	(ICD-10 I60–I69)	854	2.5	263	3.1
Respiratory disease	(ICD-10 J40–J47)	5,480	15.9	1,679	19.6
Chronic kidney disease	(ICD-10 N18–N19)	3,364	9.8	728	8.5

Amputation

	Above knee amputations		Below knee amputations		Minor amputations	
	No. of procs	(%)	No. of procs	(%)	No. of procs	(%)
No. of procedures	4,395		3,945		9,822	
Mean age (years)	71.7		66.2		67.6	
Men	2,789	63.5	2,869	72.7	6,955	70.8
Intermittent claudication	1,333	30.3	1,022	25.9	1,646	16.8
Tissue loss	1,110	25.3	805	20.4	1,626	16.6
Hypertension	2,141	48.7	1,929	48.9	4,939	50.3
Ischaemic heart disease	1,303	29.7	1,035	26.2	2,232	22.7
Diabetes mellitus	1,653	37.6	2,364	59.9	6,720	68.4
Cerebrovascular disease	310	7.1	153	3.9	304	3.1
Respiratory disease	912	20.8	582	14.8	1,229	12.5
Chronic kidney disease	723	16.5	709	18.0	1,566	15.9

n, (%) unless otherwise stated

Geographically, there was variation in the age-sex standardised procedure rates per 100,000 population across the regions for both revascularisation (Figure 4) and amputation procedures (Figure 5). The revascularisation rates were highest for Yorkshire & Humberside, the North West and North East regions, while the rates were lowest in the South East of England. There was some variation in the ratio of endovascular to bypass procedures. The same regions had the highest rates of major amputation. Regions typically performed more above knee to below knee procedures, with only the South West and West Midlands having an below-knee : above-knee amputation ratio below 1.

Figure 4: Annual population-based, age-sex standardised lower-limb revascularisation rates by Strategic Health Authority for the period between 2012 and 2013. Regional rates shown with 95% confidence intervals alongside the national average

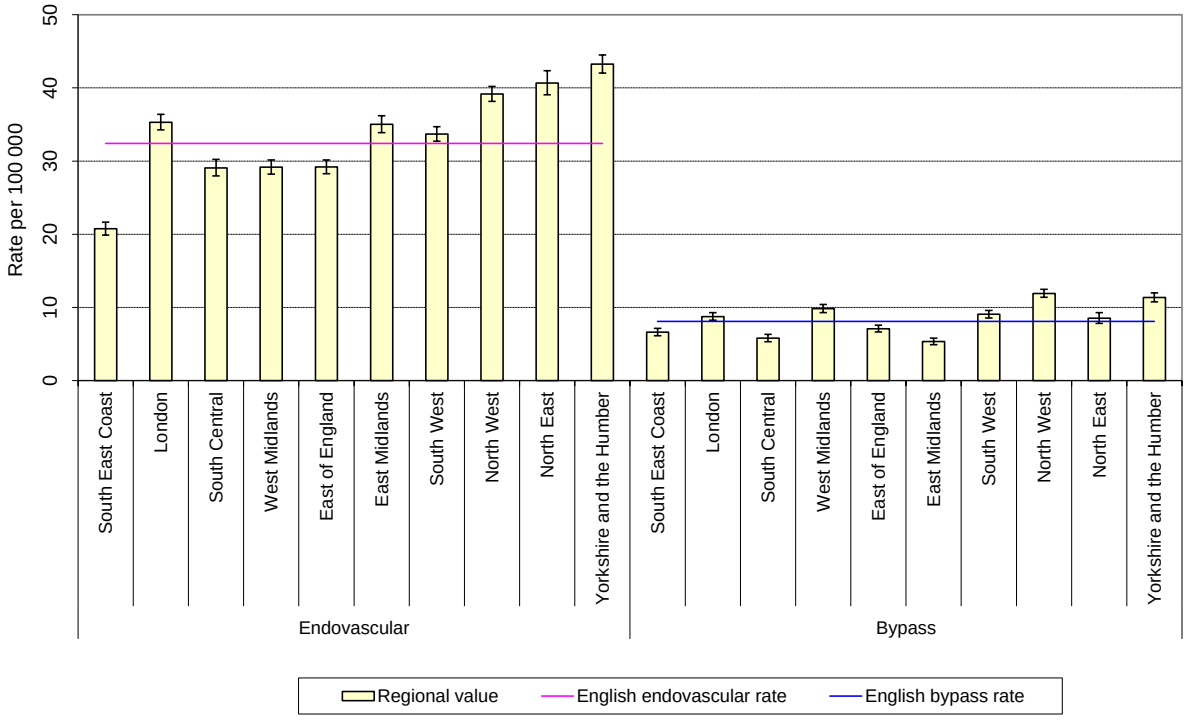


Figure 5: Annual population-based, age-sex standardised lower-limb amputation rates by Strategic Health Authority for the period between 2012 and 2013. Regional rates shown with 95% confidence intervals alongside the national average

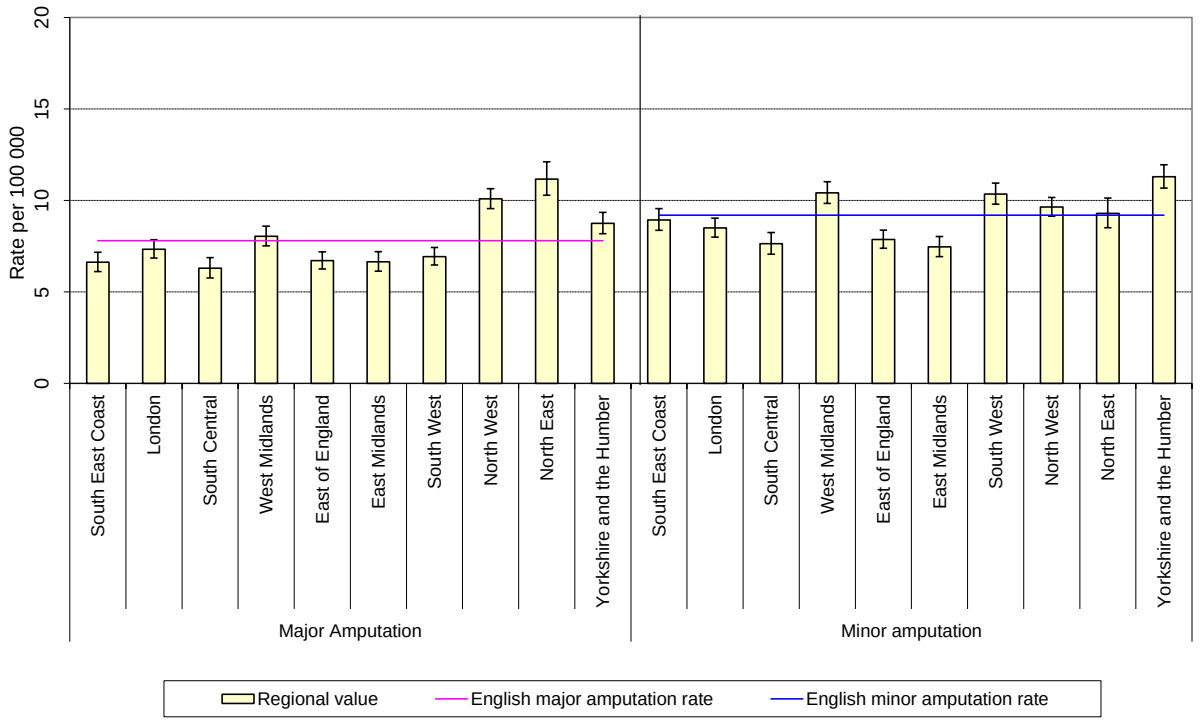


Table 9 describes the 30-day and 90-day postoperative mortality rates for the various lower limb procedures. The outcomes for endovascular procedures have remained stable over the five year period, and have the lowest mortality rates. In comparison, there has been an improvement in outcomes for bypass procedures, with both the 30-day mortality and 90-day mortality rates decreasing over the five year period. For the major amputation procedures, there has been little movement in 30-day postoperative mortality rate. There has been a small improvement in the 90-day mortality rate, with the figures for 2013 being 10% less than the baseline rate in 2009.

There was no statistically significant variation across the regions in postoperative mortality rates among the procedures performed between 2012 and 2013.

