NATIONAL VASCULAR REGISTRY

Supplementary materials of the 2022 Annual Report

Royal College of Surgeons of England
ADVANCING SURGICAL CARE

VASCULAR SOCIETY
OF GREAT BRITAIN AND IRELAND

British Society of Interventional Radiology

HQIP
Healthcare Quality Improvement Partnership

This document was prepared by

Clinical Effectiveness Unit, The Royal College of Surgeons of England
Mr Sam Waton, NVR Project Manager
Dr Amundeep Johal, Senior Statistician
Ms Panagiota Birmpili, NVR Clinical Research Fellow
Dr Qiuju Li, Research Fellow in Medical Statistics
Ms Eleanor Atkins, NVR Clinical Research Fellow
Prof David Cromwell, CEU Director

Vascular Society of Great Britain and Ireland (VSGBI)
Mr Arun Pherwani, Consultant Vascular Surgeon

British Society of Interventional Radiology (BSIR)
Dr Robin Williams, Consultant Interventional Radiologist

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. Registered charity no: 212808

The RCSEng managed the publication of the 2022 Annual report.

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. Registered charity no: 1102769

The British Society of Interventional Radiology is the specialist society that represents interventional radiologists. It is again, one of the key partners leading the audit. Registered charity no: 1084852

Commissioned by

The Healthcare Quality Improvement Partnership (HQIP) aims to promote quality improvement in patient outcomes, and in particular, to increase the impact that clinical audit, outcome review programmes and registries have on healthcare quality in England and Wales. HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing and National Voices.
Registered charity no: 1127049

Contents

Acknowledgements

The National Vascular Registry is commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP). HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing, and National Voices. Its aim is to promote quality improvement, and in particular to increase the impact that clinical audit has on healthcare quality in England and Wales. HQIP holds the contract to commission, manage and develop the NCAPOP, comprising more than 40 clinical audits and clinical outcome review programmes that cover care provided to people with a wide range of medical, surgical, and mental health conditions. The programme is funded by NHS England, the Welsh Government and, with some individual audits, also funded by the Health Department of the Scottish government and the Northern Ireland Department of Health.

We would like to acknowledge the support of the vascular specialists and hospital staff who have participated in the National Vascular Registry and the considerable time devoted to data collection.

We would also like to thank:

- VSGBI Audit and Quality Improvement Committee
- BSIR Registries and Audit Committee
- VASGBI Research and Audit Sub-Committee
- Patrick Palmer and Richard Armstrong from NEC Software Solutions UK

Please cite this as:

Waton S, Johal A, Birmpili P, Li Q, Atkins E, Cromwell DA, Williams R, Pherwani AD. *National Vascular Registry: 2022 Supplementary Report*. London: The Royal College of Surgeons of England, November 2022.

Recommendations of the 2022 annual report

Recommendation	Page(s)	Audience
1) Ensure that pathways for patients with aortic aneurysms avoid undue delays for both standard and complex repair. Units should regularly aim to meet the recommended 8 week standard pathway for elective AAA repair	Pages 39-42	NHS Trusts and vascular specialists
2) Evaluate whether the organisation of vascular services is consistent with the VSGBI 2022 "Provision of Vascular Services" document and the GIRFT 2018 Vascular Services report, with particular attention to: • Improving network pathways for vascular surgery • Providing 24/7 access to hybrid operating theatres • Developing teams with the expertise to deliver in and out of hours care including nursing staff and radiographers • Levels of staffing in vascular surgery and interventional radiology.	Page 12	NHS Trusts, vascular specialists and commissioners
3) Ensure that patients with CLTI receive care as recommended in the VSGBI Quality Improvement Framework (QIF) for peripheral arterial disease. Vascular units should: • aim for 60% of patients to have a revascularisation procedure within 5 days, in keeping with the 2022-23 CQUIN • have access to (ring-fenced) urgent interventional radiology slots, potentially within a day case unit • provide access to a supervised exercise programme • have sufficient capacity on diabetic foot MDT ward rounds for inpatients and a diabetic foot MDT clinics for outpatients	Pages 13 and 14 Pages 21 and 22	NHS Trusts and vascular specialists
4) Ensure that patients who have major lower limb amputation receive care as recommended in the VSGBI Quality Improvement Framework (QIF). Vascular units should: a. investigate the causes of long delays to surgery b. review levels of consultant presence in theatre c. ensure access to a specialist amputee rehabilitation team including psychological support and rehabilitation medical or AHP consultant.	Pages 12-14 Pages 29-34	NHS Trusts and vascular specialists
5) Commissioning of vascular units to perform complex AAA repair should be conditional on the unit submitting data on all cases to the NVR	Page 52	NHS Trusts and specialist commissioners
6) Ensure timely referral and expedited surgery for patients with symptomatic carotid disease with measures to reduce waiting times to carotid endarterectomy	Pages 61-62	NHS Trusts and vascular specialists
7) Continue to review the COVID-19 vaccine status of patients requiring vascular procedures and ensure the necessary precautions are offered.		Vascular specialists
8) Improve the completeness of data entered into the NVR by ensuring the provision of administrative support for vascular surgeons and interventional radiologists. NHS trusts should review levels of completeness in relation to: a. Details of implanted medical devices b. 'Hybrid' lower limb revascularisation procedures c. Complex repair of aortic aneurysms and aortic dissection d. Frailty among patients aged 70 years or over undergoing AAA repair.	Pages 14-15 Pages 17-18 Pages 15 and 52-53 Page 45	NHS Trusts and vascular specialists

1. Introduction

Hospital-based vascular services provide care for a variety of conditions that affect blood circulation (conditions that are part of the broad spectrum of cardiovascular disease). Treatments are typically aimed at reducing the risk of cardiovascular events such as a heart attack, stroke or rupture of an artery, and the appropriate therapeutic options will depend upon the severity of a patient's condition as well as the extent of other coexisting conditions.

The National Vascular Registry (NVR) was established in 2013 to measure the quality and outcomes of care for adult patients who undergo major vascular procedures in NHS hospitals, and to support vascular services to improve the quality of care for these patients.

This document provides supplementary materials for our 2022 Annual report (available at: https://www.vsqip.org.uk/reports/2022-annual-report/).

Information is presented on clinical practice in 2021, and on surgical outcomes for the previous three-year period (2019-21). The NVR publishes information on emergency and elective procedures for the following patient groups:

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

The NVR was designed as a procedure-based audit. Although vascular units provide care to patients with a variety of conditions that affect blood circulation (conditions that are part of the broad spectrum of cardiovascular disease), not all patients will receive a procedure within the scope of the NVR.

The NVR is commissioned by the Healthcare Quality Improvement Partnership (HQIP) on behalf of NHS England, as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP). Clinical audits commissioned by HQIP typically cover NHS hospitals in England and Wales. The NVR encourages all NHS hospitals in England, Wales, Scotland and Northern Ireland to participate, so that it continues to support the work of the Vascular Society of Great Britain and Ireland (VSGBI) and British Society of Interventional Radiologists (BSIR) to improve the care provided by vascular services within the UK. It is mandatory for individual clinicians to collect data on the outcomes of these procedures for medical revalidation, and the NVR is designed to facilitate this. The information patterns of practice and patient outcomes also play a crucial role in the commissioning of NHS vascular services.

1.1 The 2022 Annual Report Supplementary Materials

The aim of this Annual Report Supplementary Materials document is to give a description of the care provided by NHS vascular units, and outcomes delivered to patients.

It is aimed at those who provide, receive, commission and regulate vascular services. This includes clinicians and other healthcare professionals working within hospital vascular units, clinical commissioners and regulators, as well as patients and the public who are interested in knowing how NHS vascular services are delivered.

More information about the various vascular diseases described in this report can be found on the Circulation Foundation website at:

https://www.circulationfoundation.org.uk/

The outcome indictors adopted by the NVR were chosen to help vascular specialists benchmark their performance and, where possible, reduce the risk associated with the procedure. Short-term survival after surgery is the principal outcome measure for all arterial procedures, but this report also provides information about other outcomes, such as the types of complication that occur.

The NVR process measures are linked to standards of care that are drawn from various national guidelines. These focus on (i) specific aspects of care before and after a vascular intervention, and (ii) the time taken by patients to move along the care pathway. An overall framework for vascular services is described by the "Provision of Services for Patients with Vascular Disease" published by the Vascular Society [VSGBI 2021]. Standards of care specific to the various conditions/ arterial procedures are described within the documents listed below. In addition, in response to the COVID-19 pandemic, the VSGBI and other organisations made a number of recommendations for the delivery of care to vascular patients. These are referenced at appropriate places within the chapters of the report.

For elective AAA repair

- The Vascular Society. "Quality Improvement Framework for AAA" [VSGBI 2012]
- Standards and outcome measures for the National AAA Screening Programme (NAAASP) [NAAASP 2020].

For peripheral arterial disease

- The Vascular Society. "A Best Practice Clinical Care Pathway for Peripheral Arterial Disease" [VSGBI 2022]
- The Vascular Society. "A Best Practice Clinical Care Pathway for Major Amputation Surgery" [VSGBI 2016]
- National Institute for Health and Clinical Excellence (NICE). Guidance for peripheral arterial disease (CG147) [NICE 2012].

For carotid endarterectomy

- National Institute for Health and Clinical Excellence (NICE). Stroke: The diagnosis and acute management of stroke and transient ischaemic attacks (NG128) [NICE 2019]
- National Stroke Strategy [DH 2007] and its associated publication "Implementing the National Stroke Strategy – an imaging guide" [DH 2008].

1.2 Publication of information on the VSQIP website

There are additional resources that accompany this document available on the NVR website at: https://www.vsqip.org.uk/reports/2022-annual-report/ . These include the main annual report document, appendices (data tables) containing individual NHS trust results, and an organisational data viewer.

The website also provides access to:

- all previous Annual Reports
- information on the performance of each NHS organisation
- links to resources that support local services' quality improvement initiatives
- information on how the Registry collects and analyses patient data
- links to other sources of information about vascular conditions.

The results from the NVR are used by various other national healthcare organisations. In particular, the NVR has worked with HQIP and the Care Quality Commission (CQC) intelligence team to create a dashboard to support their inspections.

1.3 How to read this document

The results in this document are based primarily on vascular interventions that took place within the UK between 1 January 2019 and 31 December 2021. As noted above, the scope of the NVR extends only to patients who underwent a procedure. The NVR does not collect the details of patients who were admitted to hospital with a vascular condition (e.g. a ruptured AAA) but did not undergo an operation.

The data used in this document was extracted from the NVR IT system in June 2022. This was to enable NHS hospitals to enter follow-up information about the patients having these vascular interventions, and to provide a period in which NHS consultants could check the completeness and accuracy of their data. The analysis of the 2019-21 audit period only included records on the NVR IT system that were "locked" by NHS staff (i.e. this mechanism indicates that data entry is complete).

Results are typically presented as totals and/or percentages, medians and interquartile ranges (IQR). Where appropriate, numerators and denominators are given. In a few instances, the percentages do not add up exactly to 100%, which is typically due to the rounding up or down of the individual values, or where multiple responses can be recorded.

Where individual NHS trust and Health Board results are given, the denominators are based on the number of cases for which the question was applicable and answered. The number of cases included in each analysis may vary depending on the level of information that has been provided by NHS services and the total number of cases that meet the inclusion criteria for each analysis. Details of data submissions are given in the NHS trusts tables available on the NVR website.

For clarity of presentation, the terms NHS trust or Trusts have been used generically to describe NHS trusts and Health Boards. Appendix 2 provides a list of NHS vascular units for which results are published.

Unless stated otherwise, results are presented for all four UK nations. Where case ascertainment is mentioned, the number of records in the NVR were compared to the number of procedures recorded in the administrative hospital databases used in each nation: HES in England, PEDW in Wales, SMR01 in Scotland and HIS in Northern Ireland.

Case ascertainment rates are shown in categories in the outcomes section of the VSQIP website. The case ascertainment rates (especially for 2020 and 2021) should be interpreted with caution. This is due to the impact of the National Data Opt-Out. The opt-out allows patients in England to indicate that they do not want their confidential patient information to be shared for purposes beyond their individual care across the health and care system. Consequently, the extract of HES data provided to the NVR team contained fewer procedures than actually performed by English NHS hospitals (the opt-out rate doubled from 2.7% in October 2020 to 5.4% in September 2021). When compared to HES data, many English NHS trusts had case ascertainment rates of over 100%.

Funnel plots are used to assess whether there are systematic differences in mortality rates between NHS organisations. This is a widely used graphical method for comparing the outcomes of surgeons or hospitals. In these plots, each dot represents an NHS organisation. The solid horizontal line is the national average. The vertical axis indicates the outcome, with dots higher up the axis showing NHS 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 plots is that they show 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 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.

The postoperative mortality rates for each NHS vascular unit are adjusted to take into account differences in the case mix of patients treated at each organisation. The risk-adjusted rates were derived using multivariable logistic models. These models estimate the likelihood of postoperative death for each individual having a procedure, and these probabilities were then summed to calculate the predicted number of events for each NHS trust.

Waiting times plots are used to show the comparison of NHS trusts. In these plots the median time is represented by a black dot. The interquartile ranges (IQRs) are shown by horizontal green lines. Any horizontal lines in red indicate that the upper quartile is beyond the upper limit of the x axis of the graph (usually as a result of a small volume of procedures). The vertical red line on the graphs represents the current national average or the national target.

In some chapters, the change in distribution of patient waiting times by month is shown using a graph that uses a sequence of box plots. Each box plot summarises five points in the distribution. The bottom and top lines of the blue rectangles indicate the lower (Q1) and upper quartiles (Q3). The horizontal line inside the rectangle represents the median time. The lower and upper whiskers show the minimum or maximum values (or the distance that is 1.5 times the inter-quartile range (Q3 - Q1) if this is closer to the median).

2. Organisational Audit

2.1 Introduction

In 2022, an organisational audit of NHS vascular services was performed. A questionnaire was based on the NVR organisational audit undertaken in 2018 as well as recommendations in the VSGBI "Provision of Vascular Services" document. The questionnaire was piloted with members of the Vascular Society Audit and Quality Improvement Committee. Invitations to complete the online questionnaire were sent on 17 May 2022 to the clinical leads of NHS vascular units providing arterial services in England, Scotland, Wales and Northern Ireland. The results in this chapter were derived from questionnaires submitted before 16 September 2022.

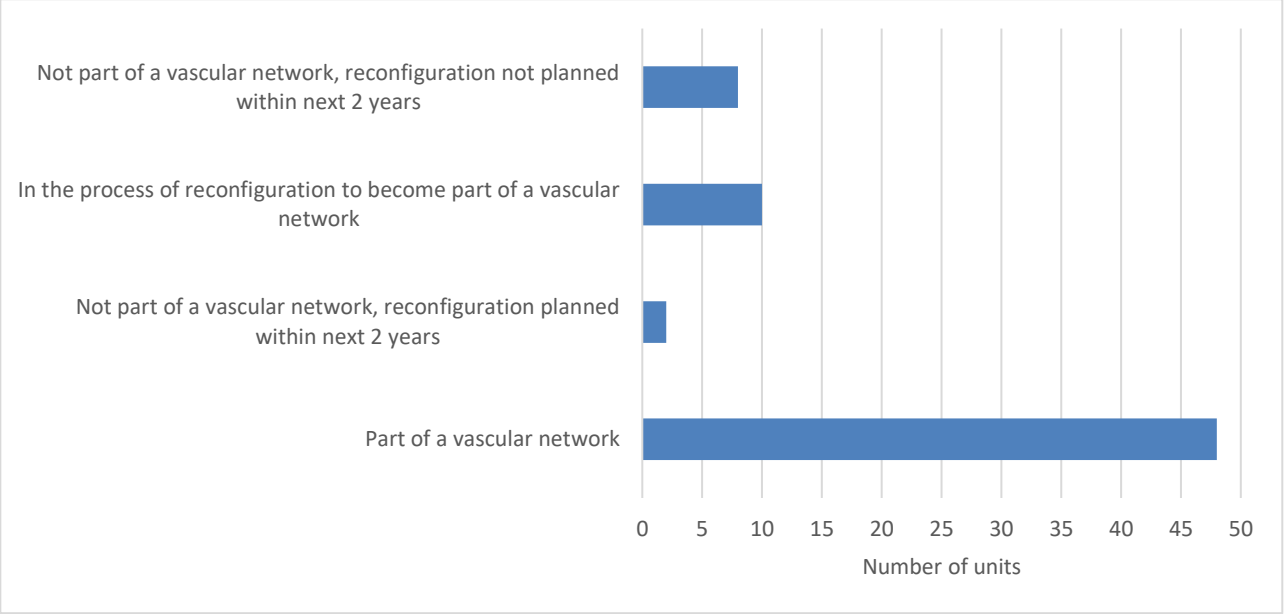
Responses were received from all 68 UK arterial centres. One response was incomplete at the time of analysis, where NHS Tayside had responded to around half of the questions, meaning that some analyses were based on 67 responses.

2.2 Networks, facilities and staffing

There has been a process of reconfiguration among vascular services over a number of years, with the steady formation of regional networks in which patients are referred to a vascular unit for major arterial procedures. The process of reconfiguration continues (see Figure 2.1). 48 of the 68 responders (70.6%) report that they have the role of hub within a vascular network.

Twelve vascular units (17.7%) stated that configuration is planned within the next two years, or are in the process of reconfiguration. The 48 arterial units have a median of three other hospitals in their network (range 1-10). Of the 154 network hospitals identified by respondents, 58 (37.7%) perform endovascular lower limb procedures.

Figure 2.1: State of reconfiguration of NHS vascular services in 2022



The VSGBI and GIRFT have both made recommendations on the minimum numbers of vascular staff that hospitals should provide. The levels reported by the arterial units in the survey are summarised in Table 2.1. The responding arterial units stated that:

- 56 of 67 units (83.6%) had 6 or more FTE (full time equivalent) consultant vascular surgeons, as recommended by the VSGBI and GIRFT. This has increased from 61% in 2018.
- 27 of 68 units (39.7%) had 6 or more FTE consultant interventional radiologists who do vascular work. This has increased slightly from the 36% reported in 2018.
- 57 of 68 units (83.8%) had ≥2 FTE vascular specialist nurses, as recommended in the VSGBI POVS document.
- 47 of 68 units (69.1%) have ≥3 FTE vascular scientists, as recommended in the VSGBI POVS document.
- 29 of 68 units (42.6%) had access to a named healthcare of the elderly physician for review of vascular inpatients.

The operating and procedural capacity reported by the 68 responding units was:

- 40 (58.8%) had ≥10 vascular operating sessions (half-day lists), compared with 62% in 2018.
- 33 (48.5%) reported no allocated operating lists for vascular surgery emergencies. Of the 35 who did, the median was 4 sessions, range 1-11.
- 44 (64.7%) had dedicated endovascular intervention lists in an interventional radiology suite. The median number of half-day lists was 6, range 1-25.
- 42 of 67 units (62.7%) had a specific unit for interventional radiology day case procedures with no requirement for an inpatient bed.
- 35 (51.5%) had access to a hybrid theatre with rotational fluoroscopic imaging (either interventional radiology or surgeon led). This has fallen from a reported 59% in 2018. Among these 35, the median number of sessions available was 9, range 1-27.

Table 2.1: Arterial centre staffing (FTE = full time equivalent)

Staff group (FTE)	0	1-2	3-5	6-8	9+
Vascular surgeon	-	-	11	34	22
Interventional radiologist doing vascular work routinely	10	8	23	20	7
Vascular specialist nurse	2	20	36	8	2
Vascular scientist	7	14	33	9	5
Amputee physiotherapist	7	44	14	2	-

2.3 Lower limb peripheral arterial disease

The VSGBI guidelines for PAD recommend patients with critical limb threatening ischaemia (CLTI) receive a revascularisation procedure within 5 days of referral if treated on an inpatient pathway, and within 14 days if they were treated after referral to outpatients. Meeting this recommendation requires vascular units to have the ability to offer an urgent review. Figure 2.2 summaries the arrangements for urgent review of patients referred to vascular services with suspected CLTI and urgent non-CLTI conditions.

On the questions about the arrangements for the assessment, investigation and management of patients who present with suspected CLTI, 67 vascular units responded as follows:

- There is a median of 9 CLTI assessment slots available per week (range 0-50).
- 53 units (79.1%) have access to consultant review within 48 hours.
- 57 units (83.8%) have access to same day imaging.
- 41 units (61.2%) have access to ring-fenced urgent angioplasty slots.

Vascular units were asked which diagnostic and therapeutic services were available in hours (8am - 6.30pm weekdays), out of hours (6.30pm – 8am weekdays and weekends) and in the daytime on weekends and bank holidays. Figure 2.3 summarises the responses received from 67 vascular units.

In the 2018 GIRFT vascular surgery report [Horrocks 2018], services were recommended to have (i) 24/7 access to CT within 30 minutes, and (ii) elective vascular surgery operating lists on weekends and bank holidays. Among the 68 responses:

- Five units (7.35%) reported not having 24/7 access to cross-sectional imaging (CT or MR angiography).
- Four units (5.88%) had access to elective vascular surgery operating lists on weekends and bank holidays.
- Seven units (10.3%) reported no access to emergency lower limb angioplasty during daytime hours.

Figure 2.2: Availability of urgent review for outpatient referrals

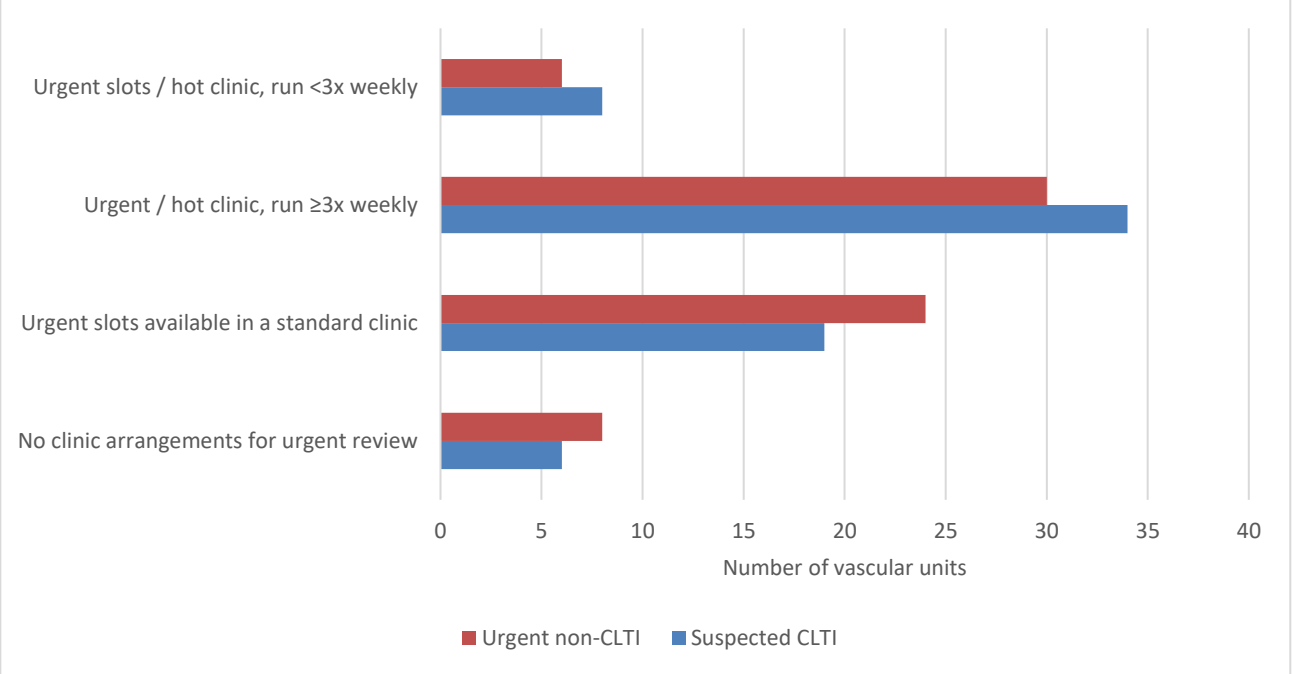
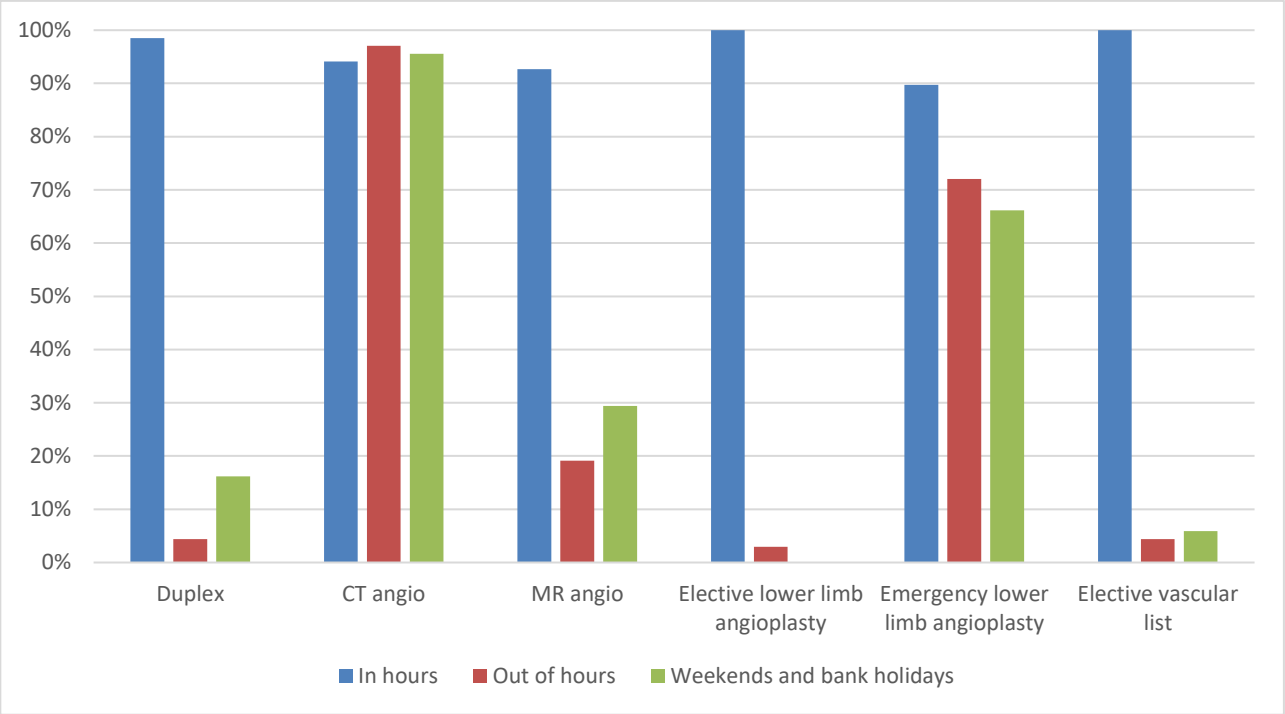


Figure 2.3: Availability of diagnostic and therapeutic services reported by 68 vascular units



In relation to the management of patients who present with lower limb disease, among the 67 units that responded:

- 25 units (37.3%) had access to a supervised exercise programme.
- 38 units (56.7%) had a diabetic foot MDT ward round for inpatients (median one round per week, range 1-5).
- 64 units (95.5%) had a diabetic foot MDT clinic for outpatients (median one clinic per week, range 1-5).
- 37 units (55.2%) had a specialist amputee rehabilitation team including psychological support and rehabilitation medical or AHP consultant.
- 59 units (88.1%) referred post-operative amputation patients to a specialised rehabilitation centre for amputees.

2.4 National Vascular Registry data entry and barcode scanning

The questions on data support for entry of patient data onto the National Vascular Registry were answered on behalf of 68 vascular surgery departments and 65 departments of interventional radiology. Overall, 44 units (64.7%) had data support staff to some extent for vascular surgeons, and 18 units (27.7%) had data support staff for interventional radiologists.

The collection of information on medical devices implanted into patients is expected to become mandatory for NHS services following the Cumberlege report [2020]. The collection of

device information is simplified by hospital operating theatres/IR procedure rooms having facilities for scanning the barcodes of medical devices into the computer system.

The 68 vascular units that responded to questions about collecting device information reported the following:

- 35 (51.5%) stated there is no facility to scan barcodes of implantable devices in any operating theatres or interventional radiology procedure rooms.
- 3 (4.41%) stated there is a facility to scan barcodes of implantable devices in all operating theatres and all interventional radiology procedure rooms.
- 30 (44.1%) stated that a facility is available in some or all operating theatres.
- 12 (17.6%) stated that a facility is available in some or all interventional radiology procedure rooms.

2.5 Aortic disease (EVAR and TEVAR)

Endovascular procedures are an important aspect of practice provided by hospital vascular services, but the ability to perform these procedures requires dedicated facilities and the availability of these can vary between vascular units. 67 vascular units reported the following:

- 64 (95.5%) perform standard elective EVAR for aortic aneurysm repair.
- 59 (88.1%) perform emergency EVAR for ruptured aortic aneurysms. Among these, 42 (71.2%) are able to offer a 24/7 service.
- 26 (61.9%) have a hybrid theatre available 24/7 for emergency EVAR.

Multiple reasons for not being able to offer a 24/7 EVAR service for ruptured aortic aneurysms were provided by 17 units. They included:

- Lack of interventional radiology cover (15 units, 88.2%).
- Lack of radiology support staff, e.g. radiographer, interventional radiology nurse (9 units, 52.9%).
- Lack of facilities, e.g. hybrid theatre, interventional radiology suite (7 units, 41.2%).
- Lack of on shelf devices for EVAR (4 units, 23.5%).
- Lack of experience in the procedure from vascular surgery (3 units, 17.6%).
- Lack of experience in the procedure from interventional radiology (3 units, 17.6%).

The number of vascular units with the facilities and expertise to perform thoracic endovascular aortic repair (TEVAR) procedures has been steadily expanding. There is increasing interest in its use for Type B aortic dissection. Out of 67 units that responded to questions about this complex procedure:

- 46 (68.7%) admit and manage uncomplicated Type B aortic dissection.
- 34 (50.7%) perform TEVAR for Type B aortic dissection.

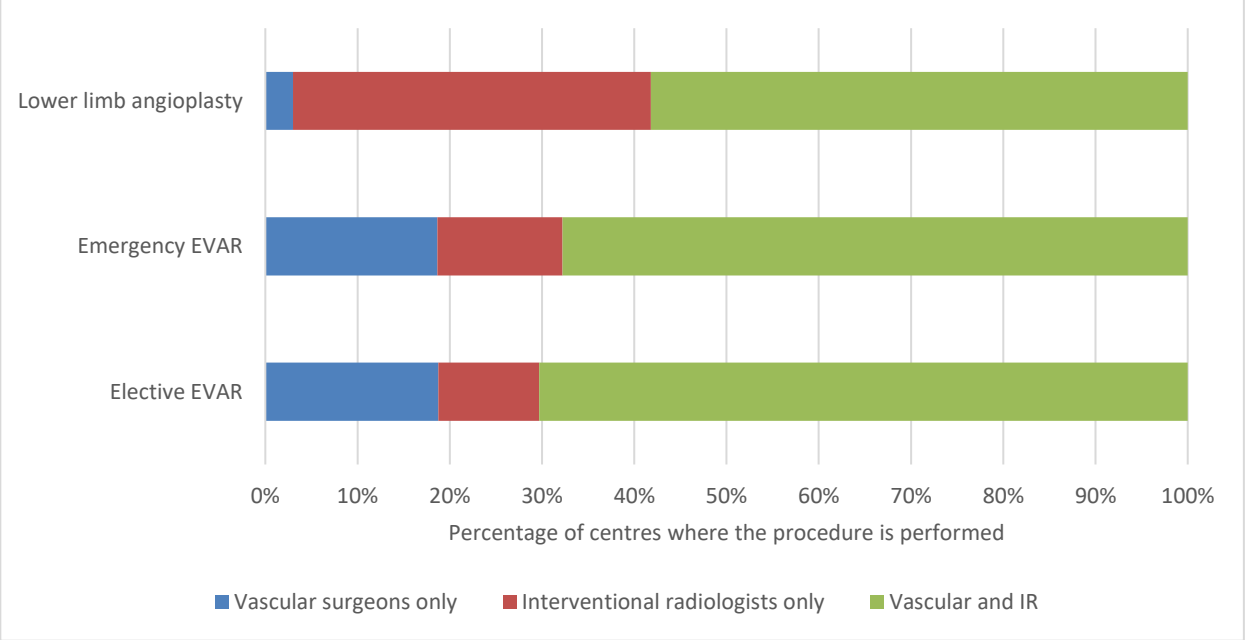
2.6 Staff performing endovascular procedures

Figure 2.5 summarises which staff perform endovascular procedures in the 67 vascular units that responded to these questions.

With respect to lower limb angioplasty:

- Vascular surgeons do not perform lower limb angioplasty in 26 units (38.8%), either supervised or independently.
- In 17 units (25.4%), vascular surgeons perform angioplasty under the supervision of interventional radiologists.
- In 35 units (52.2%), vascular surgeons perform lower limb angioplasty independently.
- In 2 units (5.71%), only vascular surgeons perform lower limb angioplasty; interventional radiologists neither perform nor supervise lower limb angioplasty.
- The number of vascular surgeons carrying out lower limb angioplasty independently per unit was median 3, range 1-12.

Figure 2.5: Performers of endovascular procedures



3. Lower limb revascularisation for PAD

3.1 Introduction

This chapter describes the processes and outcomes of care for patients who have a lower limb revascularisation. Lower limb revascularisation procedures can be performed using open surgery (bypass), endovascular techniques or a combination of both (hybrid).

In this chapter, we report on procedures performed between January 2021 and December 2021 and which cover:

- 6,509 endovascular procedures,
- 5817 open surgical procedures of which 4,209 were bypass procedures and 1,608 hybrid procedures.

The analysis focuses on the first procedure undergone by a patient during an admission; subsequent procedures are considered to be re-operations. Hybrid procedures are analysed with the open surgical (bypass/endarterectomy) procedures.

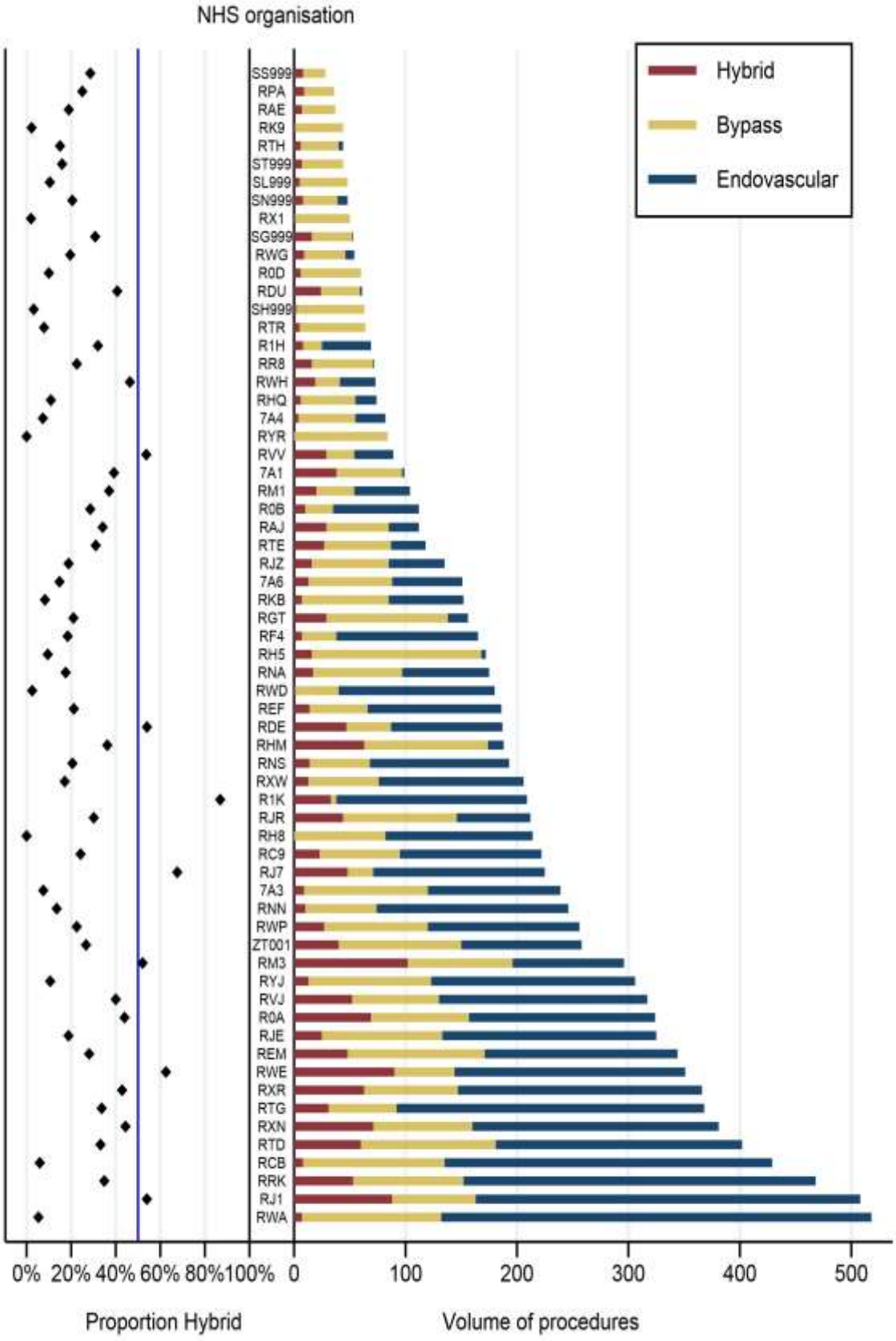
Figure 3.1 shows the frequency of each type of procedure by NHS trust, for those Trusts that perform all three types. For Trusts that have lower case ascertainment for angioplasty compared to bypass in the NVR, the figure does not depict the true distribution of procedures and should be interpreted with caution.

Case ascertainment has remained stable over time for all procedures (Table 3.1). Nonetheless, overall data submission for lower limb angioplasty remains comparatively low and there was considerable variation between NHS trusts (Figure 3.1). The 2018 GIRFT report on vascular services recommended that case ascertainment rates for lower limb endovascular procedures should exceed 85% [Horrocks 2018]. NHS hospitals should ensure there are sufficient resources (including administrative support) for vascular services to meet this target level of participation in the NVR.

Table 3.1: Estimated case ascertainment for lower limb revascularisation procedures, by year

	Open surgical procedures			Endovascular procedures		
	2019	2020	2021	2019	2020	2021
NVR procedures	6,550	5,403	5,817	8,710	6,597	6,509
Expected procedures	7,616	6,323	6,803	16,851	13,853	14,469
Estimated case ascertainment	86%	85%	86%	52%	48%	45%

Figure 3.1 Frequency of each type of revascularisation procedure by NHS trust for 2021



3.2 Patient and procedure characteristics

Endovascular

Two-thirds of patients undergoing endovascular lower limb procedures were men (68.3%), and about a quarter of patients were aged 80 years or older (24.6%). The prevalence of ischaemic heart disease, hypertension and diabetes was high and most patients were on antihypertensive, antiplatelet medication and a statin (see Appendix 3 for details). A third had undergone a previous procedure on the same limb (37.8%).

The procedures involved interventions in 10,750 vessels in 2021, a small increase from 10,946 in 2020 but still below the 14,188 in 2019 before the COVID-19 pandemic (Table 3.2). There has been an increase in the proportion of below-the-knee interventions over time, rising from 15.6% in 2019 to 20.8% (Table 3.2).

Half of the endovascular procedures involved treatment of a single vessel (53.1%), with 32.1% treating two, 12.2% treating 3 and 2.6% treating 4 or more vessels. The most common site was the superficial femoral artery, followed by the tibial/pedal, popliteal and common iliac arteries (see Appendix 3). Balloon angioplasty alone was the most common type of intervention (8,219 vessels, 76.5%), while 2,531 (23.5%) were a combination of angioplasty and stenting. The success rate of the procedures (defined as successful by the operator) was high overall, although the rate decreased slightly for anatomical locations further down the leg.

The indication for revascularisation is presented in Table 3.3, and highlights the difference between patients who were admitted electively and those who were admitted as an emergency admission.

Table 3.2: Treated vessels during lower limb endovascular procedures between 2019 and 2021

	2019		2020		2021	
Artery	Number	%	Number	%	Number	%
Aorta	126	0.9%	101	0.9%	62	0.6%
Common iliac	2,307	16.3%	1,575	14.4%	1378	12.8%
External iliac	1,731	12.2%	1,173	10.7%	1,129	10.5%
Superficial femoral	4,320	30.4%	3,249	29.7%	3,137	29.2%
Common femoral/ profunda femoral	523	3.7%	374	3.4%	343	3.2%
Popliteal	2,525	17.8%	2,062	18.8%	2,072	19.3%
Tibial/pedal	2,208	15.6%	2,047	18.7%	2,236	20.8%
Within graft	448	3.2%	365	3.3%	393	3.7%
Total vessels	14,188		10,946		10,750	

Table 3.3: Characteristics of lower limb revascularisation procedures undertaken in 2021

	Elective		Non-elective	
	Endovascular	**Open**	**Endovascular**	**Open**
Chronic limb ischaemia				
Asymptomatic	184 (4.3%)	29 (0.9%)	38 (1.7%)	19 (0.7%)
Intermittent claudication	1229 (28.6%)	637 (20.2%)	109 (4.9%)	45 (1.7%)
Nocturnal/resting pain	756 (17.6%)	1052 (33.4%)	234 (10.6%)	494 (18.5%)
Necrosis/gangrene	1865 (43.4%)	974 (30.9%)	1586 (71.7%)	1397 (52.4%)
Acute limb ischaemia	197 (4.6%)	163 (5.2%)	218 (9.9%)	573 (21.5%)
Trauma	4 (0.1%)	4 (0.1%)	10 (0.5%)	39 (1.5%)
Aneurysm	62 (1.4%)	290 (9.2%)	17 (0.8%)	100 (3.8%)

VSGBI: PAD QIF

Trusts should aim to perform at least 75% of lower limb revascularisations on planned operating lists.

Endovascular

In 2021, there were 2,212 (34.0%) non-elective and 4,297 (66.0%) elective index lower limb endovascular procedures. Most endovascular procedures (90.4%) were performed under local anaesthetic, with 1.9% under regional and 7.7% under general anaesthetic. Overall, 96.2% of the endovascular revascularisations were performed between 8am and 6pm on a weekday, which was assumed to mean they had been on planned operating lists. The percentage of endovascular procedures performed on planned lists was at least 75% for all but one NHS trust among those that submitted 10 or more procedures in 2021. This suggests that, among those Trusts with high case ascertainment, most met the QIF target of at least 75% during the 2021 audit period (53 out of 54 NHS trusts, 98.1%).

Open surgical (bypass/hybrid)

There were 3,149 elective open procedures in 2021, which was an increase of 10% compared to the 2,864 in 2020. There was also a small increase in non-elective procedures, with 2,668 in 2021 compared to 2,537 procedures in 2020. For open procedures, 84.8% were performed under general anaesthetic, 12.9% under regional and 2.3% under local.

There were 5,370 (92.8%) open procedures undertaken in 2021 that were performed between 8am and 6pm on a weekday. This was 98.0% for elective and 86.7% for non-elective procedures. The percentage of open surgical procedures performed on planned lists was at least 75% for all but two NHS trusts that submitted 10 or more procedures in the NVR in 2021 (62 out of 64 NHS trusts, 96.9%).

VSGBI: PAD QIF

Patients admitted non-electively with chronic limb-threatening ischaemia (CLTI) should have a revascularisation procedure within five days.

Endovascular

There were 4,441 patients presenting with CLTI who underwent endovascular revascularisation in 2021, of whom 1,820 (41.0%) were admitted non-electively. Among these patients, 54.5% were revascularised within 5 days in 2021, which was an improvement compared to 2019 (52.3%) but lower than 2020 (58.2%). The median time from admission to intervention was 5 days (IQR 2-9 days) in 2021 and 4 days (IQR 2-8 days) in 2020. This suggests that patients being admitted with CLTI during the COVID-19 pandemic in 2020 may have been better served than other vascular patients, but the restoration of elective activity may have led to an increase in waiting times for CLTI in 2021.

Open surgical

There was an increase in open surgical procedures for CLTI in 2021 (n=3,917) compared to 2020 (n=3,483). Among the 2021 cohort, 1,891 (48.3%) were admitted non-electively, a slight proportional decrease compared to 2020 (50.0%), indicating the resumption of elective activity in 2021. In 2021, 54% of the non-elective patients were revascularised within 5 days. As with the endovascular procedures, this was lower than 2020 (59.6%) but higher than 2019 (48.4%). The median time from admission to intervention was 5 days (IQR 2-8 days) in 2021, compared to 4 days (IQR 2-8 days) in 2020.

All revascularisation procedures

Overall, 3,711 patients were admitted non-electively with CLTI and underwent revascularisation in 2021 (vs. 3,532 in 2020). The proportion of patients revascularised within 5 days from admission was 54.3% in 2021, 58.9% in 2020 and 50.5% in 2019. The median time from admission to intervention was 5 days (IQR 2-9 days) in 2021 and 2019, and 4 days (IQR 2-8 days) in 2020. This suggests that NHS trusts have improved since the PAD QIF was published in 2019, but the marked improvement noted in 2020 may have been associated with the reduction in elective activity due to the COVID-19 pandemic and has since deteriorated slightly.