Table 9: 30-day and 90-day postoperative mortality rates by lower-limb procedure within English NHS trusts over time

Revascularisation

Year	Endovascular			Bypass		
	n	% 30-day mort	% 90-day mort	n	% 30-day mort	% 90-day mort
2009	16,345	1.8	5.2	4,337	4.1	7.6
2010	16,500	1.9	5.2	4,581	3.7	7.4
2011	16,988	2.1	5.2	4,396	4.1	7.2
2012	17,214	2.0	5.4	4,248	3.2	6.7
2013	17,179	2.1	5.3	4,314	3.3	6.3

Major amputation

Year	Above knee amputations			Below knee amputations		
	n	% 30-day mort	% 90-day mort	n	% 30-day mort	% 90-day mort
2009	2,512	11.5	24.6	2,282	4.0	11.1
2010	2,421	10.2	22.2	2,225	4.4	11.7
2011	2,282	11.4	23.6	2,088	3.6	10.2
2012	2,203	11.6	23.7	1,952	4.9	10.4
2013	2,192	11.1	21.9	1,993	4.4	10.0

4.3 Overview of lower-limb procedures for PAD within the NVR

In this section, we summarise some of the characteristics of patients whose data were entered into the NVD and NVR IT system between 2008 and 2014. The information is split into the periods during which the NVD (2008-2013) and the NVR (2014) were operational. We focus primarily on the data entered into the NVR since January 2014 because the Registry captured information on endovascular as well as bypass and amputation procedures, and it relates to the period when data were entered using the new datasets and the NVR IT system (with its more extensive validation rules). The NVR (2014) data are a snapshot of the first 10 months, and are provided as a preliminary analysis to give an overview. The data were extracted before the formal data submission deadline for the first year of data, and therefore the case-ascertainment is not as high as we would anticipate. We focus on general patterns of activity and data consistency.

Tables 10 and 11 summarise the pattern of patient characteristics within the two time periods. The figures from the NVR data share some similarities with the figures derived from HES, and provide reassurance on data quality. The distributions of age and sex are comparable, as is the prevalence of hypertension and ischaemic heart disease. A notable difference is in the reported prevalence of diabetes, which is higher in the NVR for bypass procedures, but lower for amputations.

Comparing the information on patients from the NVR (2014) and NVD (2008-2013) records, there are some notable differences. Due to the validation rules, there are notably fewer records with missing data (eg, ASA grade and smoking status). The new dataset also allows a distinction between someone who has never smoked and an ex-smoker. Fewer comorbidities were also entered in the older NVD records, particularly for hypertension. The prevalence of diabetes in the NVD records does seem more consistent with the rates in HES, however.

Table 10: Pre-operative patient characteristics by procedure type in the NVR (2014)

	Endovascular		Bypass		Major amputation	
	No. of procs	%	No. of procs	%	No. of procs	%
No. of procedures	**1,330**		**2, 317**		**1,074**	
Age group (years)						
Under 60	222	16.7	442	19.1	251	23.4
60 to 64	145	10.9	318	13.7	120	11.2
65 to 69	194	14.6	415	17.9	166	15.5
70 to 74	251	18.9	396	17.1	165	15.4
75 to 79	208	15.6	343	14.8	164	15.3
80 and over	310	23.3	403	17.4	208	19.4
Sex						
Men	866	65.1	1687	72.8	768	72.8
Women	464	34.9	630	27.2	306	27.2
Smoking						
Current smoker	301	22.6	797	34.4	345	34.4
Ex-smoker	758	57.0	1265	54.6	501	54.6
Never smoked	271	20.4	254	11.0	228	11.0
ASA grade						
Normal	164	12.3	19	0.8	6	0.8
Mild disease	515	38.7	592	25.6	95	25.6
Severe, not life-threatening	582	43.8	1542	66.6	697	66.6
Severe, life-threatening or Moribund patient	69	5.2	163	7.0	276	7.0
Fontaine score						
No symptoms	39	3.0	55	2.5	-	
Intermittent claudication	500	38.1	706	32.1	-	
Nocturnal &/or resting pain	295	22.5	761	34.7	-	
Necrosis &/or gangrene	480	36.5	674	30.7	-	
Missing	17		121			
Comorbidities						
None	194	14.6	318	13.7	115	13.7
Hypertension	798	60.0	1540	66.5	639	66.5
Ischaemic heart disease	442	33.2	871	37.6	445	37.6
Diabetes	500	37.6	700	30.2	557	30.2
Stroke	105	7.9	180	7.8	129	7.8
Chronic lung disease	181	13.6	480	20.7	198	20.7
Chronic renal disease	190	14.3	203	8.8	222	8.8
Chronic heart failure	87	6.5	155	6.7	119	6.7

Table 11: Pre-operative patient characteristics by procedure type in the NVD (2008-2013)

	Bypass		Amputation	
	No. of procs	%	No. of procs	%
Number of procedures	**22,526**		**13,643**	
Age group (years)				
Under 60	4,342	19.3	3,044	22.3
60 to 64	3,112	13.8	1,504	11.0
65 to 69	3,612	16.0	1,860	13.6
70 to 74	3,825	17.0	2,023	14.8
75 to 79	3,389	15.0	2,018	14.8
80 and over	4,246	18.8	3,194	23.4
Sex				
Men	16,057	71.3	9,517	69.8
Women	6,469	28.7	4,126	30.2
Smoking				
Current smoker	6,716	34.0	3,299	27.6
Ex-smoker	232	1.2	212	1.8
Never smoked	12,829	64.9	8,424	70.6
Missing	2,749		1708	
ASA grade				
Normal	239	1.2	120	1.0
Mild disease	6220	32.3	1,515	13.0
Severe, not life-threatening disease	11578	60.1	7,564	64.8
Severe, life-threatening disease or Moribund patient	1235	6.4	2,481	21.2
Missing	3254		1,963	
Comorbidities				
None	73	0.3	46	0.3
Hypertension	299	1.3	1,996	14.6
Ischaemic heart disease	8,324	37.0	1,267	9.3
Diabetes	5,902	26.2	6,940	50.9
Stroke	189	0.8	162	1.2
Chronic lung disease	84	0.4	57	0.4
Chronic renal disease	310	1.4	779	5.7
Chronic heart failure	28	0.1	441	3.2

In relation to postoperative outcomes, the NVR will derive estimates of short-term (30 and 90 day) and long-term (1-year) survival by linking patient records with the UK death register held by the Office for National Statistics. This linkage has not yet been implemented, so we are limited to presenting 30- and 90-day mortality rates based on in-hospital mortality in this report.

The postoperative outcomes for bypass and amputation as derived from NVD and NVR records are noticeably lower that the rates derived from HES data. For bypass procedures, the annual 30-day and 90-day in-hospital mortality rates ranged 2.0-2.4% and 2.9-3.4%, respectively. The mortality rates for above- and below-knee amputations are summarised in Table 12, and are roughly half the rates derived from HES. It is possible that the difference is due to some patients deteriorating after discharge and then dying during a subsequent readmission. This might also be an explanation for the lower mortality rates for amputation procedures. However, it might also be due to the NVD not having received information on all postoperative deaths.

Table 12: 30-day and 90-day in-hospital mortality rates for above and below-knee amputation procedures over time

Year	Above knee Amputation			Below-knee amputation		
	No. of procs	% 30-day mortality	% 90-day mortality	No. of procs	% 30-day mortality	% 90-day mortality
2009	807	9.3	14.0	762	3.8	7.9
2010	1016	8.4	12.4	1001	3.9	7.0
2011	1159	7.6	12.3	1196	2.8	5.1
2012	1174	8.2	11.8	1132	3.6	5.7
2013	1301	7.3	10.5	1275	3.6	5.7
2014	518	10.0	12.7	556	5.4	7.2

5. Changes to the National Vascular Registry in 2014

In January 2014, the National Vascular Registry swapped from the old National Vascular Database to the new IT system developed in collaboration with Northgate Information Systems.

The new IT system embodied a lot of changes. The most notable of these were to the datasets for the four procedures in the old NVD and the addition of a new dataset for lower-limb angioplasty / stent procedures. These changes were based on advice from vascular specialists on ways to simplify how data were recorded, and to ensure the datasets reflect changes in clinical practice. As a result, the NVR datasets for each procedure are now smaller and the recording of patient characteristics is more consistent across the procedures. A further improvement is that the records for patients who have one operation and later come back for another are now linked.