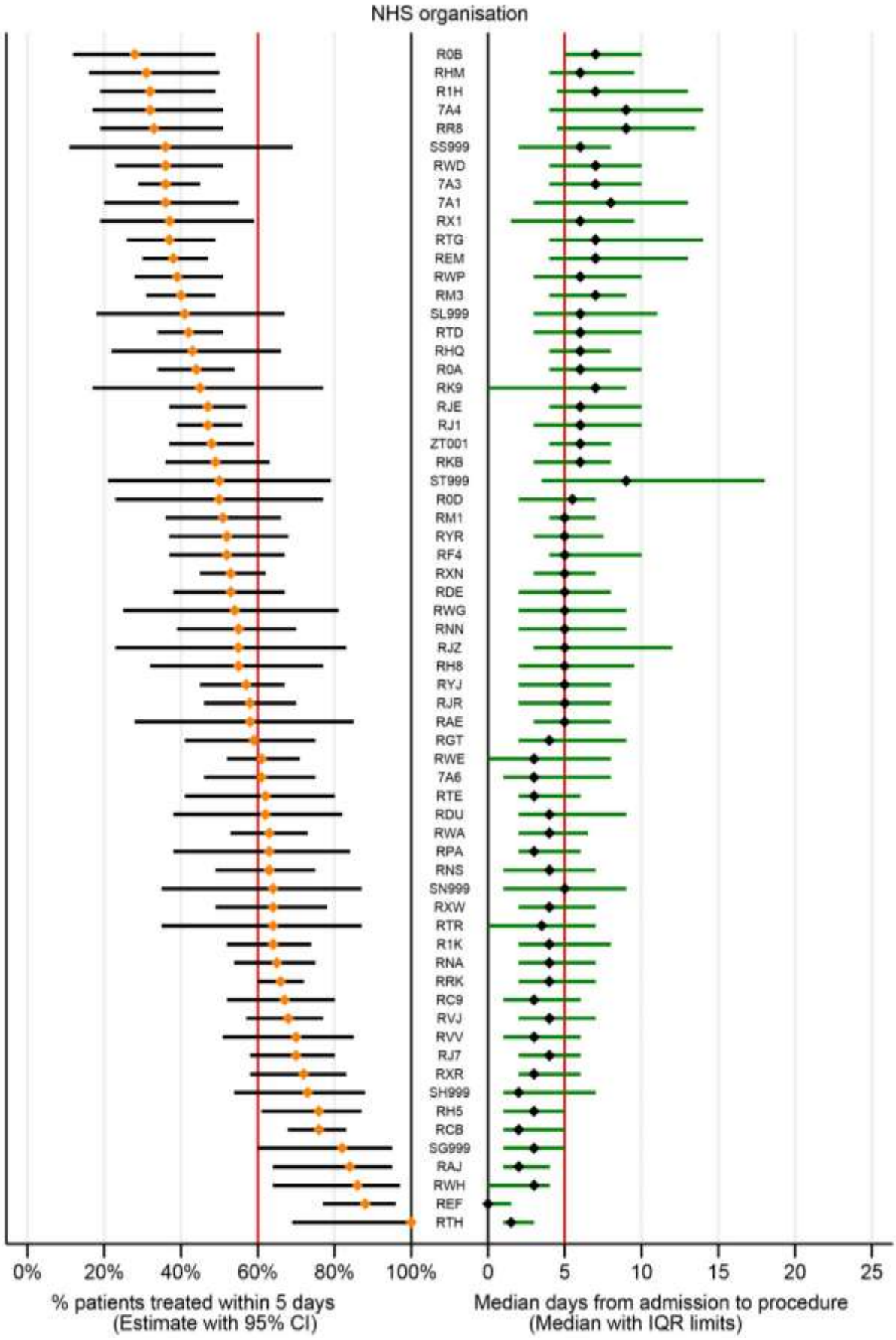
Figure 3.2 depicts the proportion of patients revascularised within 5 days from admission (left panel) across the 64 NHS trusts that performed 10 or more revascularisation procedures for non-elective CLTI admissions in 2021. The right panel summarises the median (IQR) time from admission to procedure for the same NHS trusts. The figure shows considerable variation between NHS trusts in terms of the proportion of patients with timely revascularisation in 2021.

In summary:

- at 25 vascular units, the pathway from admission to surgery took more than five days for half of patients with CLTI
- at 9 vascular units, the pathway took longer than 10 days for a quarter of patients
- 39 vascular units had more than half their patients operated on within 5 days.

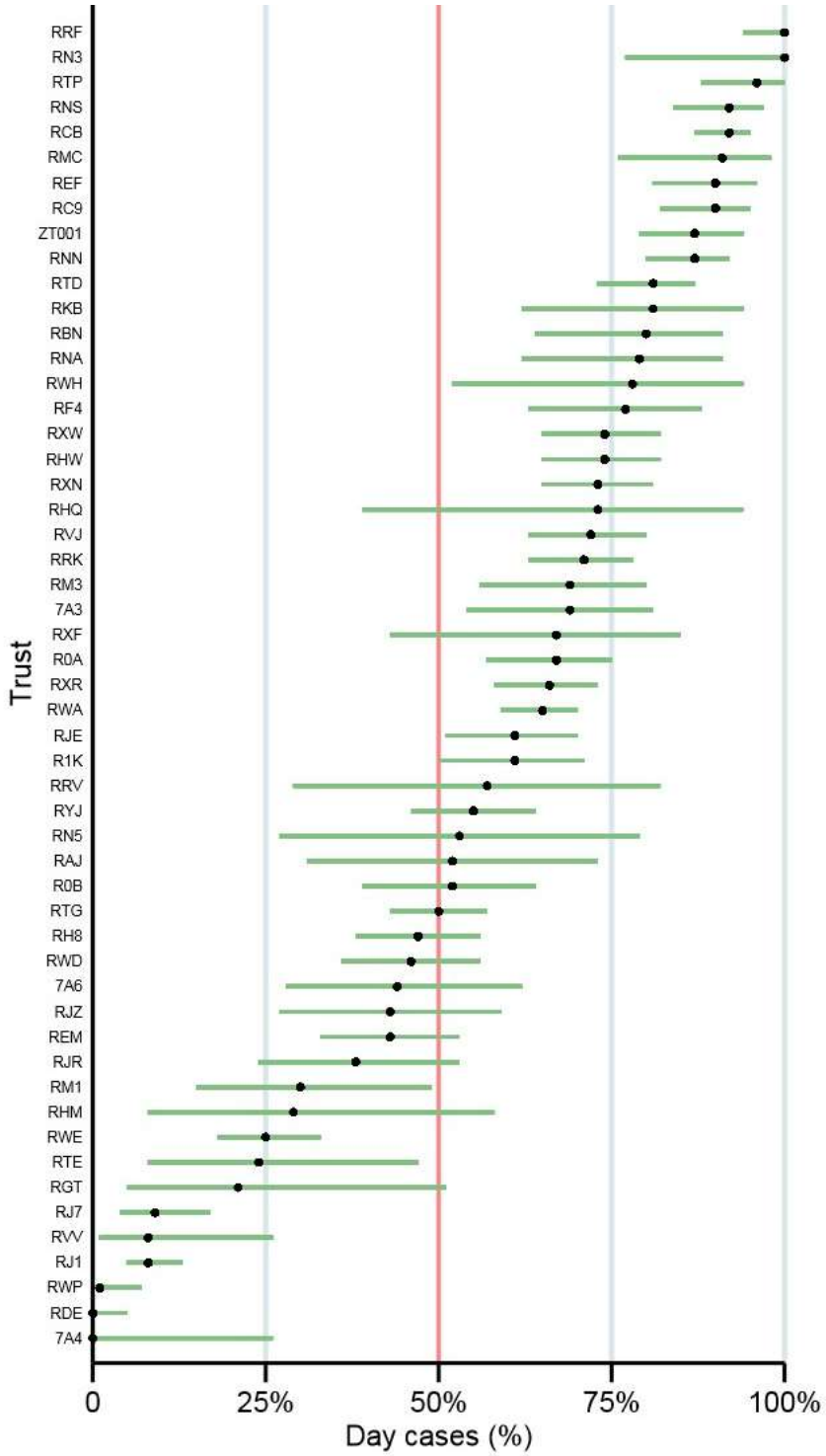
More in-depth analysis of delays to revascularisation in patients with chronic limb-threatening ischaemia can be found in Birmpili et al [2021] and Li et al [2022].

Figure 3.2: Proportion of non-elective patients with CLTI who had revascularisation (open, endovascular or hybrid) within 5 days from admission by active NHS trust with a volume of ≥10 non-elective CLTI cases per year in 2021.



The 2018 GIRFT report on vascular services emphasised the potential gains in efficiency that could stem from a greater number of endovascular revascularisation procedures being performed on a same-day basis [Horrocks 2018]. The NVR data for 2021 revealed substantial variation in the proportion of elective procedures done as day cases (Figure 3.3). Overall, 60.2% of elective endovascular procedures were performed as day cases in 2021 compared to 58.5% in 2020.

Figure 3.3: Proportion of elective endovascular procedures performed as day cases, by NHS trust with a volume of ≥10 elective cases per year in 2021.



3.3 Outcomes of lower limb revascularisation procedures

Table 3.4 summarises the outcomes of the lower limb endovascular and open revascularisation procedures, by mode of admission. As expected, patients undergoing procedures as non-elective admissions generally had higher complication rates and re-intervention rates than those undergoing elective procedures. Patients undergoing revascularisation procedures for acute limb ischaemia also had worse outcomes than CLTI, with an in-hospital mortality rate of 0.8 (95% CI 0.2-2.4) for elective and 7.7 (95% CI 5.9-9.8) for non-elective admissions.

Table 3.4: Postoperative outcomes after lower limb revascularisation for 2021 by procedure type

	Elective		Non-elective	
	Endovascular	**Open**	**Endovascular**	**Open**
Total procedures	4,297	3,149	2,212	2,668
Post-op destination	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Ward	1,861 (43.3%)	2,300 (73.0%)	2,077 (93.9%)	1,937 (72.7%)
Level 2 (HDU/PACU)	42 (1.0%)	685 (21.8%)	56 (2.5%)	552 (20.7%)
Level 3 (ICU)	<5 (0.1%)	136 (4.3%)	17 (0.8%)	172 (6.5%)
Died in theatre	0 (0.0%)	0 (0.0%)	0 (0.0%)	<5 (0.0%)
Day-case unit	2,386 (55.6%)	28 (0.9%)	61 (2.8%)	<5 (0.1%)
Complications	**Rate**	**Rate**	**Rate**	**Rate**
None	94.6	84.0	84.9	71.9
Cardiac	0.3	1.7	1.9	4.0
Respiratory	0.2	2.2	3.0	5.5
Limb ischaemia	0.4	3.3	4.3	9.0
Renal failure	0.2	0.6	0.9	2.4
Further procedures				
None	95.8	91.0	80.0	79.9
Angioplasty/stent	1.3	2.3	6.3	3.9
Bypass	0.8	1.6	4.2	4.0
Minor amputation	1.2	1.6	8.8	4.5
Major amputation	0.7	1.2	5.2	6.9
30-day major amputation	1.3	1.7	7.7	8.6
In-hospital mortality	0.6	1.3	4.1	4.8
Re-admission to higher level care	0.5	1.3	2.4	2.8
Re-admission within 30 days	8.9	10.1	19.8	13.2
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Overall LOS (days)	0 (0 - 1)	5 (3 - 8)	12 (6 - 23)	14 (8 - 24)
Admission-to-procedure (days)	0 (0 - 0)	0 (0 - 1)	5 (2 - 8)	4 (1 - 7)
Post-op LOS (days)	0 (0 - 1)	4 (3 - 7)	6 (2 - 14)	9 (5 - 17)

Patients admitted non-electively and undergoing endovascular procedures had a lower mortality rate (4.1% [95% CI 3.3-5.0]) compared to open procedures (4.8% [95% CI 4.1-5.7]) but a higher readmission rate within 30 days (19.8% [95% CI 18.1-21.5] for endovascular vs 13.2% [95% CI 11.9-14.6] for open surgical revascularisation) (Table 3.4).

The outcomes of the revascularisation procedures for patients with CLTI admitted non-electively are summarised in Table 3.5 for 2021, by type of revascularisation procedure (endovascular or open surgical). There are differences in outcomes according to whether patients met the 5-day target for the delay between admission and procedure, although we caution against the over-interpretation of these figures. Further work is required to identify the degree to which these differences arise from the time to surgery or from the patients having more severe disease, for which outcomes would be expected to be worse.

Table 3.5: Postoperative outcomes following lower limb revascularisation, for patients with CLTI[1] undergoing non-elective revascularisation in 2021, by admission-to-procedure time in days

	Admission-to-procedure ≤5 days		Admission-to-procedure >5 days	
	Endovascular	**Open**	**Endovascular**	**Open**
Procedures	990 (54.5%)	1,020 (54.0%)	826 (45.5%)	868 (46.0%)
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Overall length of stay (LOS)	7 (4 - 16)	11 (7 - 18)	19 (13 - 32)	21 (14 - 31)
Post-op LOS	5 (1 - 13)	8 (5 - 16)	7 (3 - 18)	10 (6 - 19)
Complications	**Rate**	**Rate**	**Rate**	**Rate**
None	87.0	74.9	82.2	73.2
Cardiac	1.9	2.9	2.1	3.5
Respiratory	2.3	5.5	3.9	5.0
Limb ischaemia	3.7	7.8	3.8	7.6
Renal	0.6	1.7	1.3	1.8
Further unplanned procedures				
None	80.9	80.9	79.8	78.9
Angioplasty/stent	6.1	4.4	6.4	3.9
Bypass	4.1	3.8	3.3	4.3
Minor amputation	10.0	5.7	8.4	5.5
Major amputation	4.3	5.3	5.8	7.3
30-day major amputation	7.0	6.9	8.7	8.6
In-hospital mortality	3.7	4.3	4.1	3.7
Re-admission to higher level care	1.6	2.8	2.8	2.4
Re-admission within 30 days	19.9	13.1	19.9	13.5

[1] Fontaine score 3 or 4

There were 1,608 hybrid procedures in 2021, of which 863 had endovascular elements above the surgical element angioplasties (490 elective, 373 non-elective), and 312 hybrid procedures in which the endovascular element was below (163 elective, 149 non-elective); the other procedures did not fit within these simple categories. The rate of postoperative complications differed slightly depending on whether the endovascular element was proximal (above) or distal (below) the surgical element. The rate of any complication was 16.4% for proximal and 9.2% for distal elective cases and 26.8% for proximal and 24.2% for distal non-elective cases. The rates of unplanned procedures after proximal and distal angioplasties were 9.8% vs 4.3% for elective and 17.4% vs 20.8% for non-elective procedures. The reasons for this will be explored in the coming year.

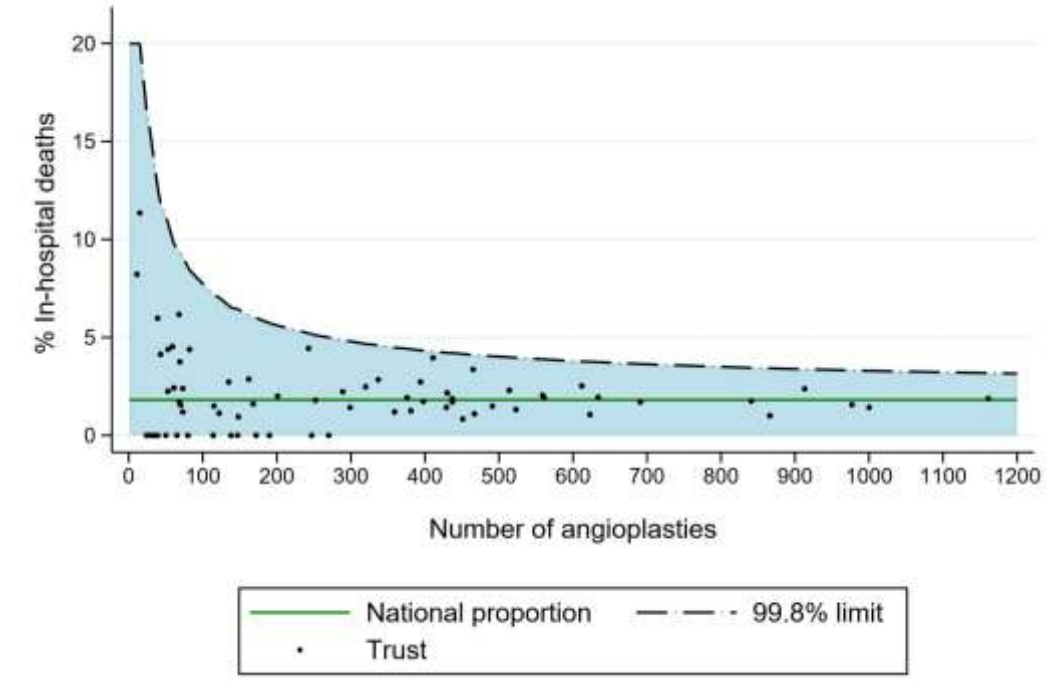
3.4 Postoperative mortality rates for lower limb revascularisation

Figure 3.5 presents the risk-adjusted mortality rates for each NHS trust that submitted 10 or more endovascular revascularisations between January 2019 and December 2021. All NHS trusts had a risk-adjusted rate of postoperative in-hospital mortality that fell within the expected range of the overall national average of 1.8% (95% CI: 1.6 to 2.0).

The rates of in-hospital mortality after endovascular revascularisation were adjusted to take account of the differences in patient populations within each organisation. The model included admission mode, presenting problem, Fontaine score, patient age, chronic lung disease, chronic renal disease, chronic heart failure and smoking status.

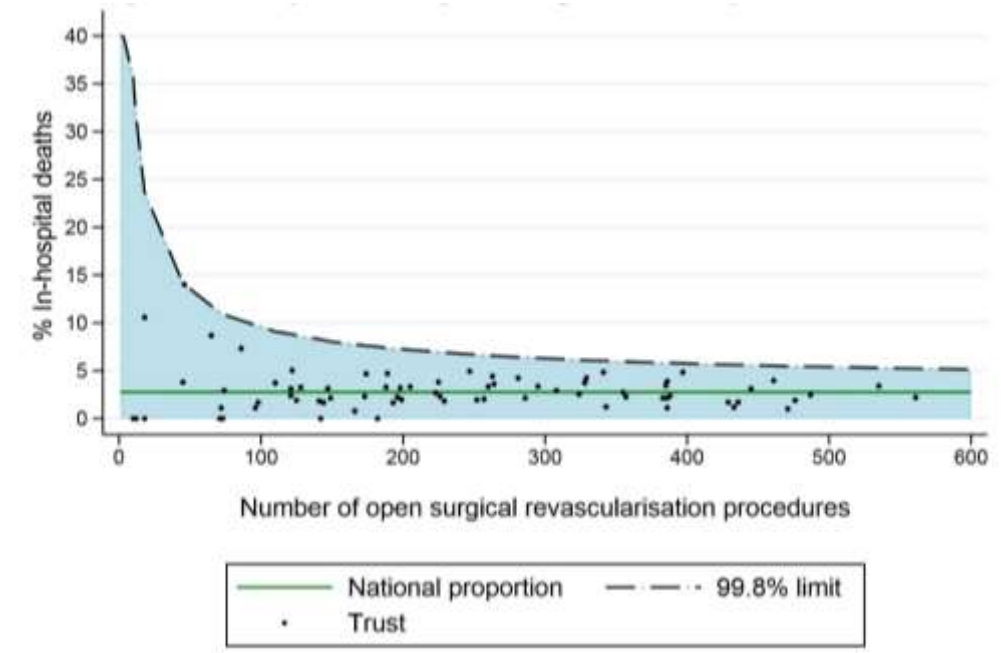
The funnel plot for open surgical procedures is shown in Figure 3.6. All NHS trusts had risk-adjusted mortality rates that were within the expected range of the national average (=2.8%;95% CI: 2.5 to 3.0). The risk adjustment model accounted for age, sex, procedure type, Fontaine score, mode of admission, ASA grade, chronic lung disease, use of antiplatelets, white blood count and haemoglobin, creatinine, sodium and potassium levels.

Figure 3.5: Funnel plot of risk-adjusted in-hospital deaths after lower limb endovascular revascularisation for NHS trusts from January 2019 to December 2021.



Note: This figure is based on data from NHS trusts that continue to offer endovacsular revascularisation, with 10 or more procedures in the NVR.

Figure 3.6: Funnel plot of risk-adjusted in-hospital deaths from lower limb bypass for NHS trusts, shown for procedures performed between January 2019 and December 2021.



4. Major lower limb amputation

4.1 Introduction

This chapter describes the patterns of care and outcomes for patients undergoing unilateral major lower limb amputations due to vascular disease during the audit period from January 2021 to December 2021.

During this period, 3,068 primary major unilateral amputations were recorded in the NVR, which consisted of 1,532 (49.9%) below the knee amputations (BKAs) and 1,536 (50.1%) above the knee amputations (AKAs). Through knee amputations (TKAs) have been analysed as part of the BKA group. TKAs accounted for 3.4% of all major amputations recorded on the NVR during the 1-year audit period.

In addition, NHS hospitals submitted information on 832 minor amputations, and other types of major amputation (59 bilateral, 29 due to trauma and 450 that were performed within 30 days of a lower limb revascularisation procedure). This chapter focuses on major unilateral lower limb amputations that were primary procedures, and these other types of procedure were not included in the analysis.

There was a slight reduction in the number of unilateral major amputations undertaken within the NHS in 2021 compared to 2020 and 2019, which is reflected in both the number of expected procedures (derived from routine hospital data) and the number submitted to the NVR (Table 4.1). The estimated case ascertainment for major unilateral lower limb amputations has remained stable, and the overall level exceeds the target of 85% recommended within the 2018 GIRFT vascular surgery report [Horrocks 2018]. Nonetheless, many NHS trusts are still failing to record a large proportion of their major lower limb amputations in the NVR.

Table 4.1: Estimated case ascertainment for major lower limb vascular amputations by year

Case ascertainment	2019	2020	2021
NVR procedures	3,703	3,663	3,512
Expected procedures	4,204	4,141	3,740
Estimated case ascertainment	88%	88%	94%

4.2 Care pathways

The demographic and clinical characteristics of patients who had lower limb major amputations in 2021 were similar to those in 2020 and 2019. Tissue loss was the most common presenting problem for both below knee and above knee procedures (42.4% and 38.1%, respectively). More than half of patients had a previous ipsilateral lower limb procedure (63.7% BKA and 52.8% AKA). More than 80% of patients were non-elective admissions. Most patients were male and over 90% of patients had one or more comorbidities – mainly hypertension, diabetes and ischaemic heart disease.