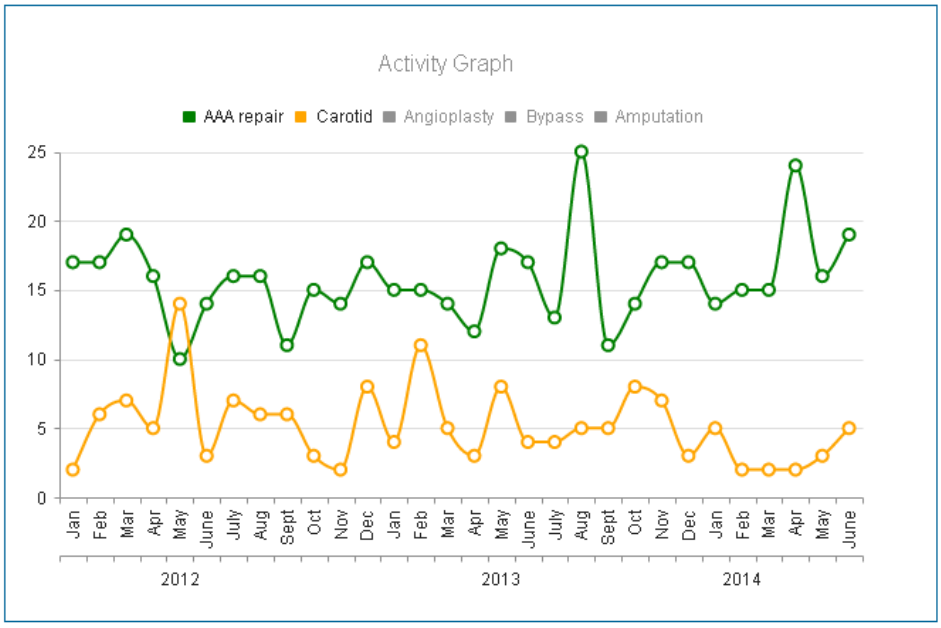
The IT system was developed in phases during 2014. The first release focused on the entry of patient records. In April 2014, some online reports were introduced, together with a few revisions to data items in response to comments from users in the first few months. The migration of the old data from the NVD also occurred during this time. Finally, in November 2014, a second set of dataset revisions and software upgrades were released. This included another online report designed to support consultant revalidation.

We will continue to improve the NVR IT system in response to comments and suggestions from vascular specialists. The first upgrade introduced in 2015 was a refinement to the lower-limb angioplasty / stent dataset. This was developed in collaboration with the Audit Committee of the British Society of Interventional Radiologists and allows for a richer description of practice and outcomes.

A benefit of the new IT system has been improved data completeness. For example, some of the characteristics used for risk adjustment were typically entered for between 80-85% of patients. Variables used for risk-adjustment are now mandated which has resulted in 100% completeness for these characteristics from January 2014.

The four online reports were introduced to support data entry and local quality initiatives. Two reports are designed to provide an overall picture of practice, either in terms of activity over time (Figure 6) or in terms of the patients having surgery (Figure 7). Both contain options that allow the results to be tailored to the user's requirements.

Figure 6: Online report that summarisies levels of activity over time, by procedure



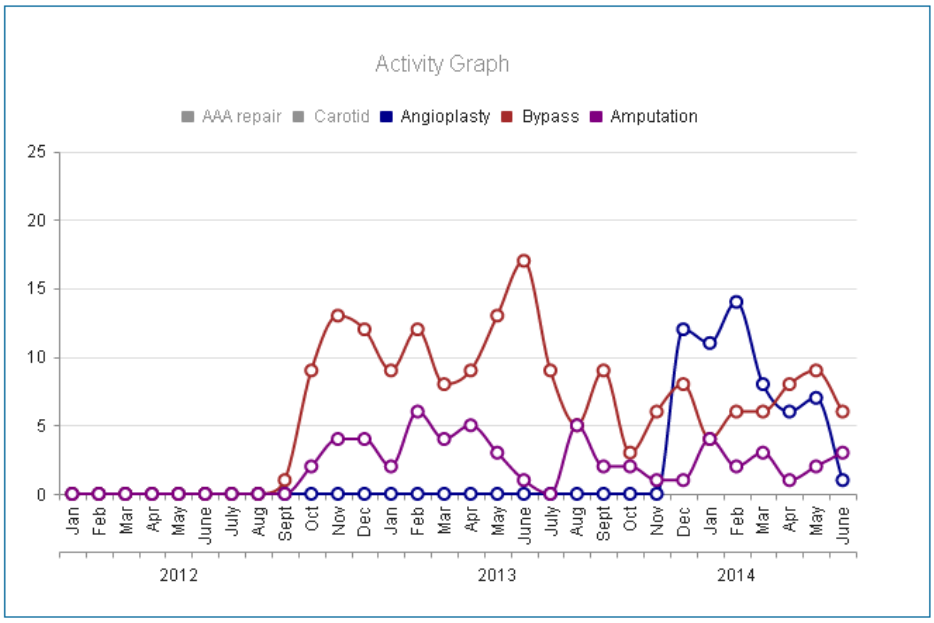
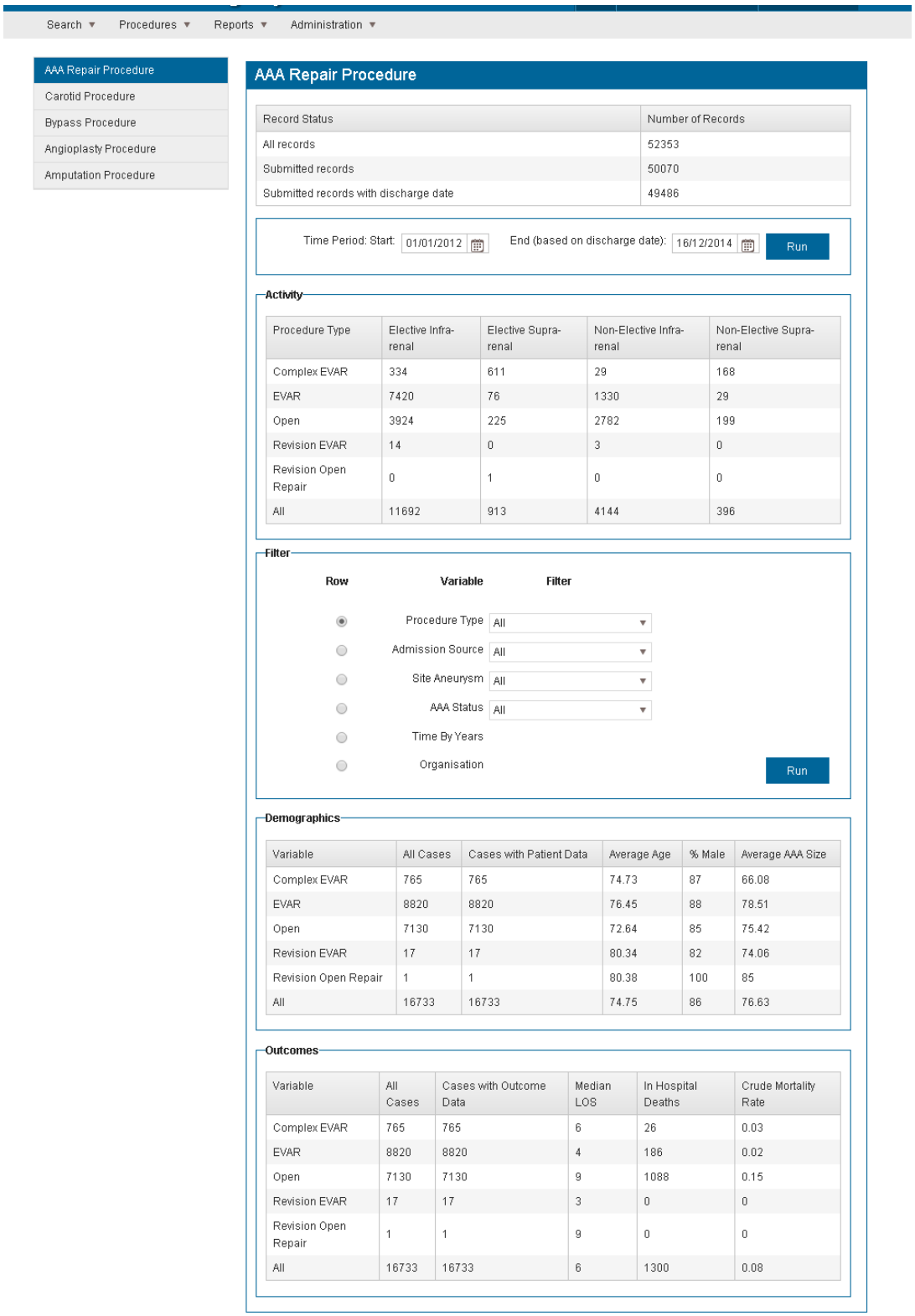