VSGBI: Amputation QIF

All patients undergoing major amputation should be admitted in a timely fashion to a recognised arterial centre with agreed protocols and timeframes for transfer from spoke sites and non-vascular units.

NHS vascular units have to balance the urgency of surgery with the need to optimise patients' condition before their operation. For patients admitted non-electively for an amputation in 2021, the median time from vascular assessment to surgery was 7 days (IQR: 3 to 19 days). For patients undergoing amputations as elective procedures, the median time was 36 days (IQR: 13 to 111 days), probably reflecting the less severe nature of their condition. Overall, the median delay was 9 days (IQR: 3 to 26 days).

Figure 4.1 describes the median and interquartile range (IQR) of the time to amputation from vascular assessment for patients admitted non-electively between 2019 and 2021. Patients undergoing major amputation in 2021 on average shared similar waiting times with those in 2019 but with a slightly smaller variation.

Figure 4.1: Distribution of times from vascular assessment to non-elective amputation by month between January 2019 and December 2021. The median is shown by the line within the blue box (whose limits are the 25th and 75th percentile). The red line is the overall median time of 7 days

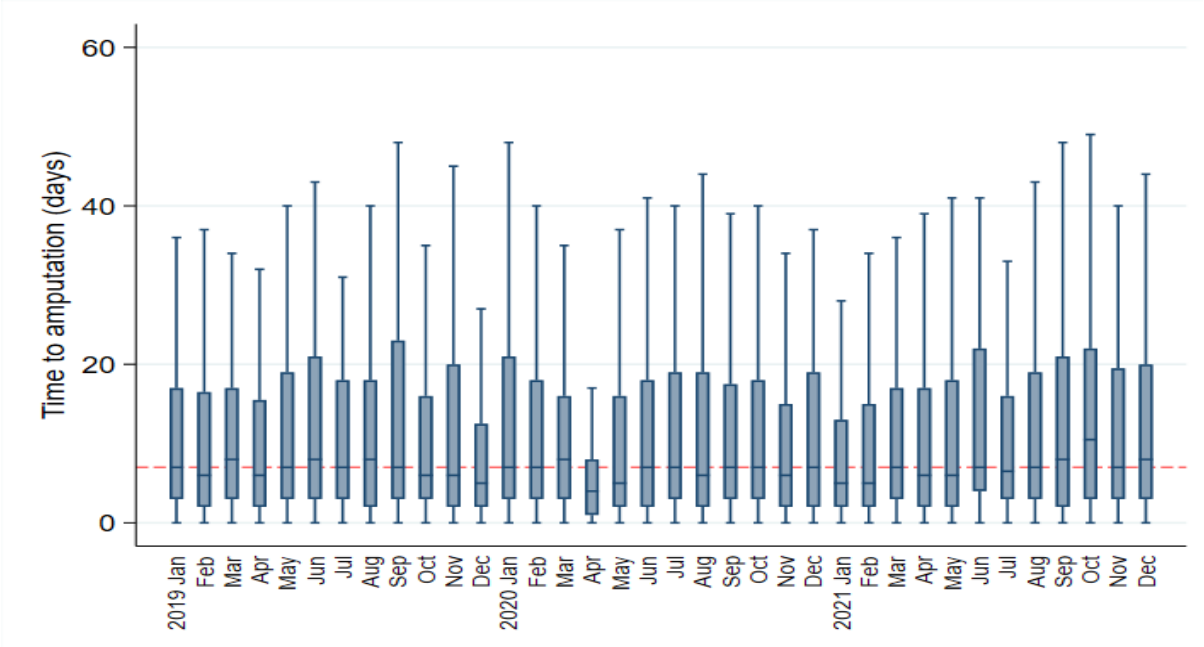


Figure 4.2 describes the times from vascular assessment to amputation by NHS trust for patients admitted non-electively in 2021. The graph shows some variation across NHS trusts in the median wait, but among the 25% of patients who have the longest waits, there was considerably greater variation across NHS trusts. At 8 NHS trusts, more than 25% of patients had a wait that exceeded 30 days.

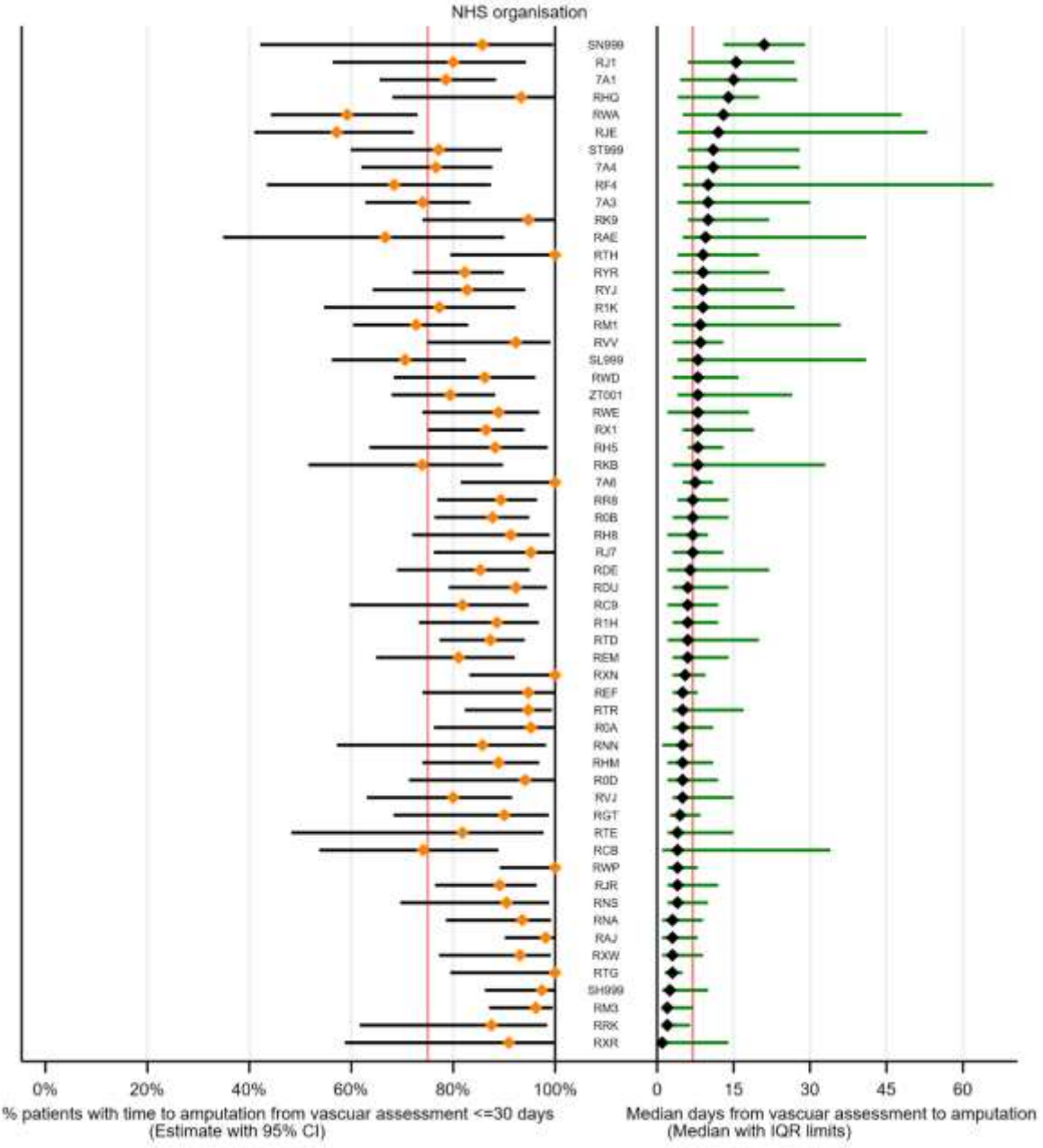
There are various reasons for patients to wait different times for an amputation, such as revascularisation attempts. However, this is unlikely to explain the variation shown in Figure 4.2. Vascular units should investigate the cause of this and attempt to reduce the longer times as much as possible.

VSGBI: Amputation QIF

Below knee amputation should be undertaken whenever appropriate. Vascular units should aim to have an above knee to below knee ratio below one.

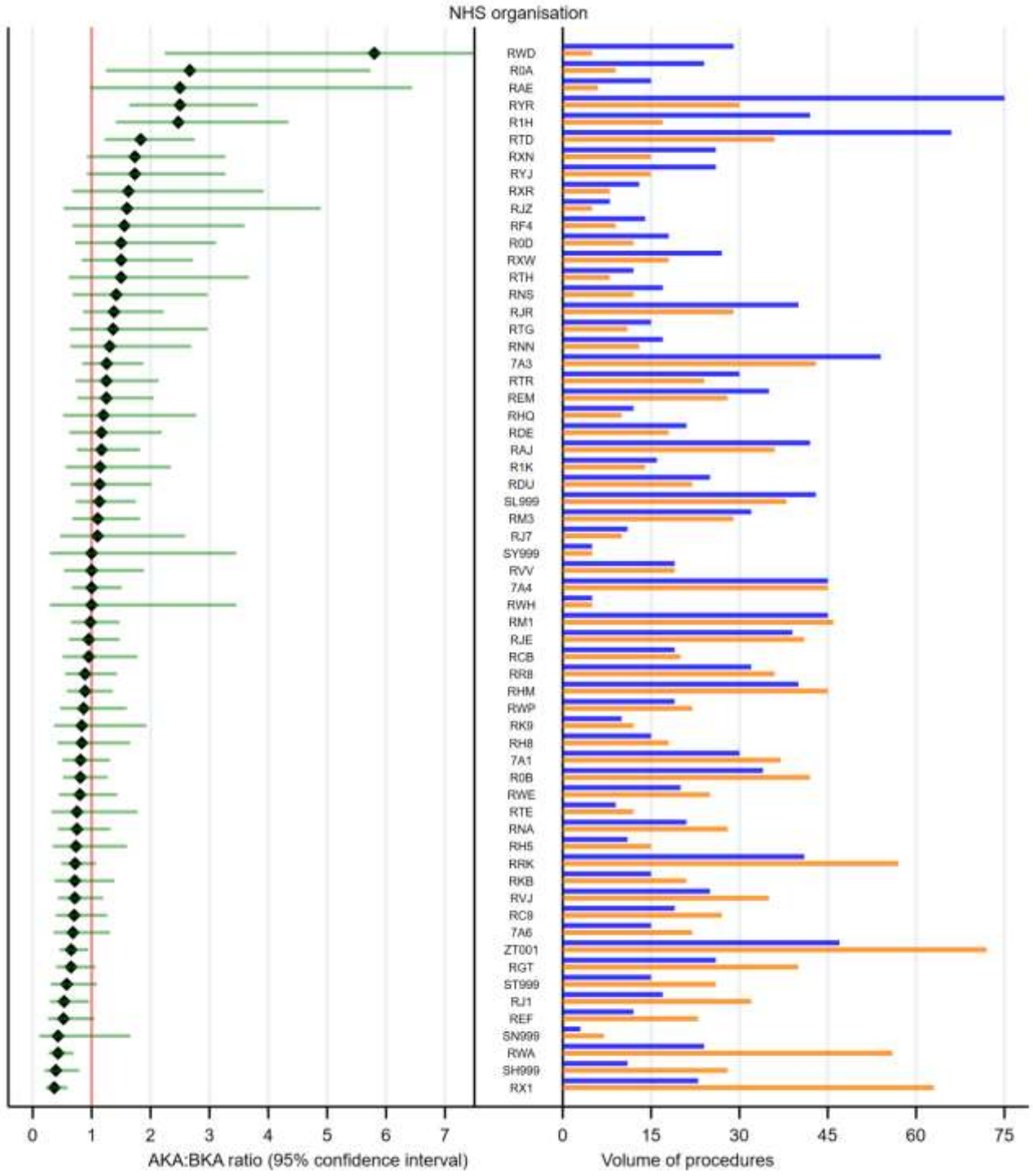
Figure 4.3 describes the volume of activity and the AKA:BKA ratio in 2021, by NHS trust. Nationally, the AKA:BKA ratio was 1.00 (95% CI: 0.93 to 1.08) in 2021. Just over half of the NHS trusts had a ratio of less than one, and 29 (47.5%) had ratios that were above 1.0. Five vascular units had a ratio above 2, of which one unit had a ratio close to 6. It is possible that the high ratios relate to some NHS trusts treating more severely ill patients, although it is not possible to confirm this with the data collected in the NVR.

Figure 4.2: Median (IQR) time from vascular assessment to non-elective amputation for procedures performed in 2021, by NHS trust[1], together with percentage (95% CI) of patients with time to amputation from vascular assessment <30 days.



[1]Figure presents NHS trusts reporting ≥10 non-elective major amputations in 2021.

Figure 4.3: Volume and ratio of above knee to below knee amputations for procedures performed in 2021, by NHS trust[1]. The blue horizontal line indicates the volume of above knee amputations, and the orange horizontal line shows the volume of below knee amputations.



[1]Figure presents NHS trusts reporting ≥10 major amputations in 2021.

VSGBI: Amputation QIF and NCEPOD: Recommendations

Major amputations should be undertaken on a planned operating list during normal working hours.
A consultant surgeon should operate or at least be present in the theatre to supervise a senior trainee (ST4 or above) undertaking the amputation.
The patient should have routine antibiotic and DVT prophylaxis according to local policy.

Table 4.2 summarises some key aspects of perioperative care for BKA and AKA patients. Performance against these standards was generally reasonable in 2021, but the figures suggest there is potential for improvement:

- The proportion of below knee and above knee major amputations performed during the day was 88.9% and 84.5%, respectively.
- A consultant surgeon was present for just over 70% of the procedures. The consultant presence rate was lower than in 2020 (BKA=77.5%; AKA=73.8%) and 2019 (BKA=80.0%; AKA=79.1%).
- Prophylactic antibiotics and DVT medication were recorded for 83% and 72% of patients, respectively.

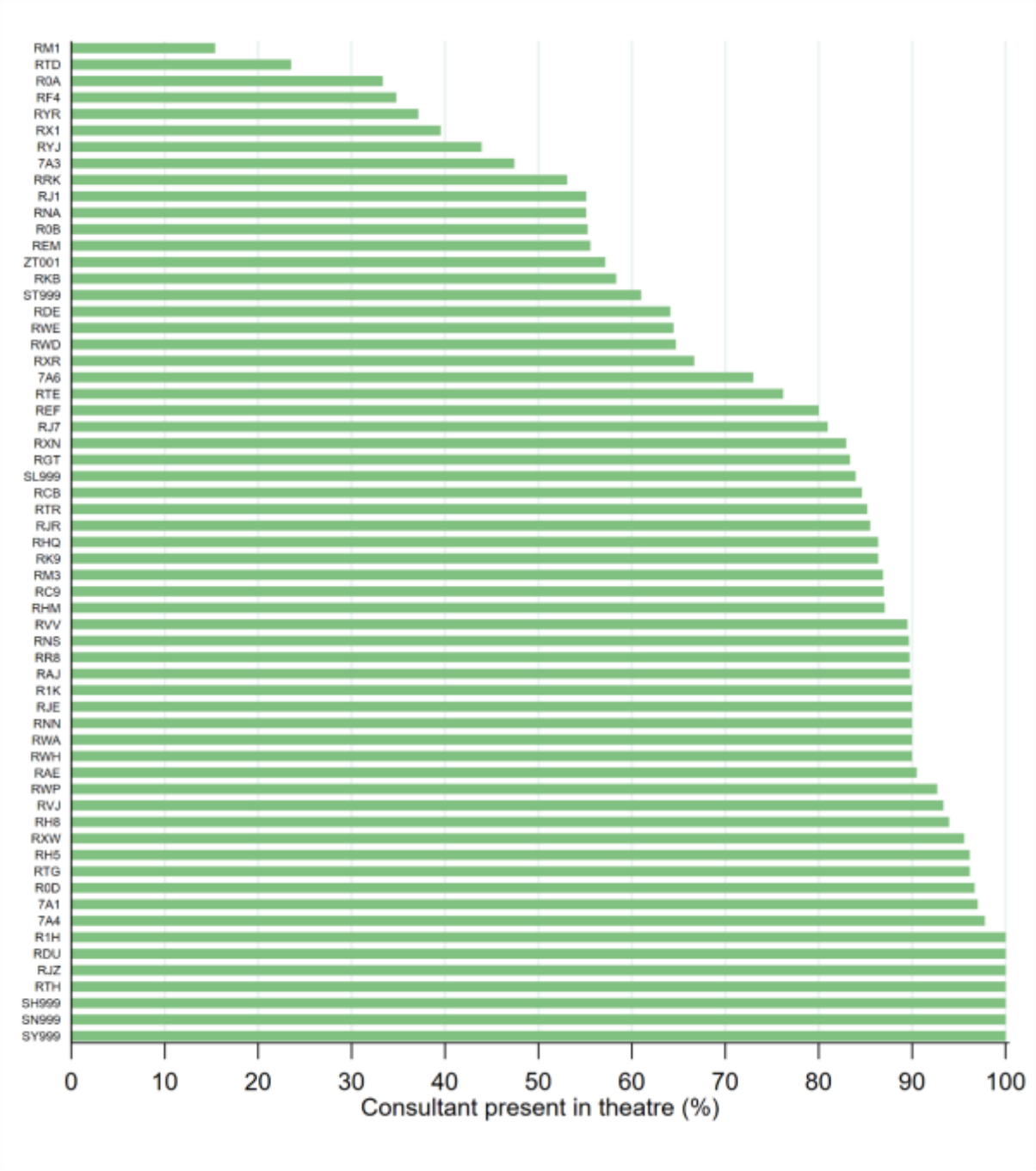
While many NHS trusts followed the recommendation that a consultant should be present in theatre during the audit period, there is some variation in practice across NHS organisations (Figure 4.4). Vascular units should investigate the reasons for this variation.

The observed levels of prophylactic antibiotics and DVT medication in 2021 were significantly higher than in previous years, in particular for prophylactic antibiotics. The NVR IT system was updated in July 2021 to make the collection of prophylaxis medication data more intuitive, and the increase in the reported rates probably reflects this change.

Table 4.2: Perioperative care of patients undergoing lower limb major amputation in 2021

	Below knee	%	Above knee	%
Procedures	1,532		1,536	
Mode of admission				
Elective	290	18.9	218	14.2
Non-elective	1,242	81.1	1,318	85.8
Time procedure started				
8am to 6pm	1,362	88.9	1,298	84.5
6pm to midnight	137	8.9	191	12.4
Midnight to 8am	33	2.2	47	3.1
Consultant present in theatre	1,115	72.8	1,103	71.8
Prophylactic medication				
Antibiotic prophylaxis	1,269	82.8	1,281	83.4
DVT prophylaxis	1,107	72.3	1,101	71.7

Figure 4.4: Percentage of major amputations where a consultant surgeon was present in theatre in 2021, by NHS trust[1]



[1]Figure presents NHS trusts reporting ≥10 lower limb major amputations performed in 2021

4.3 In-hospital outcomes following major amputation

Patient outcomes immediately following major lower limb amputation are summarised in Table 4.3.

The overall rate of in-hospital death in 2021 was 7.6% (95% CI: 6.7% to 8.6%), and the 30-day in-hospital mortality was 6.4% (95% CI: 5.5% to 7.3%). The in-hospital mortality rate for BKA and AKA procedures was 5.3% and 9.9%, respectively. These were slightly lower than the figures for 2020, respectively 6.3% and 10.7%. The overall median length of hospital stay associated with major lower limb amputations was 21 days (IQR: 13 to 34 days) in 2021. Most patients returned to the ward following amputation, while 12% of BKA patients and 18% of AKA patients were admitted to critical care (level 2 or level 3).

Overall, more than 25% of patients suffered more than one of the reported complications following major amputation. Respiratory complications occurred in 6.5% of BKAs and 8.9% of AKAs for procedures performed in 2021, which was a reduction on the rates of 8.0% for BKAs and 11.3% for AKAs in 2020.