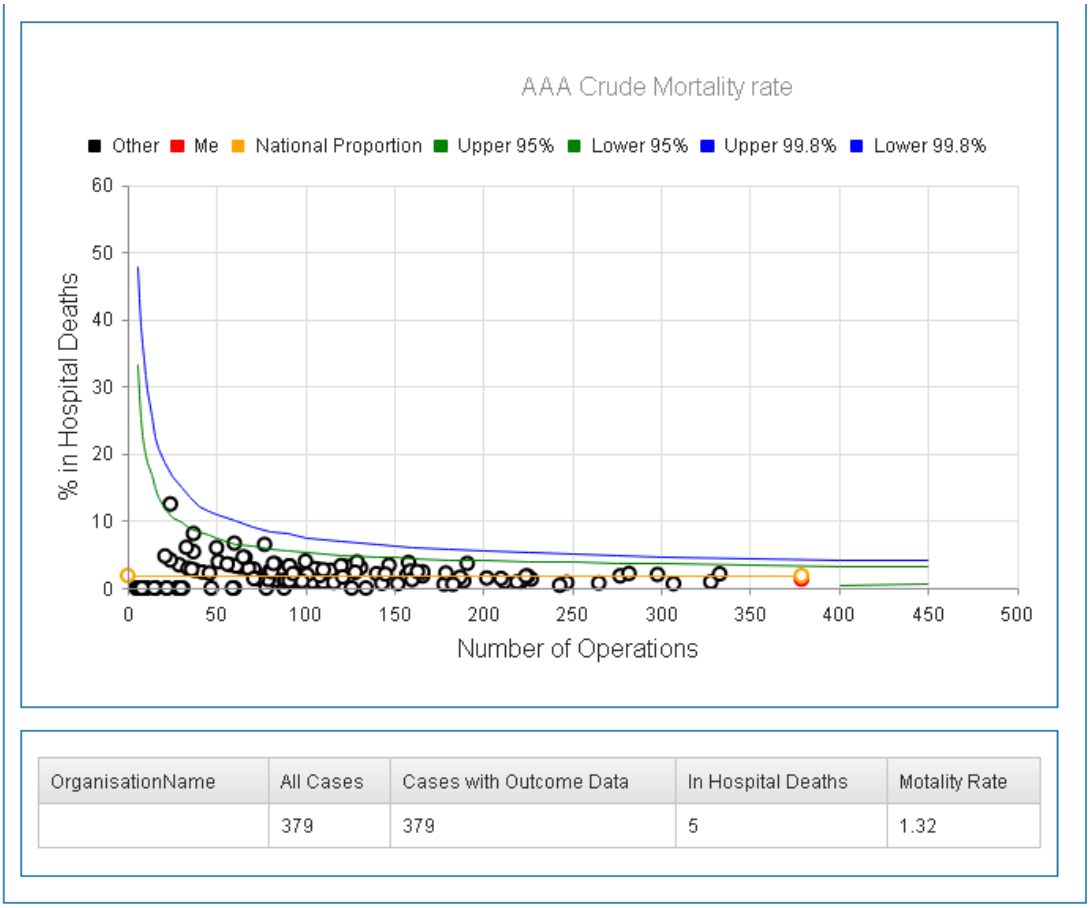
Figure 7: Online report that gives an overview of patient characteristics and outcomes



The third report provides IT users with the ability to see comparative information on the outcome of care, and produces a funnel plot of unadjusted postoperative in-hospital mortality rates for a user-defined cohort of patients and procedures (Figure 8). This report cannot be considered a definitive evaluation of comparative outcomes because the data do not undergo the extensive data checking and risk-adjustment process that characterise the process of producing the Annual reports and consultant-outcome figures. Instead, the report is intended to show how the outcomes of a vascular unit / specialist compare to the results of others and so enable hospitals to monitor and benchmark performance in-between the publication of the annual reports.

The final report is designed to support vascular specialist revalidation, and produces a summary of the specialist's activity that can be downloaded as a .pdf document. Unlike the previous reports, there are no user-defined fields and the report is date stamped to clearly show when it was produced (Figure 9).

Figure 8: Online report that enables an individual to examine unadjusted outcomes in comparison to the national rate



OrganisationName	All Cases	Cases with Outcome Data	In Hospital Deaths	Motality Rate
	379	379	5	1.32

Figure 9: Online report to support medical revalidation

16th December 2014

This is to certify that **[Consultant Name]**, [**consultant vascular specialist / consultant anaesthetist]**, has contributed the following procedures to the National Vascular Registry in the last five years.

Procedure	All procedures	Procedures with consultant as first specialist	Date of first procedure in period	Date of last procedure in period
Carotid endarterectomy	49	45	10/01/2010	30/11/2014
Abdominal aortic aneurysm repair	62	56	01/02/2010	02/12/2014
Lower-limb angioplasty / stent	10	10	10/01/2014	11/12/2014
Lower-limb bypass	40	38	02/03/2010	28/11/2014
Lower-limb amputation	37	35	17/01/2010	03/12/2014

The outcomes of these procedures were

Procedure		As first specialist		All procedures	
		Number	Crude mortality rate (%)	Number	Crude mortality rate (%)
Carotid endarterectomy		45	2.2	49	2.0
Abdominal aortic aneurysm repair	Elective Open	11	9.1	12	8.3
	Elective EVAR	35	2.9	40	2.5
	Non-elective	10	30.0	10	30.0
Lower-limb angioplasty / stent	Elective	9	0	9	0
	Non-elective	1	0	1	0
Lower-limb bypass	Elective	24	0	25	0
	Non-elective	14	7.1	15	6.7
Lower-limb amputation	Elective	7	0	7	0
	Non-elective	28	7.1	30	10.0

These procedures were undertaken at the following hospitals:

[Hospital name 1], **[Hospital name 2]**

6. Next Steps

In 2015, we expect the National Vascular Registry to start reaching its potential as the national source for comparative information on the five major vascular procedures. There have been high levels of case-ascertainment for elective AAA repair and carotid endarterectomy during the previous five years, and over the coming year, it is our aim for the NVR to start approaching similar levels of case-ascertainment for the lower-limb procedures. There has been a steady increase in coverage but, as the last section of chapter 4 shows, there looks to be considerable under-reporting in outcomes.

We hope that the new IT-based online reports will prove to be useful tools for hospitals, helping them to monitor data entry and the quality of care on a regular basis. In addition, we will be providing hospitals with regular updates on case-ascertainment based on comparisons with routine hospital data (eg, HES) for all five procedures to support data entry. Finally, the revised procedure datasets will have been in use for a complete calendar year, and this will enable the next Annual report to provide a richer description of the process and outcomes of care.

Appendix 1: Organisation of the Registry

The NVR is assisted by the Audit and Quality Improvement Committee of the Vascular Society and overseen by a Project Board, which has senior representatives from the participating organisations and the commissioning organisation.

Members of Audit and Quality Improvement Committee of the Vascular Society

Prof I Loftus	Chair	Vascular Society of GB&I
Miss R Bell		Vascular Society of GB&I
Mr J Boyle		Vascular Society of GB&I
Mr J V Smyth		Vascular Society of GB&I
Mr J J Earnshaw		National AAA Screening Programme
Dr N Chalmers		British Society of Interventional Radiology
Dr A Pichel		Vascular Anaesthesia Society of GB&I

Plus members of the project team: Dr D Cromwell (CEU Director), Mr S Waton (NVR project manager).

Members of Project Board

Prof J van der Meulen, Chair	Royal College of Surgeons of England
Mr K Varty	Vascular Society of GB&I
Dr F Miller	British Society of Interventional Radiology
Ms P Oomahdat	HQIP
Ms Z Ajdari	HQIP
Mr P Rottier	Northgate

Plus members of the project / delivery team: Prof I Loftus (Lead Clinician), Dr D Cromwell (CEU Director), Mr S Waton (NVR project manager), Ms C Junor (Northgate).

Appendix 2: Analysis of National Vascular Registry data for VSqip website

The information on the VSqip.org.uk website describes the outcomes of patients using data submitted to the NVR on two procedures: elective repair of infra-renal AAA and carotid endarterectomy.

- The information on AAA repair related to patients who had surgery for an infra-renal AAA after an elective admission in NHS hospitals within the UK, and whose operation was performed in the five-year period between 1 January 2009 and 31 December 2013.
- The information on the outcomes of patients who had a carotid endarterectomy covered operations within the UK in the three-year period between 1 October 2010 and 30 September 2013.

The analysis in this report uses the dataset that formed the basis of the surgeon and trust-level outcomes analysis.

Method of data collection

The data on these vascular procedures were collected using the National Vascular Database (NVD) before it was switched off at the end of 2013. The NVD was a secure web-based data collection system used by vascular surgeons and other members of the vascular team to enter clinical data on each patient undergoing an operation.

The data used in this report were initially extracted from the NVD on 31 December 2013. It was uploaded into the new Registry IT system in April 2014 and, over the subsequent months, vascular surgical units were asked to validate the data, ensuring that all eligible patients were entered into the NVR and that their data was complete and accurate. The extract used to produce the figures on the VSqip website and in this report was taken on 4th Aug 2014.

Data collected on patients, their surgery and outcomes

The NVR captures information about the demographics of a patient (their age, sex, and region of residence), where and when the patient was admitted to hospital, and information on the severity of a patient's condition, the type and timing of surgery received, and the care prior to discharge from hospital.

The type of AAA surgery that a patient has undergone is described using OPCS procedure codes:

- Open repairs are described using OPCS codes L19.4, .5, .6, .8
- EVAR procedures are described using OPCS codes L27.1, .5, .6, .8, .9 and L28.1, .5, .6, .8, .9

The full list of OPCS codes for AAA repair used for this report can be found at the end of this appendix**.**

Carotid endarterectomy procedures are described using OPCS codes L29.4 (Endarterectomy of carotid artery and patch repair of carotid artery) and L29.5 (Endarterectomy of carotid artery NEC).

Analysis of data on AAA repair

Summary information was produced to describe the patient characteristics and the clinical practice of organisations and consultant vascular specialists. This information included:

- the number of AAA repair operations performed,
- estimated case-ascertainment in the NVR by comparing the number of entered procedures with figures derived from the national routine datasets (eg, HES),
- the proportion of patients who died after the operation while in hospital,
- the risk-adjusted mortality

The activity figures from the national routine datasets used to estimate case-ascertainment were derived for the same five year timeframe (1 January 2009 to 31 December 2013) and were created by identifying all elective admissions that included the relevant OPCS codes in the HES procedure fields.

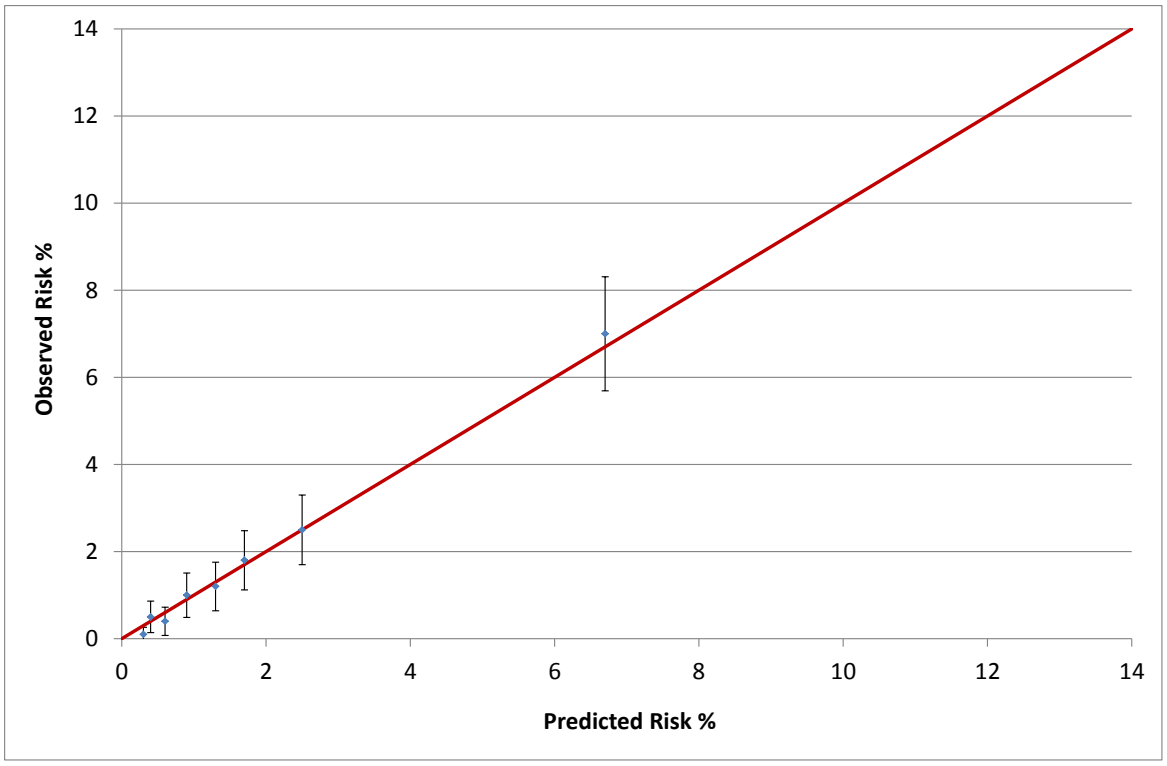
Multivariable logistic regression was used to derive the risk-adjusted mortality rates at organisational and consultant level. The regression model was used to apply indirect standardisation to the crude mortality rates and thereby remove the effect of differences in the characteristics of patients treated by the various organisations (and consultants). In this approach, the observed outcomes for the patients treated at an organisation are compared against the expected results as predicted by the regression model – this is often referred to the ratio of observed to expected outcomes (O/E ratio). In the final step, the O/E ratio is multiplied by the overall mortality rate (ie, derived from all patients) to obtain the risk-adjusted mortality rate.

The regression model contained the following factors:

- Patient age and sex
- AAA diameter
- ASA fitness grade
- Abnormal creatinine (>120 μmol/l , abnormal white cell count (<3 or >11 x 10^9/l), abnormal sodium (< 135 or > 145 mmol/l)
- Cardiac disease, abnormal ECG, and previous aortic surgery or stent

Not all patient records contained complete information on these risk factors. Multiple imputation by chained equations was used to address missing values on these case-mix variables when modelling postoperative complication rates [White et al 2011].

The regression model demonstrated good statistical performance, in both its calibration and discrimination [Altman et al 2009]. Its discrimination (the ability to distinguish between high-risk and low-risk patients) was measured using the receiver operating characteristic (ROC) C-statistic. This was estimated to be 0.788, and represents good performance. Calibration refers to the agreement between the predicted and the observed outcomes, and is most easily assessed using a calibration plot. This plots the predicted outcome on the x-axis, and the actual outcome on the y-axis, with patients grouped into categories based on their increasing predicted risk. A well calibrated model will have the values for each group fall along the 45-degree line of agreement. The calibration plot for the regression model is shown below, and demonstrates there was good agreement between the predicted and observed outcomes for the various groups.



Analysis of data on carotid endarterectomy

Summary information was produced to describe the patient characteristics and the clinical practice of organisations and consultant vascular specialists. This information included:

- the number of carotid endarterectomy operations,
- estimated case-ascertainment in the NVR by comparing the number of entered procedures with figures derived from the national routine datasets (eg, HES),
- the proportion of patients who had a stroke or died within 30 days of the carotid endarterectomy,
- the risk-adjusted rate of stroke/death within 30 days.