Table 4.3: Patient outcomes following major lower limb amputation undertaken in 2021

	Below knee		Above knee	
Procedures	1,532		1,536	
Post-op destination				
Ward	1,341	87.5%	1,256	81.8%
Level 2 (HDU/PACU)	136	8.9%	176	11.5%
Level 3 (ICU)	55	3.6%	103	6.7%
	Median	**IQR**	**Median**	**IQR**
Days in level 2 critical care	2	1 to 4	2	1 to 4
Days in level 3 critical care	3	1 to 8	5	2 to 11.5
Overall length of stay (days)	21	13 to 34.5	20	12 to 33
Postoperative length of stay (days)	13	8 to 23	14	8 to 24
	Rate	**95% CI**	**Rate**	**95% CI**
Overall in-hospital mortality	5.3	4.3 to 6.6	9.9	8.4 to 11.5
30-day in-hospital mortality	4.1	3.1 to 5.2	8.7	7.3 to 10.2
Procedure complications				
Respiratory	6.5	5.3 to 7.8	8.9	7.5 to 10.5
Cardiac	3.3	2.5 to 4.4	4.4	3.4 to 5.5
Limb ischaemia	2.7	2.0 to 3.7	2.5	1.8 to 3.5
Renal failure	2.2	1.5 to 3.1	2.4	1.7 to 3.3
Surgical site infection	4.8	3.8 to 6.0	3.8	2.9 to 4.9
Postoperative confusion	2.3	1.6 to 3.2	3.1	2.3 to 4.0
Haemorrhage	0.3	0.1 to 0.7	0.3	0.1 to 0.8
Cerebral	0.3	0.1 to 0.7	0.9	0.5 to 1.5
No defined complications	75.5	73.3 to 77.7	72.1	69.8 to 74.3
Return to theatre	9.3	7.9 to 10.9	5.4	4.3 to 6.6
Re-admission to higher level care	1.9	1.3 to 2.7	2.1	1.4 to 2.9

Table 4.4: Patient outcomes following major lower limb amputation performed in 2021

	Admission-to-procedure ≤5 days		Admission-to-procedure >5 days	
	No.		**No.**	
Procedures	1,801	58.7%	1,266	41.3%
Days in critical care	**Median**	**IQR**	**Median**	**IQR**
Level 2	2	1 to 4	2	1 to 3
Level 3	4	2 to 10	4.5	3 to 10
Overall length of stay (days)	15	9 to 24	30	21 to 46
Post-op length of stay (days)	13	8 to 22	15	9 to 26
	Rate	**95% CI**	**Rate**	**95% CI**
Overall in-hospital mortality	7.2	6.0 to 8.5	8.2	6.7 to 9.8
30-day in-hospital mortality	6.0	4.9 to 7.2	6.9	5.6 to 8.5
No defined complications	75.3	73.3 to 77.3	72.3	69.7 to 74.7
Return to theatre	7.0	5.8 to 8.2	7.8	6.4 to 9.5
Re-admission to higher level care	1.9	1.3 to 2.6	2.1	1.4 to 3.1

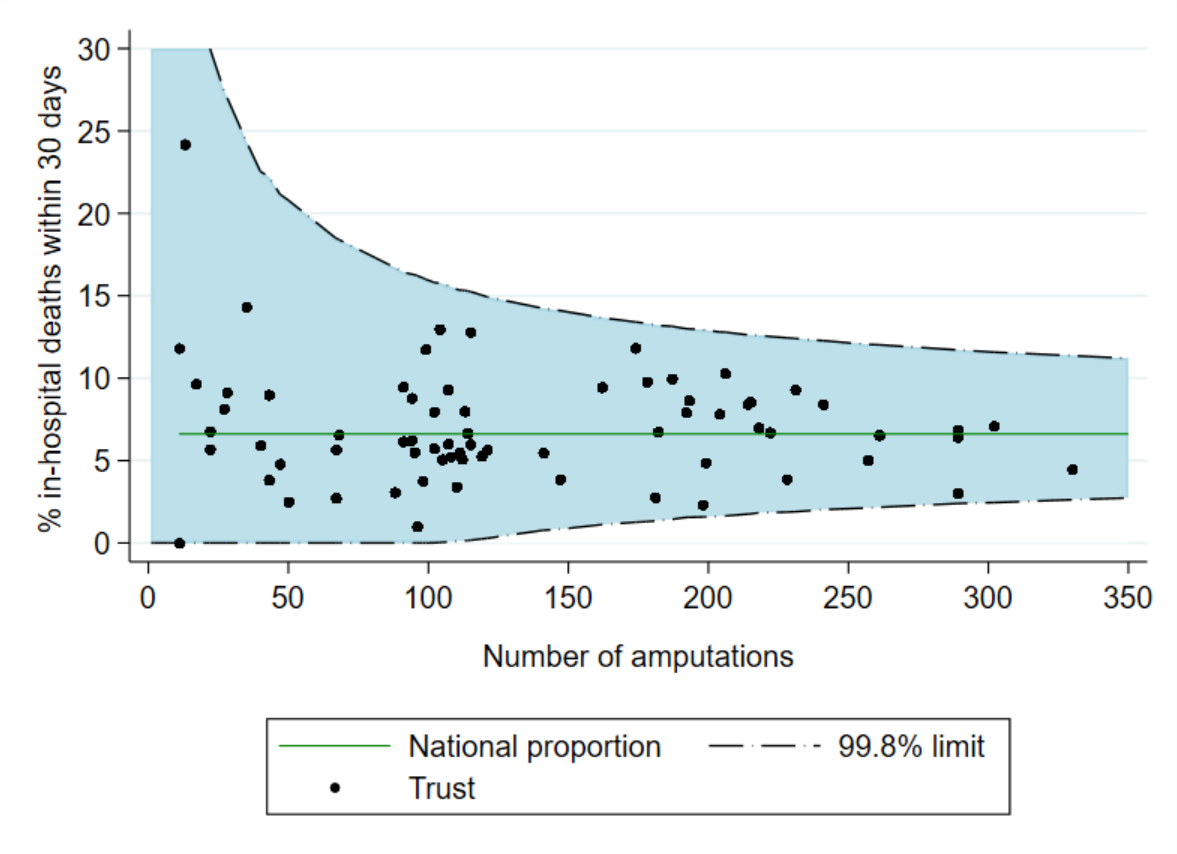
Outcomes for patients undergoing major amputations, by preoperative length of stay, are summarised in Table 4.4. About 59% of the patients underwent amputation within 5 days of being admitted. In comparison with the results for lower limb bypass and endovascular revascularisation, the differences in outcomes were small between patients with comparatively short and long times from admission to surgery.

Adjusted 30-day in-hospital mortality figures following major unilateral lower limb amputation for NHS trusts are shown in Figure 4.5. All NHS trusts had an adjusted rate that fell within the expected range from the national average of 6.6%.

For elective cases, the rates were adjusted for age, ASA grade (1-3 vs 4-5) and comorbid chronic renal disease. For non-elective cases, the risk adjustment model also included level of amputation (below or above the knee).

Among those patients who had unilateral major lower limb amputations undertaken within 30 days after revascularisation, the overall rate of in-hospital death was 7.9% (95% CI: 5.6% to 10.9%) and the 30-day in-hospital mortality was 7.2% (95% CI: 5.0% to 10.1%).

Figure 4.5: Risk-adjusted 30-day in-hospital death rate following major amputation for procedures undertaken during January 2019 and December 2021[1], shown in comparison to the three-year overall national average of 6.6%



[1]Figure presents NHS trusts reporting ≥10 major lower limb amputations between January 2019 and December 2021.

4.4 Discharge and follow-up

Discharge and follow-up of patients undergoing lower limb amputations in 2021, among patients discharged alive, are summarised in Table 4.5.

Approximately 1 in 10 patients were readmitted to hospital within 30 days of the amputations and after discharge from hospital.

Table 4.5: Discharge and follow-up of patients undergoing lower limb amputations in 2021, among patients discharged alive

	Below knee (n=1,407)	%	Above knee (n=1,375)	%
Wound healed at 30 days*	525	77.1	589	83.3
Referred to rehabilitation/limb fitting	1,150	82.8	956	70.2
Re-admission within 30 days*	143	10.2	124	9.0

* Figures calculated from patient records with available follow-up data

5. Repair of elective infra-renal abdominal aortic aneurysm

5.1 Background

An abdominal aortic aneurysm (AAA) is the local expansion of the abdominal aorta. The condition tends not to produce symptoms until the aneurysm ruptures. Most aneurysms occur below the kidneys (i.e., are infra-renal).

The organisation of vascular services undertaking AAA repair continues to evolve. The number of NHS vascular units performing any AAA repairs decreased from 74 in 2019 to 71 in 2021.

The National Abdominal Aortic Aneurysm Screening Programme (NAAASP) invites men for an ultrasound scan of their aorta in the year they turn 65 years old. If an aneurysm is detected, a repair procedure is planned with the patient and typically performed as an elective procedure.

The number of elective infra-renal AAA repairs being performed has decreased over the last three years, partly as a consequence of the COVID-19 pandemic. The number of procedures was 3,480 in 2019, but fell to 2,328 in 2020, a reduction of 33% from the previous year. In 2021, the number increased again to 2,744 procedures, but this is still below the level observed in 2019 and suggests there is a large backlog of patients with an AAA waiting for surgery.

In the last decade, there has been a decrease in the proportion of elective AAA repairs performed as endovascular (EVAR) procedures. The reasons for this could be a more conservative approach to treatment (particularly in older, sicker patients) and the influence of the draft NICE guidance, which favoured open repair over an endovascular approach.

Over the last three years, the proportion of EVAR procedures has been fairly stable, fluctuating around 60% (Table 5.2). There is a distinct pattern in the numbers of patients having open and endovascular procedures among the age groups, with open repairs being more common among patients aged under 70 (Figure 5.1). Appendix 3 contains a full description of the differences in the characteristics of patients who had EVAR and open procedures. The majority of procedures were performed for patients with an AAA diameter between 5.5 and 7.0 cm.

Table 5.1: Estimated case ascertainment of elective infra-renal AAA repairs*

	2019	2020	2021
Audit procedures	3,480	2,328	2,744
Expected procedures	3,674	2,493	3,005
Estimated case ascertainment	95%	93%	91%

*It is possible that a small number of complex EVAR procedures carried out for infra-renal aneurysms are included in the expected procedures figures due to issues related to their coding.

Table 5.2: Split of open and endovascular elective infra-renal AAA procedures by year

Year	Open	EVAR	Total	% EVAR
2019	1,378	2,102	3,480	60.4
2020	944	1,384	2,328	59.5
2021	1,116	1,628	2,744	59.3
Total	3,438	5,114	8,552	59.8

Figure 5.1: Distribution of elective infra-renal AAA repairs by age group between 2019 and 2021

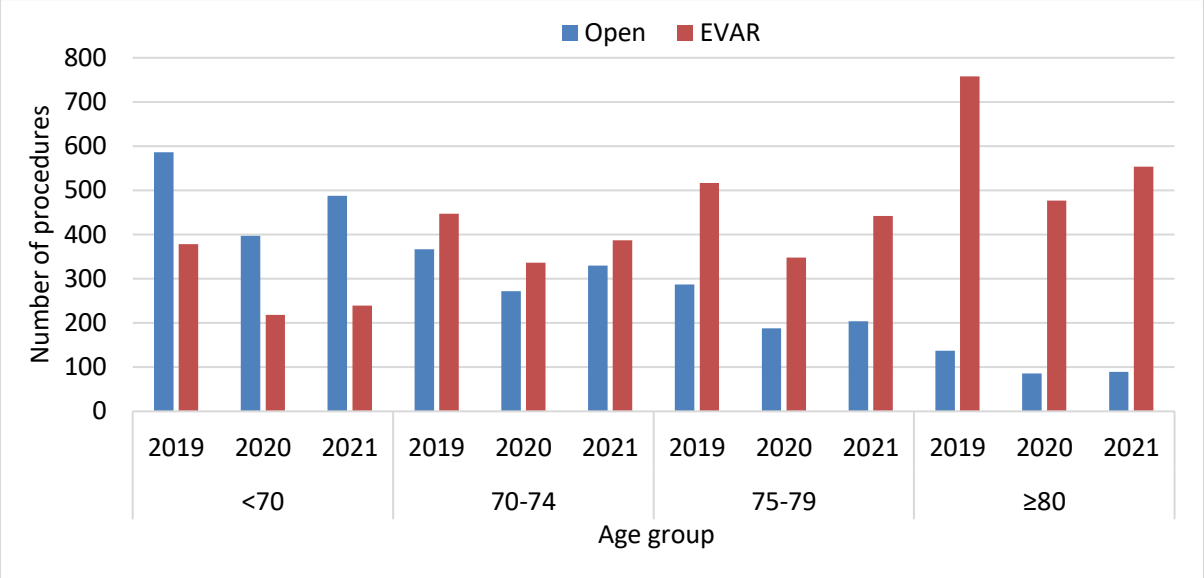


Figure 5.2 shows the proportion of EVARs in the left panel. The black horizontal bars depict their 95% confidence intervals. The right panel shows the number of open repairs (orange bars) and EVARs (blue bars) for 2021 by NHS trust. 20 of the 62 (32%) Trusts were performing more open repairs than EVARs.

A full description of a vascular network's aortic practice will include patients treated conservatively because it was not clinically appropriate for them to undergo an elective or emergency procedure. The NVR is unable to record the number of these patients, as they are outside of the scope of the NVR.

5.2 Pre-operative pathway for elective infra-renal aneurysms

The National AAA Screening Programme established the 8-week target time from referral to treatment to ensure elective repairs are scheduled sufficiently so as to reduce the risk of a patient's AAA rupturing while waiting for treatment [NAAASP 2009]. In previous NVR Annual Reports, we have used this standard to examine the time from assessment to surgery across NHS vascular units. We reintroduce the metric this year after suspending it for the 2021 report due to the COVID-19 pandemic and guidance from the VSGBI, BSIR, NHS England Vascular CRG and GIRFT that relaxed this target time.

Figure 5.2: Percentage of EVARs (left panel) and number of open repairs and EVARs (right panel) by NHS trust in 2021 with at least 10 procedures. Orange bars show open repairs and blue bars show EVARs.

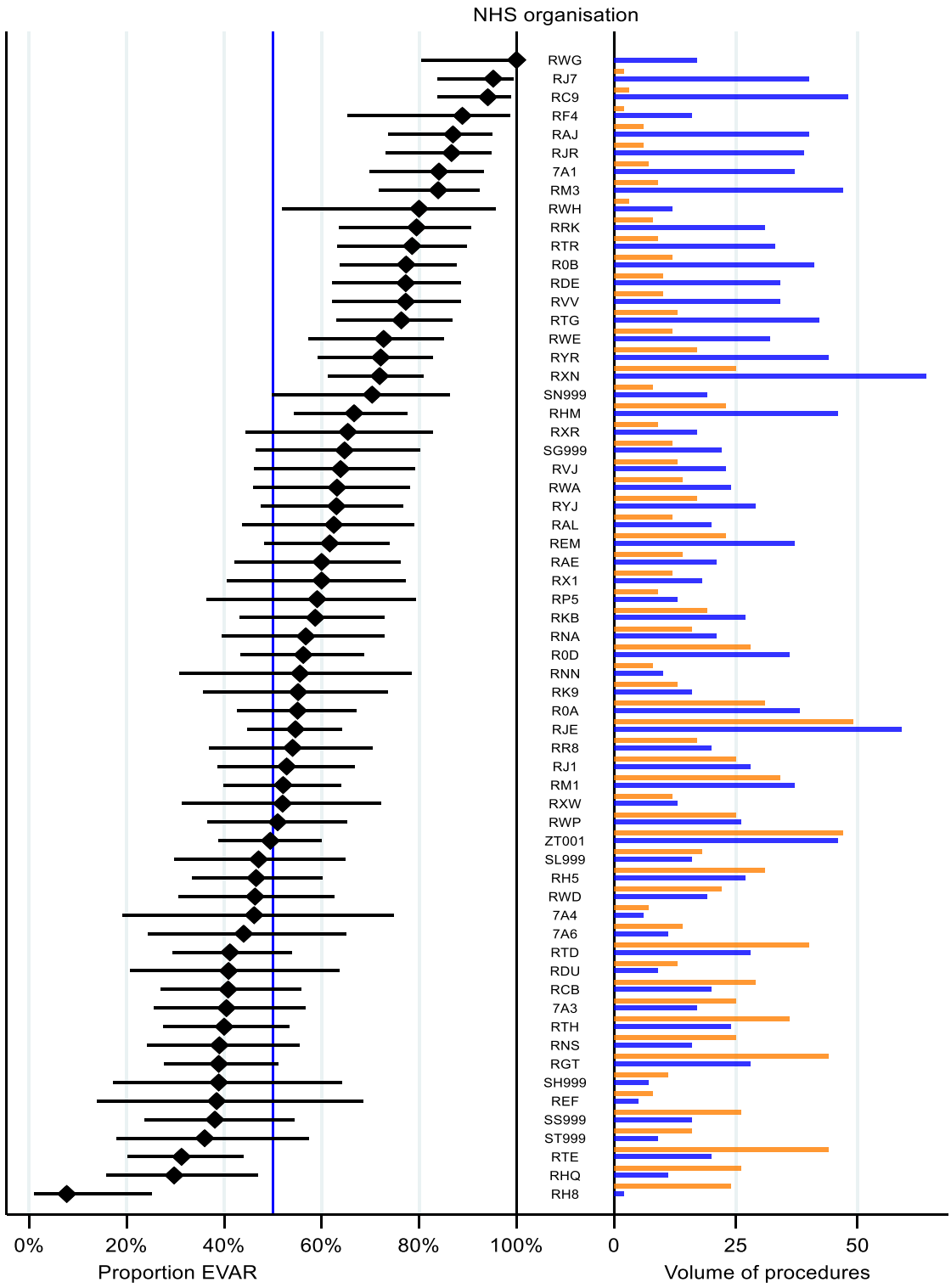


Figure 5.3 (overleaf) summarises the variation among NHS trusts in the median (IQR) time from vascular assessment to surgery for elective infra-renal procedures performed in 2021. The graph covers 62 organisations that had 10 or more infra-renal AAA repairs with assessment and procedure dates. In the right panel, the black diamonds show that the median delay at the majority of vascular units tended to fall within the range of 50 to 160 days (median 92: IQR 49-154). In 2019, the median delay was 69 days. Also, at 13% of the vascular units (8 of 62), a quarter of patients who had operations in 2021 waited more than 220 days.

In the left panel of Figure 5.3, the orange diamonds show the proportion of patients who had their procedure within 8 weeks after their CT/MR angiography assessment. The grey horizontal bars depict their 95% confidence intervals. The red line shows the 80% target indicated by NAAASP.

There are legitimate reasons why patients wait for surgery, such as the optimisation of comorbid medical conditions. However, 220 days is four times greater than the National AAA Screening Programme target of 8 weeks from date of referral to surgery (and this analysis also under-estimates this figure by being restricted to the time from vascular assessment to surgery). The values for the individual organisations can be found in the online appendices spreadsheet.

Figure 5.4 shows the distribution of patient times within each month between January 2019 and December 2021. The reduced level of activity led to an increase in the median time to surgery after April 2020. It is currently not clear why the times fell in October to December, as the lower levels of activity suggest there is a backlog of patients suitable for elective AAA repair. Furthermore, the median time has remained higher in 2021 compared to 2019.

Figure 5.3: Median (IQR) time from assessment to treatment (days) for patients who had elective infra-renal AAA repair between January and December 2021 (black diamonds) and proportion seen within 8 weeks of assessment (orange diamonds)

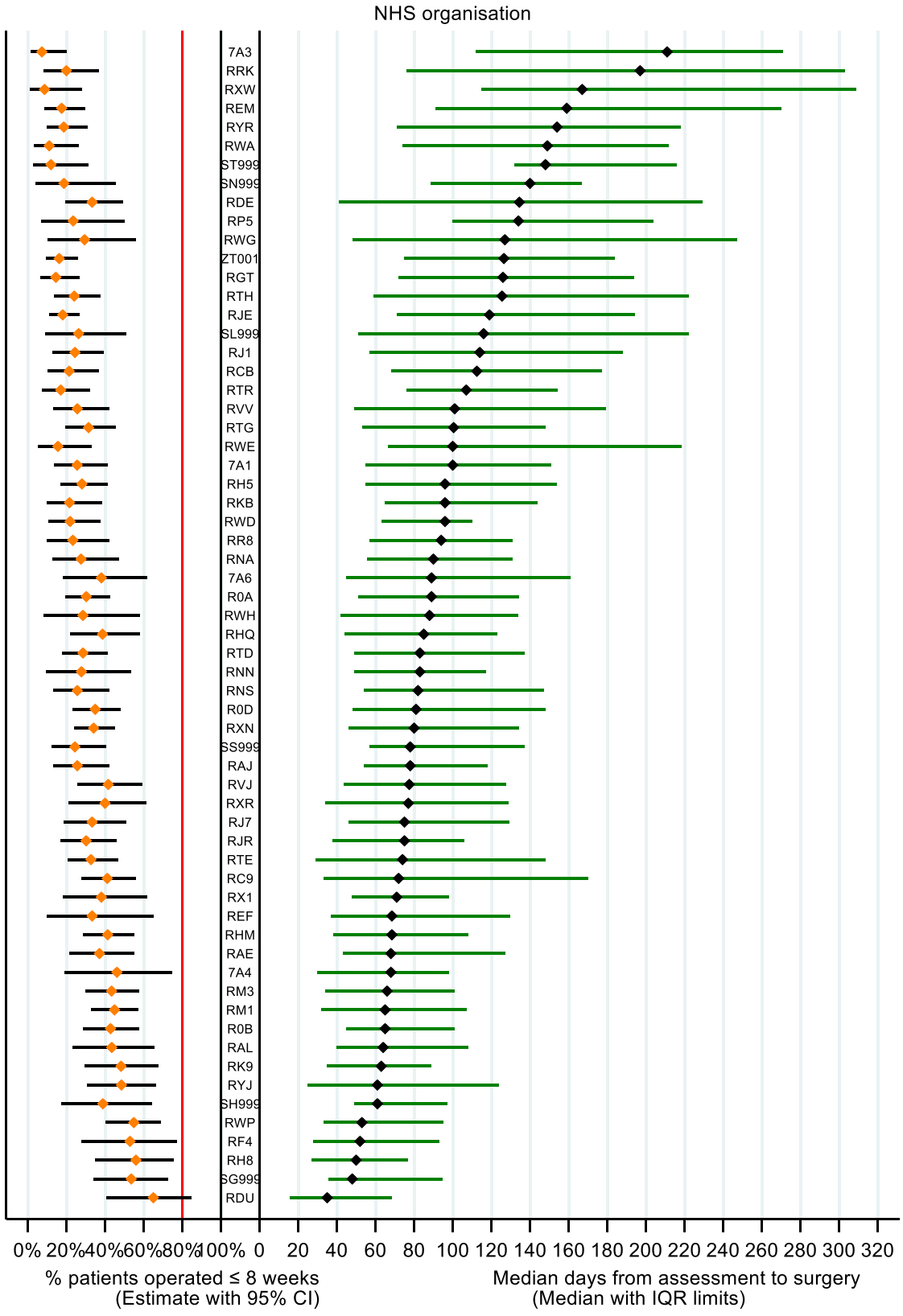
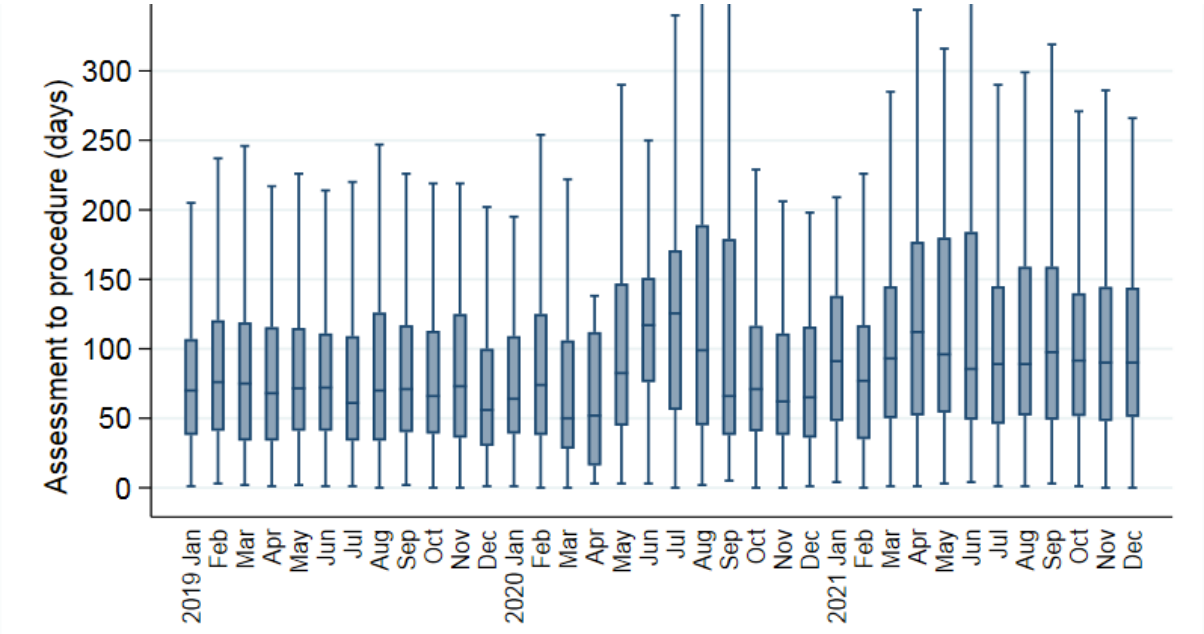


Figure 5.4: Distribution of times from assessment to treatment (days) by month for patients who had an elective infra-renal AAA repair between January 2019 and December 2021*. The median is shown as the bar within the blue box (whose outer limits are the 25th and 75th percentile)



*Excludes outlier values that exceed the upper whisker. The upper whiskers of three months which exceed 350 days are not shown.

5.3 Postoperative outcomes after elective infra-renal AAA repair

Table 5.3 describes various aspects of postoperative care for 2021.

- For EVAR, over 70% of patients went to a standard ward after surgery, and the median length of postoperative stay was 2 days.
- For patients undergoing open repair, over 95% of patients were admitted to a level 2 or level 3 critical care unit after surgery. Patients typically remained in critical care for 2 days and the median total postoperative stay was 7 days.

The in-hospital mortality rate for open repair in 2021 was 3.1% (95% CI 2.2 to 4.3), comparable to 3.2% (95% CI 2.2 to 4.5) observed in 2020. The in-hospital mortality rate for EVAR was 0.5%.

Patients undergoing open repair were more susceptible to cardiac, renal and respiratory complications, and the rate of return to theatre was also higher.

For open repair, the rate of respiratory complications was 10.1% (95% CI 8.4 to 12.0) in 2021, a slight fall from 12.1% (95% CI 10.1 to 14.3) observed in 2020. For EVARs, respiratory complications also decreased from 1.5% (95% CI 0.9 to 2.3) to 1.2% (95% CI 0.8 to 1.9) between 2020 and 2021.

Table 5.3: Postoperative details of elective infra-renal repairs undertaken in 2021

		Open repair (n=1,116)		EVAR (n=1,628)	
Admitted to	Ward	3.5%		71.4%	
	Level 2	61.2%		26.5%	
	Level 3	35.2%		2.1%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	2	1 to 3	1	0 to 1
	Level 3	2	1 to 3.5	1	1 to 2
Post-op length of stay (days)		7	6 to 10	2	1 to 3
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		3.1	2.2 to 4.3	0.5	0.2 to 1.0
Defined complications					
	Cardiac	4.5	3.4 to 5.9	1.2	0.7 to 1.8
	Respiratory	10.1	8.4 to 12.0	1.2	0.8 to 1.9
	Haemorrhage	1.6	1.0 to 2.5	0.8	0.4 to 1.4
	Limb ischaemia	3.2	2.3 to 4.4	0.8	0.4 to 1.4
	Renal failure	5.3	4.1 to 6.8	1.0	0.6 to 1.6
	Other	10.0	8.3 to 11.9	3.0	2.2 to 4.0
	None of the above	70.3	67.5 to 72.9	92.5	91.2 to 93.8
Return to theatre		6.8	5.4 to 8.5	1.8	1.2 to 2.6
Readmission within 30 days		6.4	5.0 to 8.1	5.5	4.5 to 6.8

Patients undergoing endovascular procedures may experience an endoleak. Of these, type I endoleaks (in which blood leaks around the points of graft attachment) are the most serious and generally require intervention.

Among the EVARs performed in 2021, 84 (5.4%) patients were recorded as experiencing a type I endoleak. There were 93 endoleaks (of any type) which required intervention at the time of the procedure. The rate of type I endoleaks has been relatively stable over the last three years, with 119 (5.8%) type I endoleaks recorded in 2019 and 60 (4.4%) in 2020.

Among the 2021 cohort, there were 127 patients (4.6%) who had the indication for their procedure recorded as re-intervention. Among these, 83% had an EVAR. The indication for re-intervention was sac expansion for 69 patients and a graft problem (migration/occlusion/infection) for 21 patients. The most frequent re-intervention was a relining (38.8%) or distal procedure (37.2%).

Frailty is a syndrome defined as increased vulnerability due to a decline in reserve and function, and covers both cognitive and physical domains. The importance of frailty assessment has already been established in patient selection and postoperative care among older surgical patients, and there is evidence for its use in preoperative optimisation with an elderly care physician review prior to vascular surgery.

The level of incomplete data on frailty is relatively high within the NVR. In 2021, frailty was recorded in 72% of patients, a slight decrease from the 76% achieved in 2020. We encourage vascular units to identify at risk 'frail' patients and ensure their degree of frailty is submitted to the NVR.

5.4 Postoperative in-hospital mortality for elective infra-renal AAA repair

The principal performance measure used by the NVR for elective infra-renal AAA repair is the postoperative in-hospital mortality rate. We report this outcome for NHS organisations during the period from 1 January 2019 to 31 December 2021 to give robust outcome estimates.

The risk-adjusted mortality rates for individual NHS trusts are shown in a funnel plot in Figure 5.5. The overall in-hospital mortality rate was 1.4%, and all NHS trusts had a risk-adjusted rate of inpatient mortality that fell within the expected range given the number of procedures they each performed.

Figure 5.5: Risk-adjusted in-hospital mortality rates after elective infra-renal AAA repair among NHS vascular units (January 2019 and December 2021). The overall in-hospital mortality rate was 1.4%.

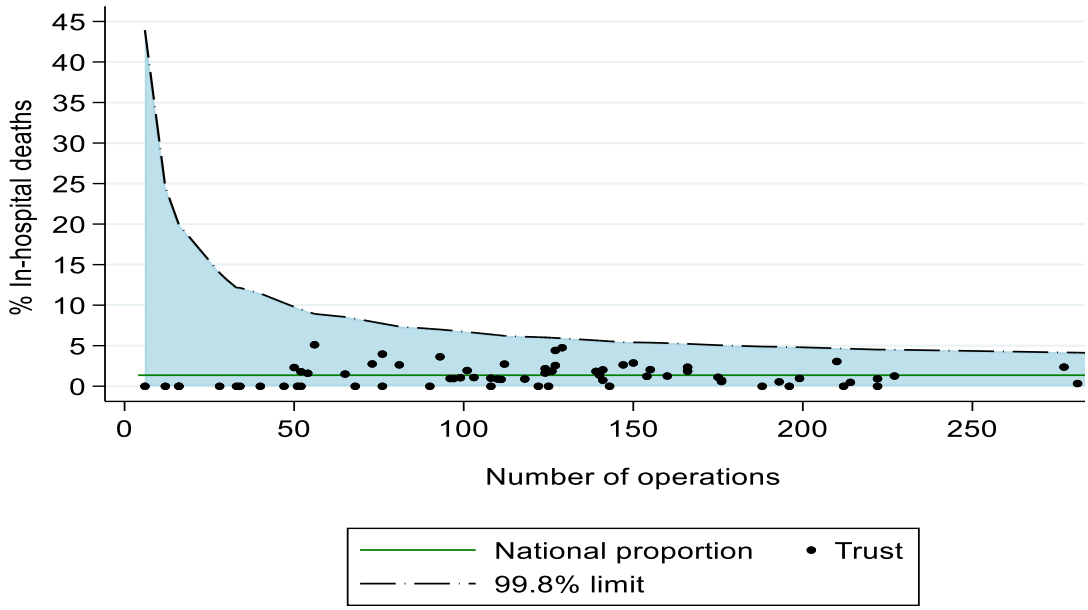
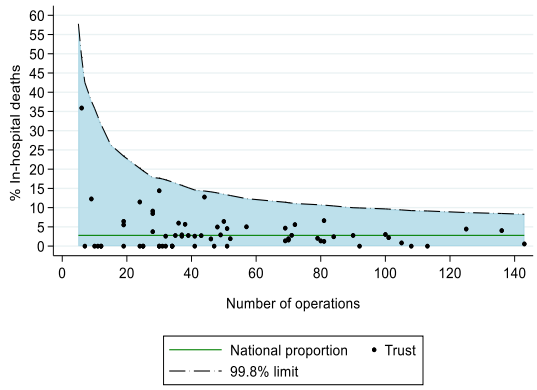
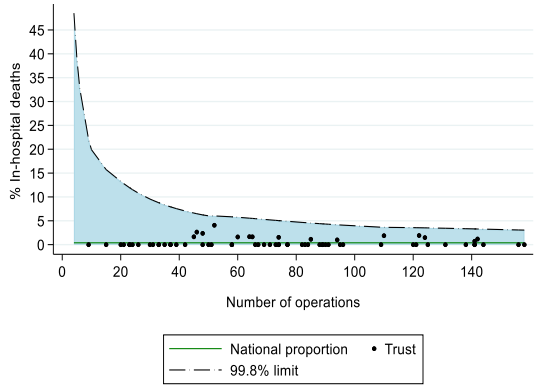


Figure 5.6: Funnel plot of risk-adjusted in-hospital mortality after elective AAA repair for open and EVAR procedures performed between 2019 and 2021.



A: Open repairs

The postoperative in-hospital mortality rate for open repair procedures was 2.8%



B: EVAR procedures

The postoperative in-hospital mortality rate for EVAR procedures was 0.4%

Figures 5.6A and 5.6B show the risk-adjusted rate of inpatient mortality among NHS trusts for open repair and EVAR procedures separately. The funnel plots are centred on the national mortality rate for these two procedures. The overall in-hospital mortality rates for open and EVAR procedures for the 3-year period between 2019 and 2021 were 2.8% and 0.4%, respectively

Postoperative in-hospital mortality after open repair has been slightly higher in 2020 (3.2%) and 2021 (3.1%) compared to 2.2% in 2019. For EVARs, the rate has remained around 0.3-0.5%.

The low rate of in-hospital mortality following elective EVAR repair raises the question of whether mortality remains the most valuable measure of outcome for infra-renal AAA [Boyle 2019]. Consequently, the NVR introduced a refined aortic dataset in 2020 to capture data on revision surgery and re-interventions following aortic surgery in the expectation that this will become a better measure of quality in time. The first NVR report on aortic devices was published in 2021 and we request that all aortic devices (both open and endovascular) are entered on the NVR.

6. Elective repair of complex aortic conditions

6.1 Background

Aneurysms can occur at various locations along the aorta. In addition to infra-renal aneurysms, a distinction is made between three other types, which collectively are referred to as complex aneurysms:

- juxta-renal (that occur near to the renal arteries)
- supra-renal (that occur above the renal arteries), and
- thoraco-abdominal (more extensive aneurysms involving the thoracic and abdominal aorta).

The repair of these complex aneurysms is often performed using endovascular procedures, the most common of which are:

- fenestrated EVAR (FEVAR), which involves the use of a graft that has holes (fenestrations) to allow the passage of blood vessels from the aorta
- branched EVAR (BEVAR), in which separate grafts are deployed on each blood vessel from the aorta after the main graft has been fitted, and
- thoracic endovascular aortic/aneurysm repair (TEVAR).

The endovascular approach may also be used when an abdominal aneurysm extends down to the common iliac arteries. Here, an iliac branch device is used to preserve the blood flow to the internal iliac arteries.

6.2 Patterns of complex repairs

This chapter collates results for the 3-year period between January 2019 and December 2021. The NVR received 2,123 records related to elective complex AAA. The numbers have fluctuated over recent years, with 803 procedures in 2019, 643 in 2020 and 677 in 2021. This represents a reduction of around 16% between 2019 and 2021. Over the three-year period, 1,875 (88%) were endovascular (Table 3.1), with over half being fenestrated repairs.

In the last three years, the median annual volume among operative vascular units has been relatively stable, being 6 in 2019 and 7 for 2021. However, the level of activity has differed markedly between NHS trusts. One vascular unit performed 250 complex repairs between 2019 and 2021, but 34 units have performed fewer than 20 procedures in the same period.

The number of NHS trusts providing elective repair of complex AAA is summarised in Figure 6.1. In 2019, 19 of the 63 (30%) Trusts were performing at least 10 procedures annually. This increased to 22 in 2021. In addition, there were 7 NHS trusts performing none of these procedures in 2019 compared to 12 in 2021. An exploration of the relationship between Trust volume and postoperative mortality found no evidence of a volume-outcome relationship (see section 6.3).

Figure 6.1: Number of Trusts performing elective complex AAA repair

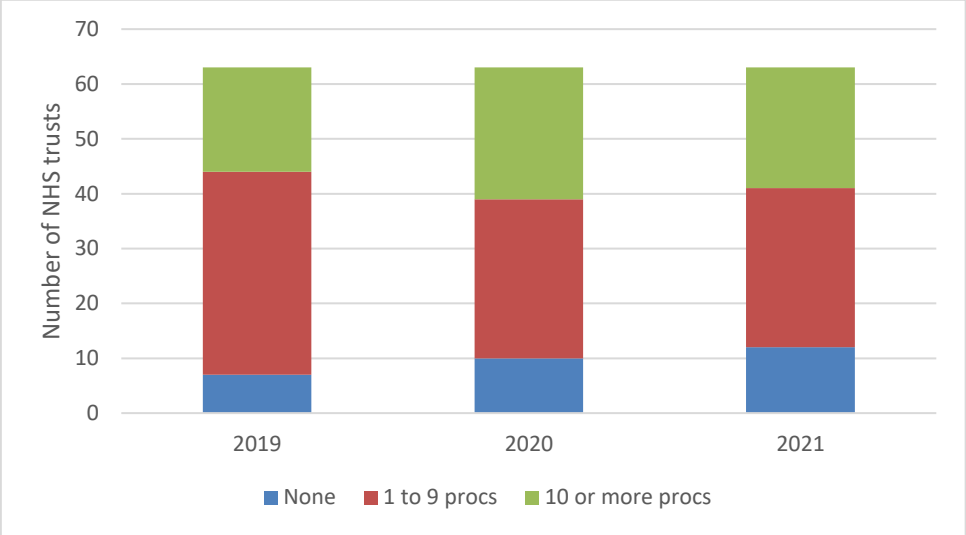


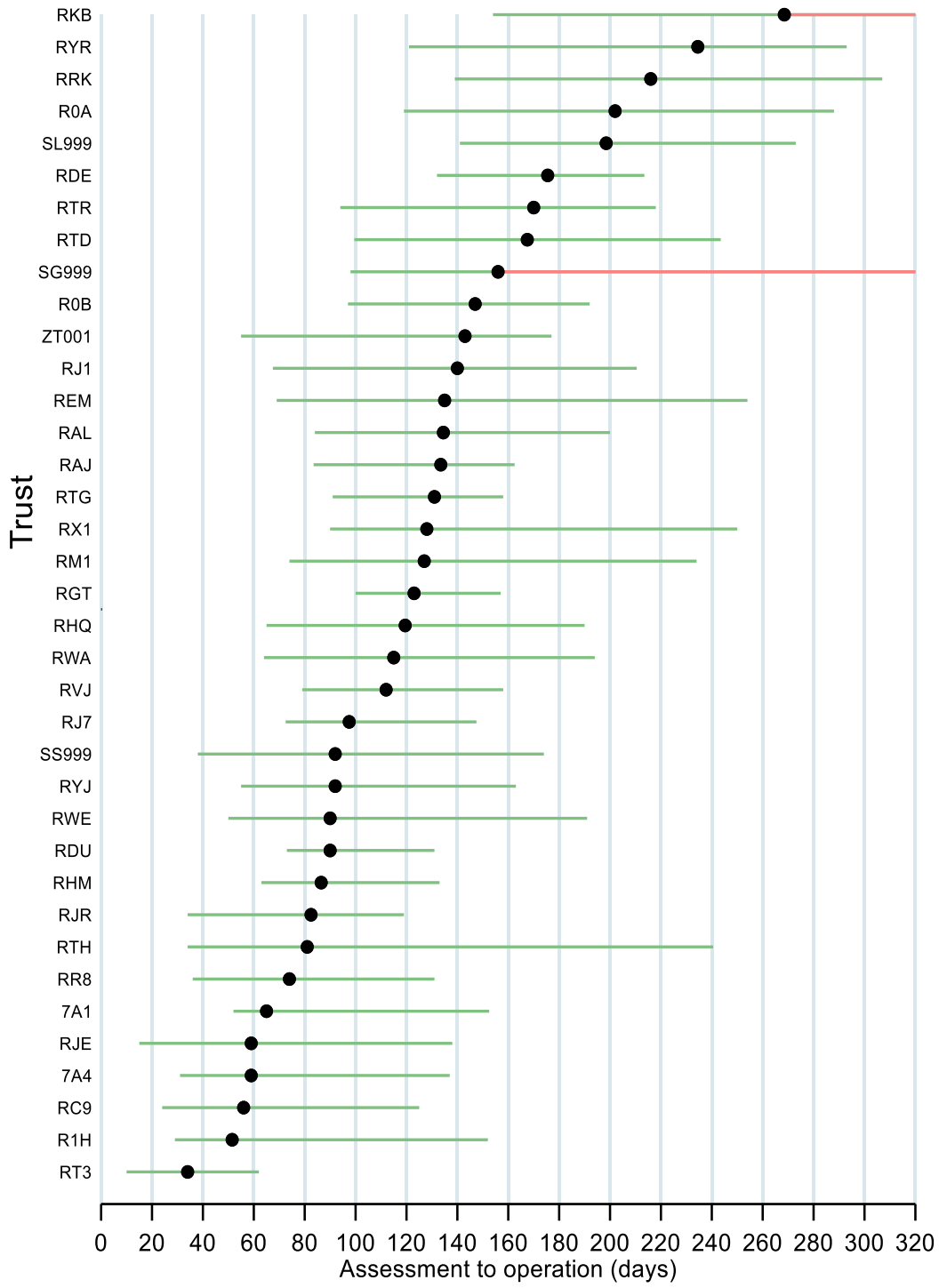
Table 6.1: Characteristics of patients who had an elective repair of complex AAA between January 2019 and December 2021.

Elective		Open repair	%	Endovascular	%	Total
Total procedures		248		1,875		2,123
Age group (years)	Under 66	63	25.4	243	13.0	306
	66 to 75	120	48.4	806	43.1	926
	76 to 85	63	25.4	759	40.6	822
	86 and over	2	0.8	62	3.3	64
Male		213	85.9	1,547	82.5	1,760
Female		35	14.1	328	17.5	363
Type of procedure	FEVAR			1,073	57.3	
	BEVAR			152	8.1	
	TEVAR			393	21.0	
	Iliac branch graft			211	11.3	
	Composite graft			13	0.7	
	Other (e.g., chimney / snorkel / periscope)			31	1.7	

Figure 6.2 shows the median (IQR) assessment-to-procedure time at Trust level. Nationally, between 2019 and 2021 the median was 130 days (IQR: 72-211), a similar figure to that observed between 2017 and 2019 when this was examined in the 2020 Annual Report.

For the current audit period, the median for a large number of vascular units fell within the range of 60 to 200 days. However, the upper limit of the interquartile ranges shows that, at nine vascular units, a quarter of patients waited more than 240 days to have a complex AAA repair.

Figure 6.2: Median (IQR) time from assessment to treatment (days) for patients who had an elective complex AAA repair between January 2019 and December 2021, by NHS trust



The 2016 NVR snapshot audit identified a number of reasons why patients having complex repairs typically had a longer delay between vascular assessment and surgery than patients having infra-renal endovascular repair. These included:

- over a quarter of patients having a complex open repair required a specialist opinion from a physician in cardiology, respiratory medicine or nephrology (renal disease)
- the time it took for a non-conventional device to be delivered, with the average delivery time being 67 days.

The main concern that arises from significant delays between assessment and surgery is the possibility of aneurysm rupture while the patient is waiting. The NVR does not capture this data, but encourages rapid fitness assessment MDT decision making and device procurement to reduce these delays.

Tables 6.2 and 6.3 describe the outcomes of elective complex aortic repairs for 2019-2021. As with elective infra-renal AAA repairs, some differences and similarities can be seen between 2019 and 2021:

- For open repairs, over 50% of patients were admitted to a level 3 critical care unit. The median overall postoperative stay was around 9 days.
- For endovascular repairs, the majority of patients were admitted to level 2 critical care and the median length of stay was 4 days.

The in-hospital postoperative mortality rates for open and endovascular procedures were greater than the equivalent rates for infra-renal AAA repair, reflecting the complex nature of the disease and surgery. For open repairs, there was also a high risk of return to theatre (13%). Comparing 2017-2019 with 2019-2021, for endovascular repairs the rates of in-hospital deaths were similar at 2.7% (95% CI 2.1 to 3.4) and 2.6% (95% CI 1.9 to 3.4), respectively.

For the two most common complex endovascular procedures, the mortality rate for TEVAR patients was slightly higher than for FEVAR patients (Table 6.3). Furthermore, more TEVAR cases were admitted to level 3 care.