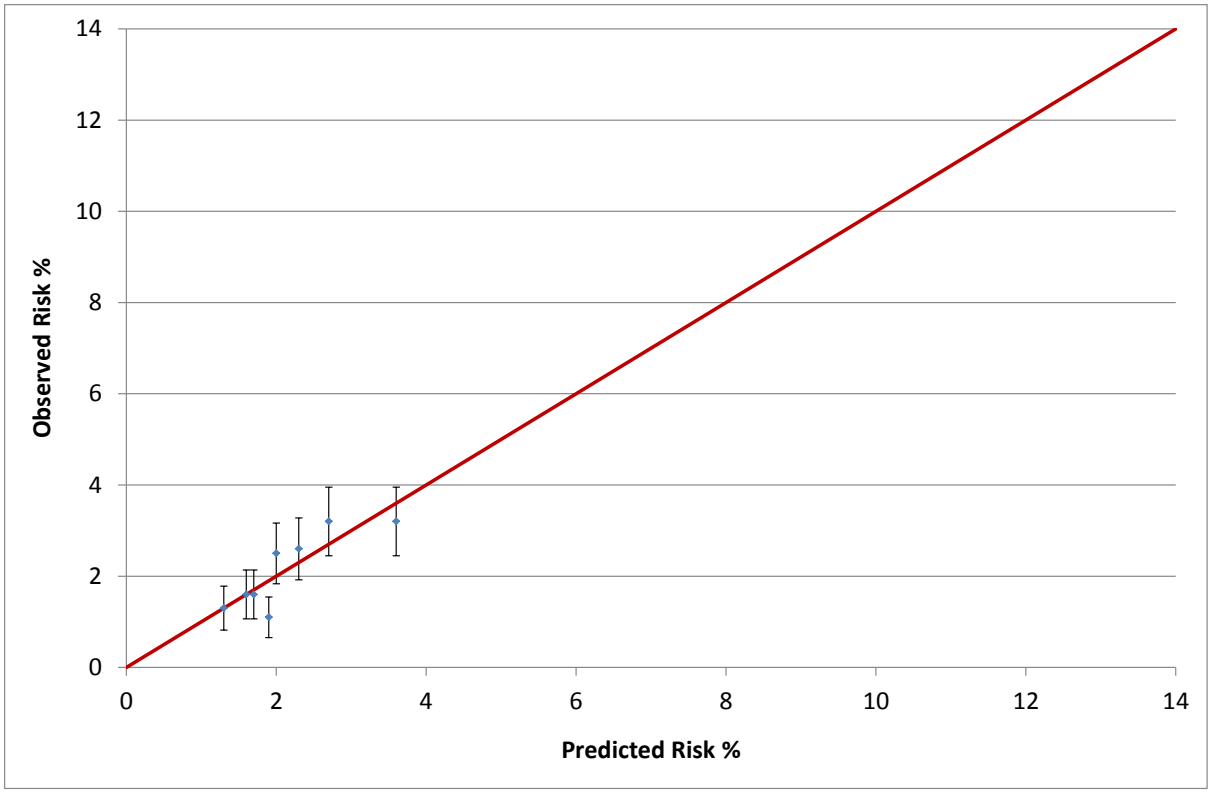
The website also contained the figures on length of stay and the delay from symptom to surgery for symptomatic patients. The median (and inter-quartile range) for length of stay was calculated using the three years of data. The median (and IQR) delay was derived only on patients who underwent a carotid endarterectomy between 1 October 2012 and 30 September 2013 for moderate symptoms. There has been a considerable reduction in the median delay from symptom to carotid endarterectomy since 2010 and using older data could give a misleading impression of times between symptom and surgery. The information was only derived for NHS trusts because it is recommended that patients are referred to the next available operating list rather than an individual surgeon, and so the information at this level more accurately reflects the practice within organisations.

The activity figures from the national routine datasets used to estimate case-ascertainment were derived for the same three-year timeframe (1 October 2010 to 30 September 2013) and were created by identifying all admissions that included the relevant OPCS codes in the HES procedure fields.

Multiple logistic regression was used to derive the risk-adjusted mortality rates at organisational and consultant level, and was used to apply indirect standardisation to the crude mortality rates. The risk model contained the following patient factors:

- age at operation,
- the amount of stenosis in the ipsilateral artery, and
- the pre-operative Rankin score.

The regression model demonstrated reasonable statistical performance in terms of its calibration and discrimination. Its discrimination was estimated to be 0.60, and indicates satisfactory performance. The calibration plot shows good calibration with the values for each group falling along the 45-degree line of agreement. However, the gradient in risk across the patient groups is not very steep, which reflects the level of its discrimination.



Graphical representation on VSqip website

A funnel plot was used to examine whether there are systematic differences in mortality rates between NHS organisations and consultants. This is a widely used graphical method for comparing the outcomes of surgeons or hospitals [Spiegelhalter, 2005].

In these plots, each dot represents an NHS organisation or consultant. The vertical axis indicates the outcome with dots higher up the axis showing trusts with a higher stroke and/or death rate. The horizontal axis shows NHS trust activity with dots further to the right showing the trusts that perform more operations. The benefit of funnel plot is that it shows whether the outcomes of NHS trusts differ from the national average by more than would be expected from random fluctuations. Random variation will always affect outcome information like mortality rates, and its influence is greater among small samples. This is shown by the two funnel-shaped dotted lines. These lines define the region within which we would expect the outcomes of NHS trusts to fall if their outcomes only differed from the national rate because of random variation.

If the risk-adjusted mortality rate fell outside the outer control limits of the funnel plot, the organisation would be flagged as an outlier. If this occurred, there could be a systematic reason for the higher or lower rate, and they would be flagged for further investigation. In

this report, outliers are managed according to the outlier policy of the Vascular Society, drawn up using guidance from the Department of Health. This policy can be found at

http://www.vsqip.org.uk/wp/wp-content/uploads/2013/07/National-Vascular-Registry-Outlier-Policy.pdf.

Finally, differences in proportions between patient subgroups were tested using the chi-square test, and P values lower than 0.05 were judged to be statistically significant. Stata 11 (StataCorp LP, College Station, TX, USA) was used for all statistical calculations.

OPCS codes for elective AAA repair

Code	Description
L19.4	Other replacement of aneurysmal segment of aorta, Replacement of aneurysmal segment of infrarenal abdominal aorta by anastomosis of aorta to
L19.5	Other replacement of aneurysmal segment of aorta, Replacement of aneurysmal segment of abdominal aorta by anastomosis of aorta to aorta nec
L19.6	Other replacement of aneurysmal segment of aorta, Replacement of aneurysmal bifurcation of aorta by anastomosis of aorta to iliac artery nec
L19.8	Other replacement of aneurysmal segment of aorta, Replacement of aneurysmal segment of abdominal aorta by anastomosis of aorta to femoral artery
L27.1	Preferred EVAR code - Endovascular insertion of stent graft for infrarenal abdominal aortic aneurysm
L27.5	Preferred EVAR code -Endovascular insertion of stent graft for aortic aneurysm of bifurcation NEC
L27.6	Preferred EVAR code- Endovascular insertion of stent graft for aorto-monoiliac aneurysm
L27.8	Preferred EVAR code - Other specified transluminal insertion of stent graft for aneurysmal segment of aorta
L27.9	Preferred EVAR code - Unspecified transluminal insertion of stent graft for aneurysmal segment of aorta
L28.1	Endovascular stenting for infrarenal abdominal aortic aneurysm
L28.5	Endovascular stenting of aortic bifurcation NEC
L28.6	Endovascular stenting of aorto-uniiliac aneursym
L28.8	Other specified transluminal operations on aneurysmal segment of aorta
L28.9	Unspecified transluminal operations on aneurysmal segment of aorta

Appendix 3: Median times from symptom to surgery by NHS trusts for carotid endarterectomy

This appendix contains the NHS trust figures shown in Figure 3 on the median time from the onset of symptoms to surgery. For NHS trusts that still provide this surgery, these figures were first published in October 2014 on the www.VSqip.org.uk website

NHS trusts displayed in grey and with an asterisk are no longer performing carotid endarterectomies, as of December 2014.