Table 6.2: Postoperative details of complex open AAA repairs undertaken between January 2019 and December 2021

2019 - 2021		Open repair (n=248)		Endovascular (n=1,875)	
Admitted to	Ward	2.4%		23.9%	
	Level 2	43.1%		61.2%	
	Level 3	53.2%		14.8%	
	Died in theatre	1.2%		0.1%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	3	2 to 5	2	1 to 2
	Level 3	4	2 to 7.5	2	1 to 3
Post-op length of stay (days)		9	7 to 15	4	2 to 6
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		10.9	7.3 to 15.4	2.6	1.9 to 3.4
Readmission to critical care		6.5	3.8 to 10.4	1.8	1.2 to 2.5
Return to theatre		12.7	8.8 to 17.5	5.5	4.5 to 6.6
30 day readmission rate		5.7	3.0 to 9.8	7.5	6.3 to 8.8

Table 6.3: Postoperative details of complex TEVAR and FEVAR undertaken between January 2019 and December 2021

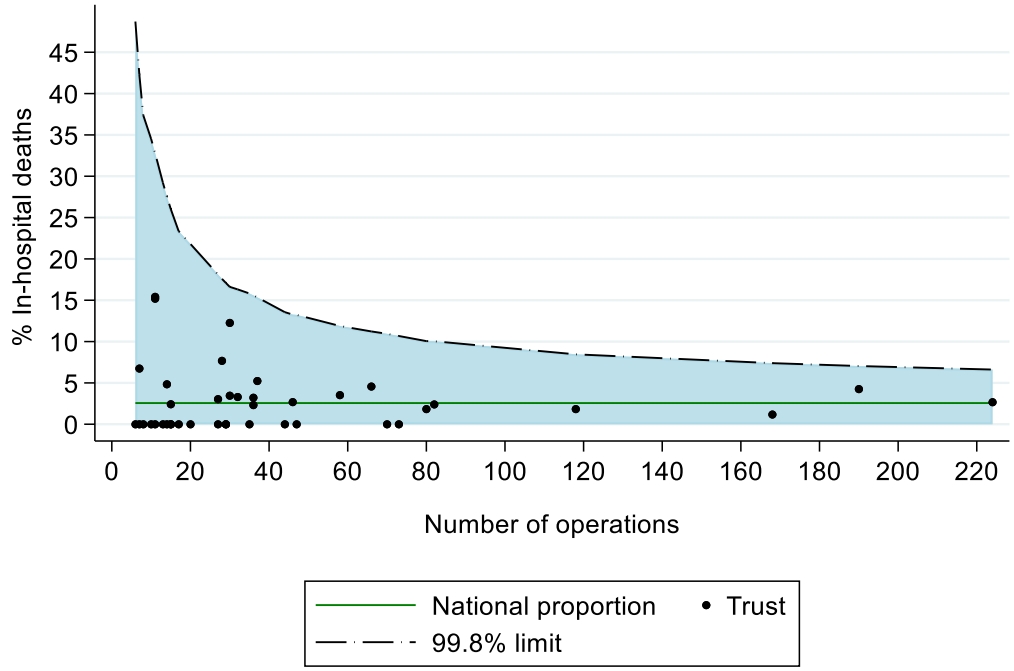
2019 - 2021		TEVAR (n=393)		FEVAR (n=1,073)	
Admitted to	Ward	22.1%		18.8%	
	Level 2	55.7%		67.4%	
	Level 3	21.9%		13.9%	
	Died in theatre	0.3%		0.0%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	2	1 to 3	2	1 to 2
	Level 3	2	1 to 3	2	1 to 3
Post-op length of stay (days)		4	2 to 6	4	2 to 7
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		3.1	1.6 to 5.3	2.6	1.7 to 3.7
Readmission to critical care		1.0	0.3 to 2.6	2.1	1.3 to 3.1
Return to theatre		4.3	2.5 to 6.9	5.4	4.1 to 7.0
30 day readmission rate		10.6	7.5 to 14.3	7.4	5.8 to 9.1

6.3 Postoperative in-hospital mortality for complex endovascular procedures

This section describes the in-hospital postoperative mortality rates for NHS organisations that performed complex endovascular procedures during the period from 1 January 2019 to 31 December 2021.

The adjusted mortality rates for individual NHS trusts are shown in Figure 6.3. All NHS trusts had an in-hospital postoperative mortality that fell within the expected range around the national average of 2.6%, given the number of procedures performed.

Figure 6.3: In-hospital mortality after complex endovascular repairs between January 2019 and December 2021



6.4 Comment

Complex aortic aneurysm repairs account for a relatively small part of the overall vascular surgical workload, but they consume a relatively greater proportion of healthcare resources than infra-renal AAA repairs. The relatively high postoperative mortality rate, particularly for open repairs, highlights the need for NHS trusts and commissioners to focus on ensuring care for these patients is delivered safely. It is recommended that complex aortic surgery should only be commissioned from vascular units that submit complete and accurate data on caseload and outcomes of these procedures to the NVR.

The area of endovascular repair continues to evolve, with new complex endovascular grafts being made available to vascular services.

Patients undergoing complex repair admitted with a Type B aortic dissection

A subgroup of patients within the cohort who have complex aortic repair are those admitted with chronic or acute type B aortic dissection. These patients can be either elective or non-elective admissions.

Between 2016 and 2021, the NVR received details of 540 patients with type B aortic dissection. Most patients underwent endovascular procedures classified here as a complex EVAR (96.5%), and among these 88.9% were TEVARs, 6.7% were FEVARs and 2.1% were BEVARs.

The number of procedures submitted by individual NHS trusts varied considerably over the six years. Four NHS trusts submitted details of 35 or more TEVAR procedures (St George's University Hospitals NHS Foundation Trust, Imperial College Healthcare NHS trust, North Bristol NHS trust and Royal Brompton & Harefield NHS Foundation Trust). Another 10 vascular units reported 11-29 procedures, while 20 reported 1-10 procedures. In March 2022, NHS England and NHS Improvement published the Emergency Acute Aortic Dissection (AAD) Toolkit to help NHS hospitals to work collaboratively within regions so that the provision of services is equitable. Information about the toolkit can be found on the Vascular Society website (see references).

The postoperative in-hospital mortality rate for this patient group was 8.9% (95% CI 6.6 to 11.6). For elective procedures, it was 6.2% (95% CI 3.5 to 10.0), and 11.1% (95% CI 7.8 to 15.2) for non-electives. After the operation, 90% were admitted to level 2 or 3 critical care, where the median stay was 2-3 days (Table 6.4). The post-operative length of stay was 7 days for dissection cases.

A map showing all NHS trusts in the UK who treat patients with Type B aortic dissections with a TEVAR procedure is shown in Figure 6.4. The number of TEVARs for TBAD submitted to the NVR each year by each trust can be found in Appendix 4 and also in the trust level appendices spreadsheet.

Table 6.4: Postoperative details of elective and emergency complex AAA repairs undertaken between January 2016 and December 2021 with a dissection

		Aortic dissections (n=540)	Days in critical care median (IQR)
Admitted to	Ward	9.6%	
	Level 2	49.0%	2 (1 to 3)
	Level 3	40.8%	3 (2 to 7)
	Died in theatre	0.6%	
		Rate	***95% CI***
In-hospital postoperative mortality		8.9	6.6 to 11.6
		Median	***IQR***
Post-op length of stay (days)		7	4 to 13

Figure 6.4: Map of UK hospitals treating patients with Type B aortic dissection with TEVAR

For interactive version, please visit:
https://batchgeo.com/map/2fbd4c083be28e98885bbac91917bc1b

7. Repair of ruptured abdominal aortic aneurysms

7.1 Surgical activity for ruptured AAA

Although there has been a steady decline in the incidence of ruptured abdominal aneurysms, it remains a common vascular emergency. In this chapter, the outcomes of emergency repairs among patients with a ruptured AAA are described for the period between 1 January 2019 and 31 December 2021. Details of 1,690 procedures were submitted to the NVR, giving an estimated case ascertainment of approximately 90%. In 2020 and 2021, there were 494 and 512 procedures recorded on the NVR, respectively, a reduction of almost 30% compared to the 684 recorded in 2019.

Compared to patients who had an elective infra-renal AAA repair, patients who had surgery for a ruptured AAA were older, with over 50% being over 75 years old. The average diameter of the aneurysm was also larger.

The proportion of patients having an EVAR in recent years has changed over time (Figure 7.1). In 2018, around 30% of all procedures were EVARs; in 2020 and 2021, this has risen to around 40%. Over the three years, around a quarter of all NHS trusts performed more EVARs than open repairs for ruptured AAA (Figure 7.2).

Overall, in the three year period, EVARs attributed 37.8% (n=638) of all cases. For patients undergoing EVAR, the basic characteristics of their anatomy were:

- 88.2% had a neck angle between 0-60 degrees; for 7.4%, it was 60-75 degrees
- the median neck diameter was 24mm (IQR: 21 – 26) and the median neck length was 20mm (IQR: 15 – 30)
- the aneurysm was extended into either the left/right iliac artery for 16.2% of procedures and was extended bilaterally for 4.2% of procedures
- the median aortic diameter was 7.1cm (IQR: 6.0 – 8.8).

For patients having open repair, 71.9% underwent tube grafts, 27.5% included a bifurcated graft and 5.2% had a groin incision.

Overall, 39% of these procedures occurred on a weekday between 8am and 6pm. There has been a small shift over time in the type of anaesthetic used. In 2021, 20% of procedures involved local anaesthetic (without GA) compared to 15% in 2019.

The outcomes of the procedures for ruptured AAA are summarised in Table 7.1. Postoperative details for patients undergoing open and EVAR procedures between 2019 and 2021 were as follows:

- Median postoperative length of stay was around 15 days for open repair in the last three years compared with 8 days for

EVAR patients, among those discharged alive.

- Over 80% of patients who had an open procedure required level 3 critical care after the procedure (over 40% for patients undergoing an endovascular procedure), with a median length of stay of 4 days for open repair and 2 days for EVAR.
- a greater proportion of patients who had open repair suffered from cardiac, renal and respiratory complications.
- Among open repairs in 2020, 34.3% (95% CI 28.7 – 40.3) had respiratory complications, but for 2021, it was 30.9% (95% CI 25.7 – 36.6). For EVARs, it was 16.6% (95% CI 11.6 – 22.6) and 17.4% (95% CI 12.3 – 23.5), respectively.

These differences are likely to reflect the severity of patients' conditions and the suitability of patients for endovascular repair.

The in-hospital postoperative mortality rates for the years 2019, 2020 and 2021 for open procedures were 39.6%, 50.3% and 44.9% respectively. For EVARs, the rates were around 20% for all three years. This is likely to reflect the selection of more stable patients with better aortic anatomy for EVAR, and should be interpreted as indicating their relative effectiveness. The results of the IMPROVE trial reported 30-day mortality rates of 37.4% for open repair and 35.4% for EVAR among patients with ruptured AAA [Powell et al 2014]. The NVR data does not include any information on out-of-hospital care, such as transfers of patients from non-arterial hospitals to arterial hospitals. There could be delays in the pre-hospital pathways that may determine whether a patient is offered a repair of their ruptured AAA or what type of repair they may be suitable for. This may mean that comparisons between patient characteristics and post-operative outcomes at different NHS trusts should be interpreted with caution.

Figure 7.1: Number of open repairs and EVARs for ruptured AAAs between January 2019 and December 2021.

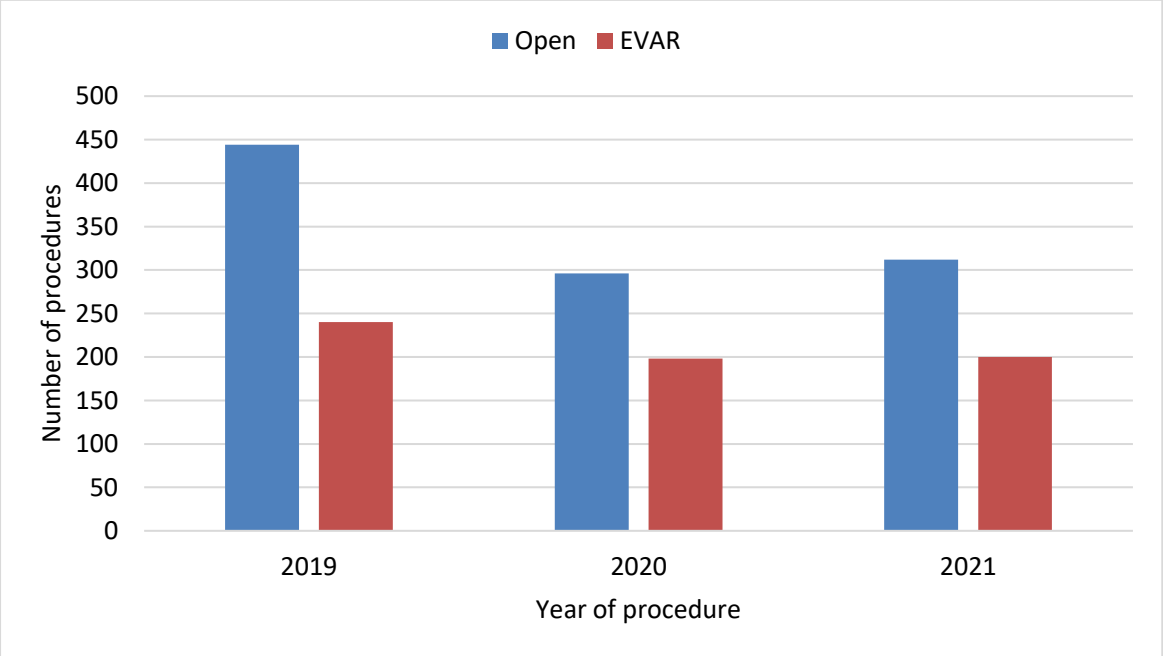


Figure 7.2: Percentage of EVARs (left panel) and number of open repairs and EVARs (right panel) by NHS trust between January 2019 and December 2021 with at least 10 procedures. Orange bars show open repairs and blue bars show EVARs.

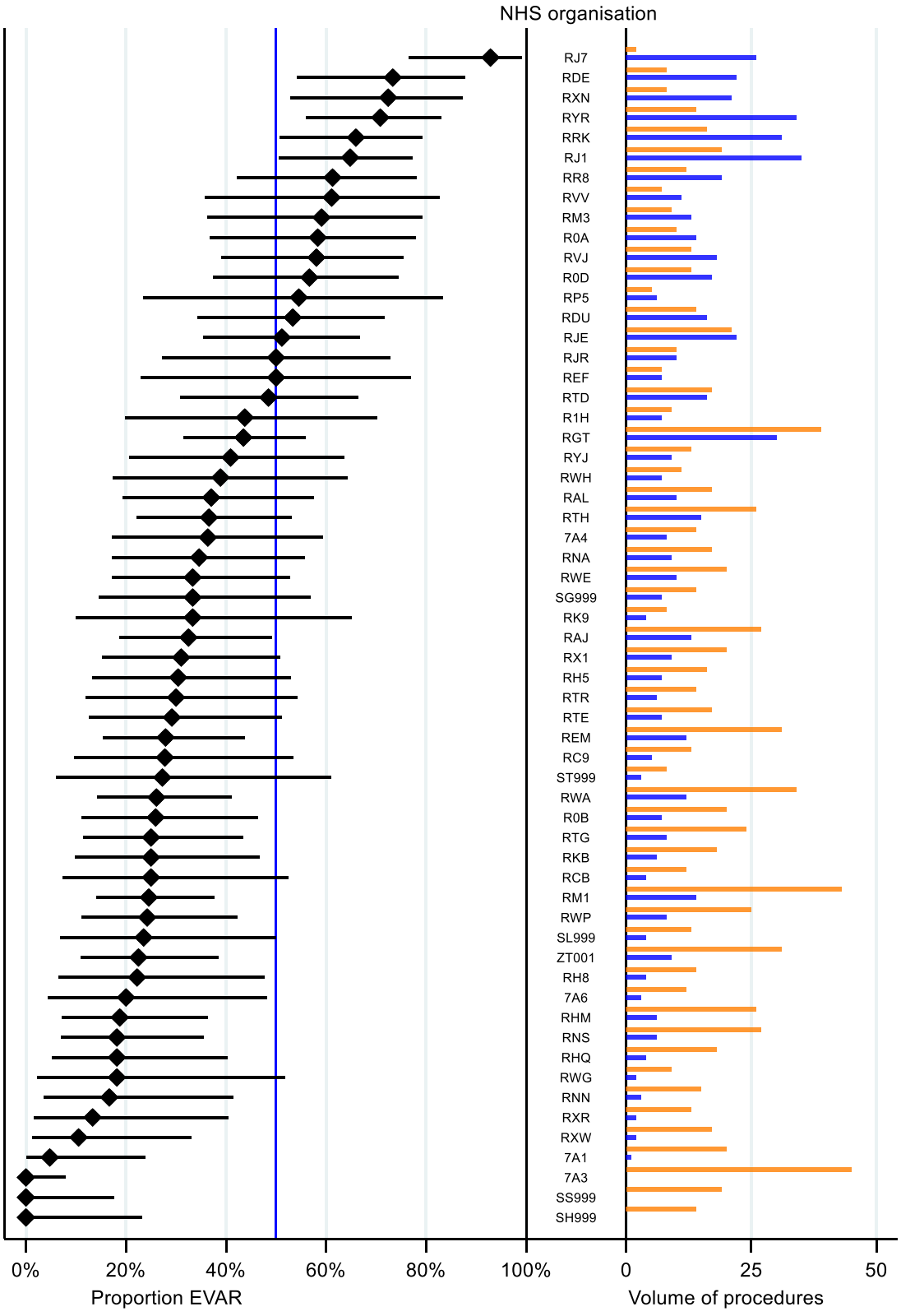


Table 7.1: Postoperative details of emergency repairs for ruptured AAAs undertaken between January 2019 and December 2021

2019-2021		Open repair (n=1,052)		EVAR (n=638)	
Admitted to	Ward	0.6%		15.1%	
	Level 2	8.5%		38.5%	
	Level 3	83.6%		43.2%	
	Died in theatre	7.3%		3.1%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care: Level 2		4	2 to 5	1	1 to 2
Level 3		4	2 to 8	2	1 to 6
Post-op length of stay (days)		10	2 to 19	7	3 to 14
Post-op length of stay for patients discharged alive (days)		15	10 to 26	8	5 to 14
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		44.2	41.2 to 47.3	20.7	17.6 to 24.0
Defined complications					
	Cardiac	20.5	18.0 to 23.2	8.9	6.8 to 11.4
	Respiratory	31.6	28.7 to 34.6	15.9	13.1 to 19.0
	Stroke	2.3	1.4 to 3.4	1.6	0.8 to 3.0
	Haemorrhage	4.0	2.9 to 5.4	3.1	1.9 to 4.8
	Limb ischaemia	11.4	9.5 to 13.5	2.6	1.5 to 4.2
	Renal failure	29.1	26.3 to 32.1	12.2	9.7 to 15.0
	Ischaemic bowel	12.3	10.3 to 14.5	3.1	1.9 to 4.8
	None of predefined	29.9	27.1 to 32.9	57.5	53.5 to 61.5
Return to theatre		20.9	18.4 to 23.6	10.2	7.9 to 12.9
Readmission within 30 days		9.3	7.0 to 11.9	10.5	8.0 to 13.6

7.2 Postoperative in-hospital mortality for ruptured AAA repair

For NHS organisations undertaking repair of a ruptured AAA between 1 January 2019 and 31 December 2021, the risk-adjusted postoperative mortality rates are shown in Figure 7.3.

All NHS trusts had a risk-adjusted rate of in-hospital postoperative mortality that fell within the expected range around the national average of 35.3%, given the number of procedures performed. There were two NHS trusts that had a mortality rate lower than the lower 99.8% control limit.

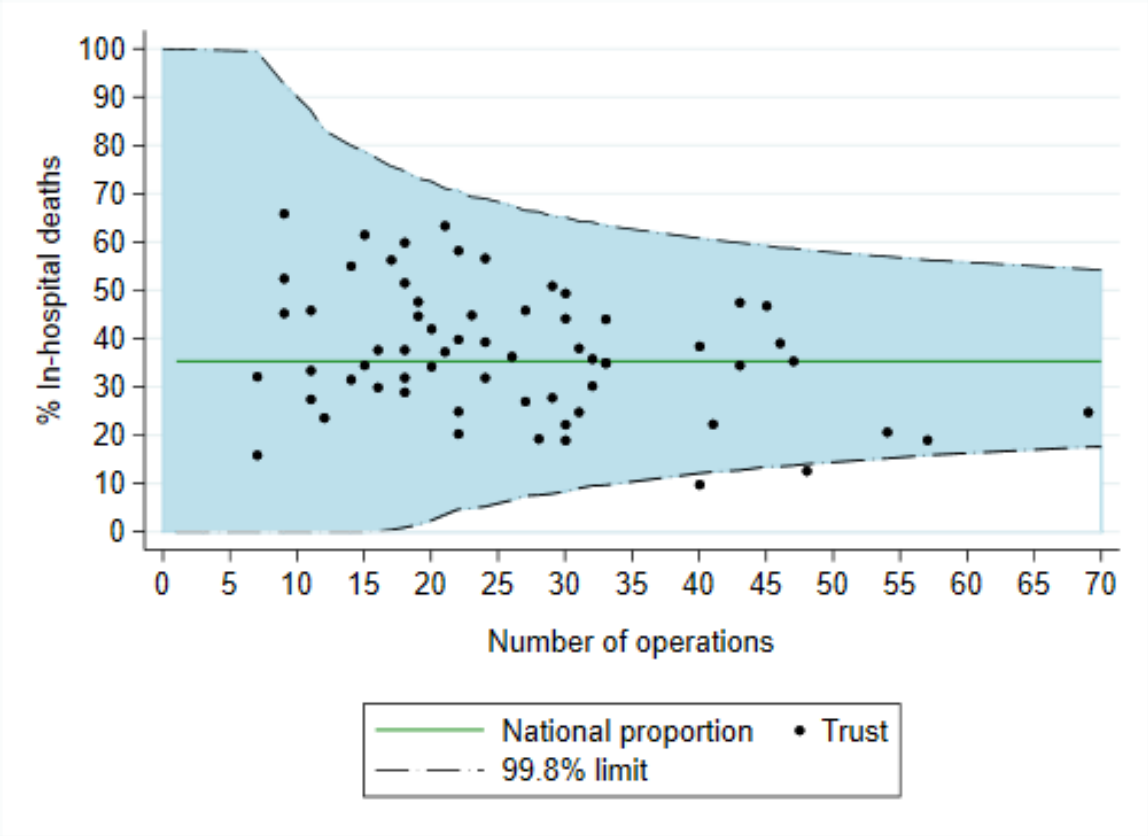
The rates among NHS trusts typically ranged from 20% to 60%, which reflects the relatively low volumes used to calculate these rates. The online appendices spreadsheet gives the figures for each NHS trust.

Vascular units should evaluate how access to endovascular repair can be improved for emergency repair of ruptured aneurysms. This may require:

- network pathways for vascular surgery working in collaboration with interventional radiology and vascular anaesthesia

- 24/7 access to hybrid operating theatres
- developing teams with the required expertise qualified to deliver in and out of hours care including nursing staff and radiographers
- addressing workforce for both vascular surgery and interventional radiology.

Figure 7.3: Risk-adjusted in-hospital mortality for emergency repairs of ruptured AAAs between January 2019 and December 2021 by NHS trust. The overall mortality rate was 35.3%.



8. Carotid endarterectomy

8.1 Background

In the UK, around 3,000-4,000 patients undergo a carotid endarterectomy (CEA) each year to remove plaque that has built up within the carotid arteries (the main vessels that supply blood to the brain, head and neck). Most procedures are performed in patients who have experienced transient symptoms or a stroke. A minority of procedures are performed in patients found to have reduced blood flow to the brain but who are asymptomatic. A few vascular units also perform carotid stenting but this equates to only around 250 procedures annually.

The information in this chapter focuses primarily on carotid procedures performed within NHS hospitals between 1 January 2021 and 31 December 2021.

The number of procedures reported to the NVR in 2020 showed a reduction compared to the previous year and a sharp decline around April 2020 following the impact of COVID-19. This is in line with the guidance published in March 2020 by the VSGBI, BSIR, NHS England Vascular CRG and GIRFT. Whether this resulted in an increase in the incidence of stroke during the pandemic is unclear.

This reduced level of activity has remained in 2021. The decreasing number of carotid interventions should prompt consideration into the relevance of the numbers of carotid procedures undertaken by vascular networks in the guidance provided by the VSGBI.