NHS Trust	Median delay and IQR from index symptom to surgery	Number in symptom to procedure plot (figure 3)
East Midlands		
Derby Hospitals NHS Foundation Trust	6 (3, 15)	7
Northampton General Hospital NHS Trust	12 (6, 25)	51
Nottingham University Hospitals NHS Trust	4 (3, 7)	2
Sherwood Forest Hospitals NHS Foundation Trust*	29 (9, 67)	103
United Lincolnshire Hospitals NHS Trust	8 (5, 17)	18
University Hospitals of Leicester NHS Trust	9 (7, 14)	28
East of England		
Basildon and Thurrock University Hospitals NHS Foundation Trust	9 (8, 13)	30
Bedford Hospital NHS Trust	17 (9, 49)	83
Cambridge University Hospitals NHS Foundation Trust	23 (15, 48)	99
Colchester Hospital University NHS Foundation Trust	19 (8, 52)	90
East and North Hertfordshire NHS Trust	6 (4, 9)	10
Ipswich Hospital NHS Trust*	43 (23, 60)	108
Mid Essex Hospital Services NHS Trust	11 (8, 19)	48
Norfolk and Norwich University Hospitals NHS Foundation Trust	7 (5, 11)	14
Peterborough and Stamford Hospitals NHS Foundation Trust*	32 (18, 75)	105
Princess Alexandra Hospital NHS Trust	18 (18, 18)	89
Southend University Hospital NHS Foundation Trust	5 (4, 5)	4
West Hertfordshire Hospitals NHS Trust	13 (7, 20)	59

NHS Trust	Median delay and IQR from index symptom to surgery	Number in symptom to procedure plot (figure 3)
London		
Barking, Havering And Redbridge University Hospitals NHS Trust	12 (8, 16)	53
Barts Health NHS Trust	11 (5, 16)	39
Guy's and St Thomas' NHS Foundation Trust	6 (5, 10)	11
Imperial College Healthcare NHS Trust	10 (6, 24)	33
King's College Hospital NHS Foundation Trust	8 (5, 18)	19
North West London Hospitals NHS Trust	8 (4, 14)	16
Royal Free London NHS Foundation Trust	9 (7, 14)	29
St George's Healthcare NHS Trust	9 (6, 12)	24
University College London Hospitals NHS Foundation Trust	4 (3, 7)	1
North East		
City Hospitals Sunderland NHS Foundation Trust	12 (10, 14)	57
County Durham and Darlington NHS Foundation Trust	12 (6, 16)	49
Gateshead Health NHS Foundation Trust	13 (9, 26)	65
Newcastle upon Tyne Hospitals NHS Foundation Trust	14 (8, 38)	70
South Tees Hospitals NHS Foundation Trust	15 (10, 23)	78
North West		
Aintree University Hospital NHS Foundation Trust*	10 (9, 13)	38
Bolton NHS Foundation Trust	15 (11, 27)	80
Central Manchester University Hospitals NHS Foundation Trust	10 (6, 18)	32
Countess of Chester Hospital NHS Foundation Trust	20 (10, 47)	94
East Lancashire Hospitals NHS Trust	20 (8, 46)	93
Lancashire Teaching Hospitals NHS Foundation Trust	28 (13, 56)	102
Mid Cheshire Hospitals NHS Foundation Trust*	52 (10, 93)	110
North Cumbria University Hospitals NHS Trust	18 (10, 56)	88
Pennine Acute Hospitals NHS Trust	8 (5, 21)	21
Royal Liverpool and Broadgreen University Hospitals NHS Trust	11 (7, 21)	42
Tameside Hospital NHS Foundation Trust*	11 (6, 18)	40
University Hospital of South Manchester NHS Foundation Trust	13 (7, 39)	60
University Hospitals of Morecambe Bay NHS Foundation Trust	8 (3, 24)	15
Warrington and Halton Hospitals NHS Foundation Trust*	16 (10, 25)	81
Wirral University Teaching Hospital NHS Foundation Trust*	30 (14, 50)	104
Wrightington, Wigan and Leigh NHS Foundation Trust	56 (31, 95)	111

NHS Trust	Median delay and IQR from index symptom to surgery	Number in symptom to procedure plot (figure 3)
South Central		
Buckinghamshire Healthcare NHS Trust	15 (9, 23)	76
Oxford University Hospitals NHS Trust	12 (8, 22)	54
Portsmouth Hospitals NHS Trust	11 (7, 23)	43
University Hospital Southampton NHS Foundation Trust	12 (9, 15)	56
South East Coast		
Ashford and St Peter's Hospitals NHS Foundation Trust	5 (2, 19)	3
Brighton and Sussex University Hospitals NHS Trust	12 (6, 18)	50
Dartford and Gravesham NHS Trust*	49 (24, 150)	109
East Kent Hospitals University NHS Foundation Trust	6 (4, 9)	8
East Sussex Healthcare NHS Trust	20 (3, 32)	92
Frimley Park Hospital NHS Foundation Trust	8 (5, 12)	17
Maidstone and Tunbridge Wells NHS Trust	9 (8, 13)	31
Medway NHS Foundation Trust	8 (6, 10)	22
Surrey and Sussex Healthcare NHS Trust*	5 (5, 5)	6
Western Sussex Hospitals NHS Trust*	14 (13, 17)	74
South West		
Dorset County Hospital NHS Foundation Trust	13 (5, 18)	58
Gloucestershire Hospitals NHS Foundation Trust	14 (9, 23)	71
Great Western Hospitals NHS Foundation Trust*	10 (7, 12)	35
North Bristol NHS Trust	9 (6, 17)	26
Northern Devon Healthcare NHS Trust	12 (7, 37)	52
Plymouth Hospitals NHS Trust	15 (9, 29)	77
Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust	15 (8, 32)	75
Royal Cornwall Hospitals NHS Trust	7 (4, 14)	12
Royal Devon and Exeter NHS Foundation Trust	5 (4, 9)	5
Royal United Hospital Bath NHS Trust*	9 (6, 18)	27
Salisbury NHS Foundation Trust	8 (6, 16)	23
South Devon Healthcare NHS Foundation Trust	9 (6, 13)	25
Taunton and Somerset NHS Foundation Trust	13 (8, 28)	64
University Hospitals Bristol NHS Foundation Trust*	18 (10, 52)	87
West Midlands		
Heart of England NHS Foundation Trust	11 (7, 39)	45
Royal Wolverhampton Hospitals NHS Trust*	11 (8, 15)	46
Sandwell and West Birmingham Hospitals NHS Trust*	22 (22, 22)	98
Shrewsbury and Telford Hospital NHS Trust	11 (6, 26)	41
The Dudley Group NHS Foundation Trust	10 (6, 25)	34

NHS Trust	Median delay and IQR from index symptom to surgery	Number in symptom to procedure plot (figure 3)
University Hospitals of North Midlands NHS Trust	13 (8, 22)	62
University Hospitals Birmingham NHS Foundation Trust	14 (9, 29)	72
University Hospitals Coventry and Warwickshire NHS Trust	24 (10, 55)	100
Worcestershire Acute Hospitals NHS Trust	14 (8, 36)	68
Yorkshire and The Humber		
Bradford Teaching Hospitals NHS Foundation Trust	8 (5, 19)	20
Calderdale and Huddersfield NHS Foundation Trust	13 (10, 14)	66
Doncaster and Bassetlaw Hospitals NHS Foundation Trust	13 (8, 20)	61
Hull and East Yorkshire Hospitals NHS Trust	20 (12, 49)	95
Leeds Teaching Hospitals NHS Trust	6 (4, 9)	9
Mid Yorkshire Hospitals NHS Trust*	12 (9, 15)	55
Sheffield Teaching Hospitals NHS Foundation Trust	14 (8, 34)	67
York Teaching Hospital NHS Foundation Trust	7 (5, 10)	13
Northern Ireland		
Belfast Health and Social Care Trust	18 (8, 45)	86
Southern Health and Social Care Trust	14 (10, 18)	73
Western Health and Social Care Trust	25 (15, 75)	101
Scotland		
NHS Ayrshire & Arran	13 (8, 23)	63
NHS Dumfries and Galloway	42 (15, 58)	107
NHS Fife	19 (13, 30)	91
NHS Forth Valley	15 (11, 21)	79
NHS Grampian	14 (8, 36)	69
NHS Greater Glasgow and Clyde	17 (11, 38)	84
NHS Highland	32 (21, 48)	106
NHS Lanarkshire	17 (14, 25)	85
NHS Lothian	16 (11, 24)	82
NHS Tayside	11 (8, 15)	47
Wales		
Abertawe Bro Morgannwg University Local Health Board	11 (7, 30)	44
Aneurin Bevan Local Health Board	21 (13, 43)	96
Betsi Cadwaladr University Local Health Board	22 (11, 43)	97
Cardiff and Vale University Local Health Board	10 (7, 60)	36
Cwm Taf Local Health Board	10 (8, 18)	37

Appendix 4: Analysis of HES data on peripheral arterial disease

The results in chapter 4 were derived from data extracted from the Hospital Episode Statistics (HES) database. This national hospital database contains records describing the type, timing, and location of all surgery among patients admitted to NHS acute trusts in England. Patients' diagnoses, comorbidities, and complications are coded using ICD-10 (International Classification of Diseases, 10th revision), and procedures are coded using the classification of surgical operations from the UK Office of Population Censuses and Surveys (OPCS), version 4. A unique identifier (the HESID) links episodes of care related to the same patient, which enables studies to examine events before or after an index admission.

We extracted records from HES for patients who underwent a major lower-limb vascular procedure between 1 January 2009 and 31 December 2013. These records were linked to records from the Office for National Statistics Death Register to provide the date of death. For each type of procedure, a patient's index operation was identified. Patients were categorised into three broad procedure groups (lower limb amputations, bypasses and endovascular procedures) using the OPCS coding system.

Diagnostic information was used in two ways. First, the index procedures were filtered so that the analysis only covered patients whose procedure was associated with a diagnosis of peripheral arterial disease (see table below). Second, the diagnostic fields were searched for ICD-10 diagnostic coding related to key conditions and comorbidities. The comorbidities included: hypertension, diabetes, heart disease, chronic renal dysfunction, cerebrovascular disease and respiratory conditions.

Population data for each of the ten English strategic health authorities (SHA) was obtained from figures published by the Office for National Statistics from the 2011 National Census, and were used to calculate the annual age-sex standardised procedure rate per 100,000 head of population at national and regional level.

OPCS codes for lower limb amputations

Code	Description
X09.3	Amputation of leg above knee – above knee amputation
X09.4	Amputation of leg through knee – above knee amputation
X09.5	Amputation of leg below knee – below knee amputation
X10	Amputation of foot – minor amputation
X11	Amputation of toe – minor amputation

OPCS codes for lower limb bypasses

L16.1	Emergency bypass of aorta by anastomosis of axillary artery to femoral artery
L16.2	Bypass of aorta by anastomosis of axillary artery to femoral artery nec
L20.6	Emergency bypass of bifurcation of aorta by anastomosis of aorta to iliac artery nec
L21.6	Bypass of bifurcation of aorta by anastomosis of aorta to iliac artery nec
L51.1	Bypass of common iliac artery by anastomosis of aorta to common iliac artery nec
L51.2	Bypass of iliac artery by anastomosis of aorta to external iliac artery nec
L50.3	Emergency bypass of artery of leg by anastomosis of aorta to common femoral artery nec
L51.3	Bypass of artery of leg by anastomosis of aorta to common femoral artery nec
L59.1	Bypass of femoral artery by anastomosis of femoral artery to femoral artery nec
L57.2	Replacement of aneurysmal femoral artery by anastomosis of femoral artery to popliteal artery using prosthesis nec
L58.2	Emergency bypass of femoral artery by anastomosis of femoral artery to popliteal artery using prosthesis nec
L58.3	Emergency bypass of femoral artery by anastomosis of femoral artery to popliteal artery using vein graft nec
L59.2	Bypass of femoral artery by anastomosis of femoral artery to popliteal artery using prosthesis nec
L59.3	Bypass of femoral artery by anastomosis of femoral artery to popliteal artery using vein graft nec
L56.5	Emergency replacement of aneurysmal femoral artery by anastomosis of femoral artery to tibial artery using vein graft
L58.4	Emergency bypass of femoral artery by anastomosis of femoral artery to tibial artery using prosthesis nec
L58.5	Emergency bypass of femoral artery by anastomosis of femoral artery to tibial artery using vein graft nec
L59.4	Bypass of femoral artery by anastomosis of femoral artery to tibial artery using prosthesis nec
L59.5	Bypass of femoral artery by anastomosis of femoral artery to tibial artery using vein graft nec
L58.6	Emergency bypass of femoral artery by anastomosis of femoral artery to peroneal artery using prosthesis nec
L58.7	Emergency bypass of femoral artery by anastomosis of femoral artery to peroneal artery using vein graft nec
L59.6	Bypass of femoral artery by anastomosis of femoral artery to peroneal artery using prosthesis nec
L59.7	Bypass of femoral artery by anastomosis of femoral artery to peroneal artery using vein graft nec
L57.3	Replacement of aneurysmal femoral artery by anastomosis of femoral artery to popliteal artery using vein graft nec

OPCS codes for lower limb endovascular procedures

L63.1	Percutaneous transluminal angioplasty of femoral artery
L63.5	Percutaneous transluminal insertion of stent into femoral artery
L54.1	Percutaneous transluminal angioplasty of iliac artery
L54.4	Percutaneous transluminal insertion of stent into iliac artery
L60.1	Endarterectomy of femoral artery and patch repair of femoral artery
L60.2	Endarterectomy of femoral artery nec
L66.5	Percutaneous transluminal balloon angioplasty of artery
L71.1	Percutaneous transluminal angioplasty of artery nec

ICD 10 diagnosis codes used to limit the procedures to patients with peripheral arterial disease

E10	Insulin-dependent diabetes mellitus
E11	Non-insulin-dependent diabetes mellitus
E14	Unspecified diabetes mellitus
I70	Atherosclerosis
I71	Aortic aneurysm and dissection
I72	Other aneurysm
I73	Other peripheral vascular diseases
I74	Arterial embolism and thrombosis
I77	Other disorders of arteries and arterioles
I79	Disorders of arteries, arterioles and capillaries in diseases classified elsewhere
L03	Cellulitis
L97	Ulcer of lower limb, not elsewhere classified
M86	Osteomyelitis
R02	Gangrene not elsewhere classified
T81	Complications of procedures, not elsewhere classified
T82	Complications of cardiac & vascular prosthetic devices, implants & grafts

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Glossary

Abdominal Aortic Aneurysm (AAA)	This is an abnormal expansion of the aorta. If left untreated, it may enlarge and rupture causing fatal internal bleeding
Amaurosis fugax	Transient loss of vision in one eye due to an interruption of blood flow to the retina.
Asymptomatic Patient	A patient who does not yet show any outward signs or symptoms of plaque.
Carotid Endarterectomy (CEA)	Carotid Endarterectomy is a surgical procedure in which build-up is removed from the carotid artery.
Carotid Stenosis	Abnormal narrowing of the neck artery to the brain.
Cranial Nerve Injury (CNI)	Damage to one of the 12 nerves supplying the head and neck.
Endovascular Aneurysm Repair (EVAR)	A method of repairing an abdominal aortic aneurysm by placing a graft within the aneurysm from a small cut in the groin.
Hospital Episode Statistics (HES)	HES is the national statistical data warehouse for England regarding the care provided by NHS hospitals and for NHS hospital patients treated elsewhere. There are equivalent agencies in Northern Ireland, Scotland and Wales but in this report, the term HES is used generically to describe data that are collected by any of these national agencies.
Inter-quartile range (IQR)	Once the data are arranged in ascending order, this is the central 50% of all values and is otherwise known as the 'middle fifty' or IQR.
Median	The median is the middle value in the data set; 50% of the values are below this point and 50% are above this point.
Myocardial Infarct (MI)	Otherwise known as a Heart Attack, MI involves the interruption of the blood supply to part of the heart muscle.
Occluded artery	An artery that has become blocked and stops blood flow.
National Abdominal Aortic Aneurysm Screening Programme (NAAASP)	A programme funded by the Department of Health to screen men over the age of 65 years for AAA
NHS	National Health Service
National Vascular Database (NVD)	An on-line database funded by The Vascular Society to collect data on major vascular procedures performed in the National Health Service. This was the predecessor of the National Vascular Registry.
OPCS	Office of Population and Censuses Surveys. A procedural classification list for describing procedures undertaken during episodes of care in the NHS

Plaque	Scale in an artery made of fat, cholesterol and other substances. This hard material builds up on the artery wall and can cause narrowing or blockage of an artery or a piece may break off causing a blockage in another part of the arterial circulation.
Strategic Health Authority (SHA)	An organisation, accountable to government, that assesses the health needs of local people and ensures that local health services are commissioned and provided to meet those needs.
Stroke	A brain injury caused by a sudden interruption of blood flow with symptoms that last for more than 24 hours.
Symptomatic	A patient showing symptoms is known to be symptomatic.
Transient ischaemic attack (TIA)	A “mini-stroke” where the blood supply to the brain is briefly interrupted and recovers within 24 hours.
Trust or Health Board	A public sector corporation that contains a number of hospitals, clinics and health provisions. For example, there were 4 hospitals in the trust and 3 trusts in the SHA.
Vascular Society of Great Britain and Ireland (VSGBI)	The VSGBI is a registered charity founded to relieve sickness and to preserve, promote and protect the health of the public by advancing excellence and innovation in vascular health, through education, audit and research. The VSGBI represents and provides professional support for over 600 members and focuses on non-cardiac vascular disease.

The Royal College of Surgeons of England is dedicated to enabling surgeons achieve and maintain the highest standards of surgical practice and patient care. To achieve this, the College is committed to making information on surgical care accessible to the public, patients, health professionals, regulators and policy makers.

Registered charity number: 212808

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