Table 8.1: Estimated case ascertainment of carotid endarterectomy in the UK

	2019	2020	2021
Audit procedures	4,162	3,063	3,171
Expected procedures	4,279	3,206	3,403
Estimated case ascertainment	97%	96%	93%

8.2 Treatment pathways

Patients may be referred for carotid endarterectomy from various medical practitioners. In 2021, the most common source of referral was the stroke physician (87.0%), followed by neurologists (2.9%), vascular surgeons (2.1%) and general practitioners (1.9%).

The characteristics of patients having carotid procedures have remained stable over time (see appendix 3). The mean age at surgery was 72 years, and there was no obvious change in the proportion of older or more comorbid patients being treated. Similarly,

the distribution of symptoms and degree of stenosis was relatively unchanged:

- There were 3,038 patients (95.8%) with symptomatic disease. TIA was the most common symptom (44.7%), followed by stroke (39.0%).
- Over 70% of patients had at least 70% stenosis in their ipsilateral carotid artery at the time of operation.
- Only 0.6% of patients had a previous ipsilateral treatment.

Medication for cardiovascular conditions was common among patients prior to surgery. Overall, 91.5% were on antiplatelet medication (54.9% on single and 45.1% on dual therapy), while 81.2% were taking statins.

NICE guideline (NG128)

The target time from symptom to operation is 14 days in order to minimise the chance of a high-risk patient developing a stroke.

In the years from 2009 to 2012, the proportion of patients who were treated within the 14-day target rose from 37% to 56%. This figure has been relatively stable since then, with 58% of patients in 2021 being treated within 14 days. This is slightly lower than the figure of 62% observed in 2020.

The median time from symptom onset to surgery for symptomatic patients in 2021 was 13 days (IQR 8-22). For the three distinct phases within this pathway, the median time delays were:

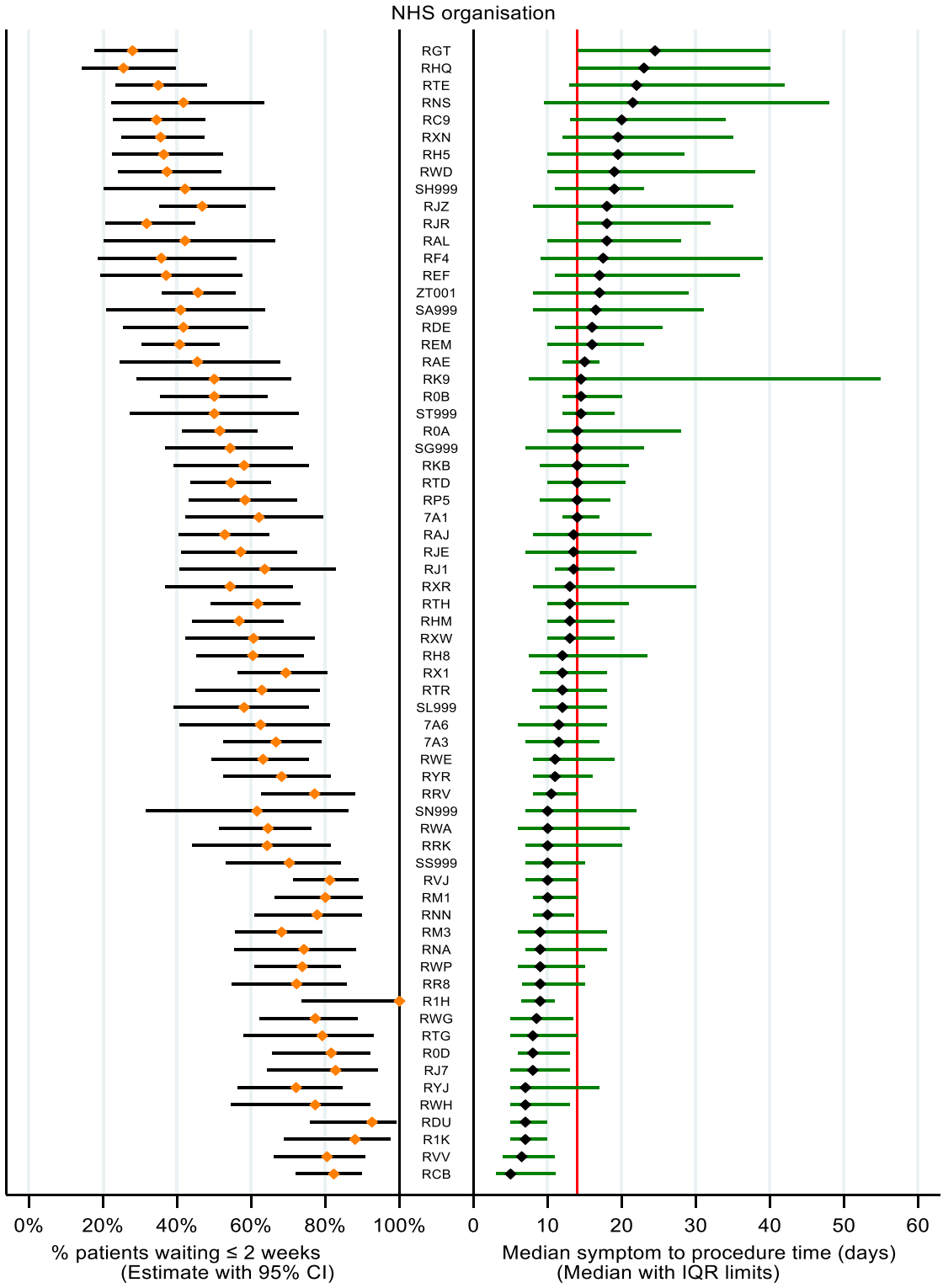
- 4 days (IQR 1-8) from symptom to first medical referral
- 1 day (IQR 0-4) from first medical referral to being seen by the vascular team, and
- 6 days (IQR 3-9) from being seen by the vascular team to undergoing CEA.

The distribution of symptom to operation times (right panel) and the proportion operated on within 14 days (left panel) for all NHS trusts is summarised in Figure 8.1. The grey horizontal bars represent their 95% confidence intervals. The graph contains figures for all organisations that performed 10 or more procedures for symptomatic cases with known symptom and procedure dates. The NICE guidance standard of 14 days is included on the graph as a vertical red line.

There was considerable variation among NHS trusts in the median time to surgery during 2021 (right panel, Figure 8.1):

- 44 of the 66 NHS organisations had a median time of 14 days or less
- the median exceeded 20 days for just 4 vascular units, a considerable improvement from the 16 found in 2016
- 19 Trusts had less than half of their patients operated on within 14 days.

Figure 8.1: Median time (and interquartile range) from symptom to procedure by NHS trust for procedures performed between January and December 2021 (black diamonds) and proportion waiting less than 2 weeks following symptoms (orange diamonds)



8.3 Outcomes after carotid endarterectomy

Patients may experience various complications following carotid endarterectomy. The rate of postoperative stroke is of primary concern, but other complications include: bleeding, cardiac complications such as myocardial infarction, and cranial nerve injury (CNI), which describes damage to one of the nerves to the face and neck.

The complication rates for the 3,000 procedures performed in NHS hospitals in 2021 are summarised in Table 8.2. The rates of the different complications tended to be around 0.5-2.5% and have remained fairly consistent over the last few NVR Annual Reports.

Over this 12-month period:

- the median length of stay was 2 days (IQR: 1 to 5 days)
- the rate of return to theatre was 2.7% (95% CI 2.2 to 3.4), and
- the rate of readmission within 30 days was 4.3% (95% CI 3.6 to 5.0).

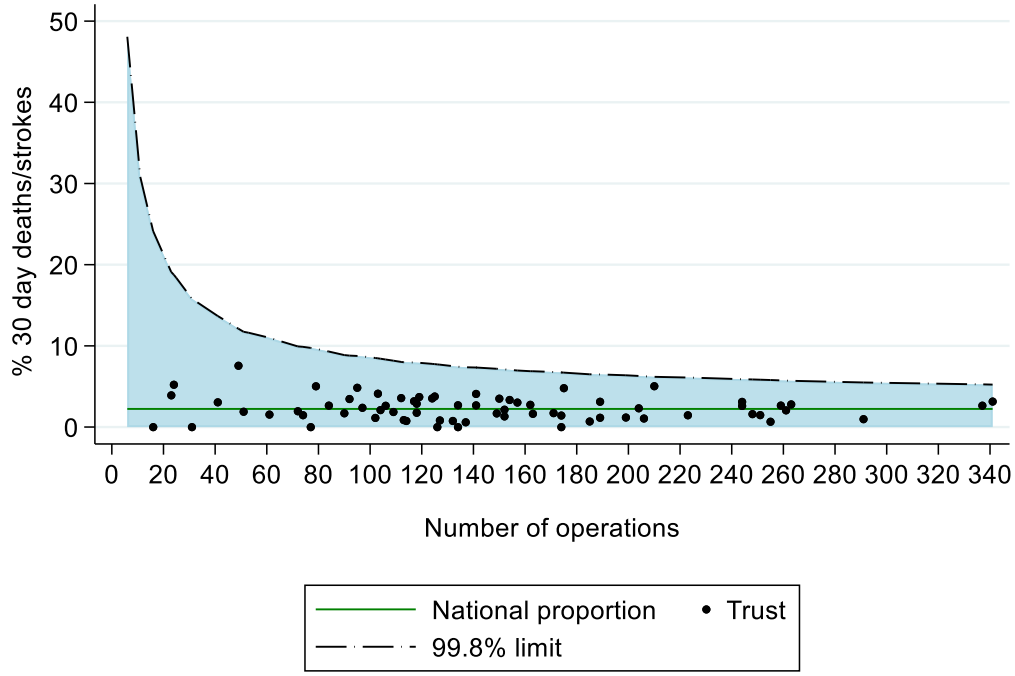
Table 8.2: Postoperative outcomes following carotid endarterectomy for 2021

Procedures	**3,171**
Complication	**Complication rate (%) 2021**
Death and/or stroke within 30 days	2.3 (1.8 – 2.9)
Stroke within 30 days	1.9 (1.4 – 2.4)
Death within 30 days	0.7 (0.4 – 1.0)
Bleeding within admission	2.5 (1.9 – 3.1)
Myocardial infarct within admission	0.8 (0.5 – 1.2)
Cranial nerve injury within admission	2.1 (1.7 – 2.7)

8.4 Rates of stroke/death within 30 days among NHS trusts

The primary measure of safety after carotid endarterectomy is the rate of death or stroke within 30 days of the procedure. The risk-adjusted values for each NHS trust for this outcome indicator are shown in Figure 8.2. Between 2019 and 2021, all NHS organisations were within the expected distance of the overall national average rate of 2.2% (i.e., they were within the 99.8% control limits).

Figure 8.2: Funnel plot of risk-adjusted rates of stroke/death within 30 days for NHS trusts, for carotid endarterectomies between January 2019 and December 2021



The overall national average rate of stroke/death within 30 days = 2.2%

Appendix 1: NVR Governance structure

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

Mr A Pherwani	Chair	VSGBI
Mr D Adam		VSGBI
Mr N Hopper		VSGBI
Mr I Hunter		VSGBI
Ms K Sritharan		VSGBI
Ms L Wales		VSGBI
Mr B Cooper		Society for Vascular Nursing
Mr A Nasim		National AAA Screening Programme
Dr R Williams		British Society of Interventional Radiology
Dr D Taylor		Vascular Anaesthesia Society of GB & I
Mr A McLaren		Medicines and Healthcare products Regulatory Agency
Mr D Dunphy		Association of British HealthTech Industries

plus members of the CEU involved in the NVR: Ms Panagiota Birmpili, Ms Eleanor Atkins, Prof David Cromwell, Dr Amundeep Johal, Dr Qiuju Li, and Mr Sam Waton

Members of Project Board

Prof I Loftus, Chair	VSGBI
Ms S Hewitt	HQIP
Ms S Bhatti	HQIP
Mr P Palmer	NEC Software Solutions UK
Mr R Armstrong	NEC Software Solutions UK

plus members of the project/delivery team: Mr Arun Pherwani (Surgical Lead), Dr R Williams (IR Lead), Ms Panagiota Birmpili, Ms Eleanor Atkins, Prof David Cromwell, Dr Amundeep Johal, Dr Qiuju Li, and Mr Sam Waton

Appendix 2: NHS organisations that perform vascular procedures

Code	Organisation Name	AAA	CEA	Angio	Bypass	Amp
7A1	Betsi Cadwaladr University Health Board	Yes	Yes	Yes	Yes	Yes
7A3	Swansea Bay University Health Board	Yes	Yes	Yes	Yes	Yes
7A4	Cardiff and Vale University Health Board	Yes	Yes	Yes	Yes	Yes
7A5	Cwm Taf Morgannwg University Health Board	No	No	Yes	No	No
7A6	Aneurin Bevan University Health Board	Yes	Yes	Yes	Yes	Yes
R0A	Manchester University NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
R0B	South Tyneside and Sunderland NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
R0D	University Hospitals Dorset NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
R1H	Barts Health NHS trust	Yes	Yes	Yes	Yes	Yes
R1K	London North West University Healthcare NHS trust	No	Yes	Yes	Yes	Yes
RA9	Torbay and South Devon NHS Foundation Trust	Yes	No	Yes	Yes	Yes
RAE	Bradford Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RAJ	Mid and South Essex NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RAL	Royal Free London NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RBD	Dorset County Hospital NHS Foundation Trust	No	No	Yes	No	No
RBN	St Helens & Knowsley Teaching Hospitals NHS trust	No	No	Yes	No	No
RBQ	Liverpool Heart And Chest NHS Foundation Trust	Yes	No	No	No	No
RBZ	Northern Devon Healthcare NHS trust	No	No	Yes	No	Yes
RC9	Bedfordshire Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RCB	York Teaching Hospital NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RD1	Royal United Hospital Bath NHS trust	No	No	Yes	No	No
RD8	Milton Keynes Hospital NHS Foundation Trust	No	No	Yes	No	No
RDE	East Suffolk and North Essex NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RDU	Frimley Health NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
REF	Royal Cornwall Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
REM	Liverpool University Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RF4	Barking, Havering and Redbridge University Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RGN	North West Anglia NHS Foundation Trust	No	No	Yes	No	No
RGR	West Suffolk NHS Foundation Trust	No	No	Yes	No	No
RGT	Cambridge University Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RH5	Somerset NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RH8	Royal Devon and Exeter NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RHM	University Hospital Southampton NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes

Code	Organisation Name	AAA	CEA	Angio	Bypass	Amp
RHQ	Sheffield Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RHU	Portsmouth Hospitals NHS trust	No	No	Yes	No	No
RHW	Royal Berkshire NHS Foundation Trust	No	No	Yes	No	No
RJ1	Guy's and St Thomas' NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RJ7	St George's University Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RJE	University Hospital of North Midlands NHS trust	Yes	Yes	Yes	Yes	Yes
RJR	Countess of Chester Hospital NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RJZ	King's College Hospital NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RK9	University Hospitals Plymouth NHS trust	Yes	Yes	Yes	Yes	Yes
RKB	University Hospitals Coventry and Warwickshire NHS trust	Yes	Yes	Yes	Yes	Yes
RL4	Royal Wolverhampton Hospitals NHS trust	No	No	Yes	No	No
RM1	Norfolk and Norwich University Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RM3	Northern Care Alliance NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RMC	Bolton NHS Foundation Trust	No	No	Yes	No	No
RN3	Great Western Hospitals NHS Foundation Trust	No	No	Yes	No	No
RN5	Hampshire Hospitals NHS Foundation Trust	No	No	Yes	No	No
RNA	The Dudley Group NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RNN	North Cumbria Integrated Care NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RNS	Northampton General Hospital NHS trust	Yes	Yes	Yes	Yes	Yes
RP5	Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RPA	Medway NHS Foundation Trust	No	Yes	Yes	Yes	Yes
RQW	Princess Alexandra Hospital NHS trust	Yes	No	Yes	Yes	Yes
RR7	Gateshead Health NHS Foundation Trust	No	No	Yes	No	No
RR8	Leeds Teaching Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RRF	Wrightington, Wigan And Leigh NHS Foundation Trust	No	No	Yes	No	No
RRK	University Hospitals Birmingham NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RRV	University College London Hospitals NHS Foundation Trust	No	Yes	Yes	No	No
RT3	Royal Brompton & Harefield NHS Foundation Trust	Yes	Yes	Yes	Yes	No
RTD	Newcastle upon Tyne Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RTE	Gloucestershire Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RTG	University Hospitals of Derby and Burton NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RTH	Oxford University Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RTK	Ashford and St Peter's Hospitals NHS Foundation Trust	No	No	Yes	No	No
RTP	Surrey and Sussex Healthcare NHS trust	No	No	Yes	No	No
RTR	South Tees Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RVJ	North Bristol NHS trust	Yes	Yes	Yes	Yes	Yes

Code	Organisation Name	AAA	CEA	Angio	Bypass	Amp
RVV	East Kent Hospitals University NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RVY	Southport and Ormskirk Hospital NHS trust	No	No	Yes	No	No
RWA	Hull University Teaching Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RWD	United Lincolnshire Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RWE	University Hospitals of Leicester NHS trust	Yes	Yes	Yes	Yes	Yes
RWG	West Hertfordshire Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RWH	East and North Hertfordshire NHS trust	Yes	Yes	Yes	Yes	Yes
RWP	Worcestershire Acute Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RWY	Calderdale and Huddersfield NHS Foundation Trust	No	No	Yes	No	No
RX1	Nottingham University Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RXF	Mid Yorkshire Hospitals NHS trust	No	No	Yes	No	No
RXN	Lancashire Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RXP	County Durham and Darlington NHS Foundation Trust	No	No	Yes	No	No
RXQ	Buckinghamshire Healthcare NHS trust	No	No	Yes	No	No
RXR	East Lancashire Hospitals NHS trust	Yes	Yes	Yes	Yes	Yes
RXW	Shrewsbury and Telford Hospital NHS trust	Yes	Yes	Yes	Yes	Yes
RYJ	Imperial College Healthcare NHS trust	Yes	Yes	Yes	Yes	Yes
RYR	University Hospital Sussex NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
SA999	NHS Ayrshire & Arran	Yes	Yes	Yes	Yes	Yes
SF999	NHS Fife	No	No	Yes	No	No
SG999	NHS Greater Glasgow and Clyde	Yes	Yes	Yes	Yes	Yes
SH999	NHS Highland	Yes	Yes	Yes	Yes	Yes
SL999	NHS Lanarkshire	Yes	Yes	Yes	Yes	Yes
SN999	NHS Grampian	Yes	Yes	Yes	Yes	Yes
SS999	NHS Lothian	Yes	Yes	Yes	Yes	Yes
ST999	NHS Tayside	Yes	Yes	Yes	Yes	Yes
SV999	NHS Forth Valley	No	No	Yes	No	No
SY999	NHS Dumfries and Galloway	No	Yes	Yes	Yes	Yes
ZT001	Belfast Health and Social Care Trust	Yes	Yes	Yes	Yes	Yes

Key

AAA – Perform AAA repair
CEA – Performs carotid endarterectomy
Angio – Performs lower limb angioplasty/stent
Bypass – Performs lower limb bypass
Amp – Performs major lower limb amputation

Appendix 3: Summary of procedures and patient characteristics

Lower limb revascularisation

Table A3.1 Characteristics of patients undergoing lower limb revascularisation in 2021

	Elective				Non-elective			
	Endovascular		Open surgical		Endovascular		Open surgical	
	No.	%	No.	%	No.	%	No.	%
Total procedures	4,297	66.0	3,149	54.1	2,212	34.0	2,668	45.9
Age group (years)								
Under 60	681	15.9	587	18.7	358	16.2	526	19.8
60 to 69	1,205	28.1	1,015	32.4	601	27.2	747	28.1
70 to 79	1,395	32.6	1,112	35.4	653	29.6	892	33.5
80 and over	1,003	23.4	425	13.5	595	27.0	494	18.6
Men	2,933	68.3	2,345	74.5	1,510	68.3	1,931	72.4
Women	1,364	31.7	804	25.5	702	31.7	737	27.6
Smoking status								
Current smoker	1,101	25.7	1,108	35.2	581	26.5	1,150	43.3
Ex-smoker	2,265	52.9	1,708	54.3	1,048	47.9	1,194	44.9
Never smoked	913	21.4	331	10.5	560	25.6	313	11.8
Comorbidities								
None	519	12.1	385	12.2	160	7.2	309	11.6
Diabetes	2,135	49.8	1,179	37.5	1,389	62.8	1,150	43.2
Hypertension	2,692	62.7	2,090	66.4	1,368	61.9	1,746	65.6
Chronic lung disease	774	18.0	802	25.5	404	18.3	696	26.2
Ischaemic heart disease	1,190	27.7	973	30.9	684	30.9	902	33.9
Chronic heart failure	365	8.5	175	5.6	284	12.8	217	8.2
Chronic renal disease	706	16.5	317	10.1	514	23.3	314	11.8
Stroke	382	8.9	227	7.2	212	9.6	241	9.1
Medication								
None	198	4.6	19	0.60	103	4.7	29	1.1
Antiplatelet	3,287	76.6	2,651	84.21	1,571	71.1	2,060	77.3
Statin	2,960	69.0	2,596	82.47	1,488	67.3	2,025	76.0
Beta blocker	1,143	26.6	827	26.27	635	28.7	705	26.5
ACE inhibitor	1,475	34.4	1,194	37.93	685	31.0	948	35.6

Table A3.2: Characteristics of lower limb endovascular procedures undertaken in 2021 by anatomical location

	Vessels treated		Stent insertion		Non-occlusive		Procedure success[2]	
	n	%	n	%	n	%	n	%
Aorta	62	0.6	43	69.4	-	-	-	-
Common iliac	1378	12.8	889	64.5	1004	72.9	1307	94.8
External iliac	1129	10.5	522	46.2	873	77.3	1083	95.9
Superficial femoral	3137	29.2	632	20.1	1787	57.0	2954	94.2
CFA, PFA	343	3.2	45	13.1	249	72.6	311	90.7
Popliteal	2072	19.3	289	13.9	1205	58.2	1930	93.1
Tibial/pedal	2236	20.8	84	3.8	1069	47.8	1897	84.8
Within graft	393	3.7	27	6.9	344	87.5	365	92.9

[1] The other indication for intervention was occlusion.
[2] The other outcomes were residual stenosis and failure.

Lower limb major amputation

Characteristics of patients undergoing major unilateral amputations are summarised in Table A3.3, separately for above knee amputations (AKAs) and below knee amputations (BKAs) in 2021. Overall, BKAs were more common in patients under 60 years and AKAs more common in patients older than 80 years. Most patients in both amputation groups were men and around 80% were either current or ex-smokers.

The most common presenting problem for BKAs as well as AKAs was tissue loss. Among the BKA patients, the second most common presenting problem was uncontrolled infection, followed by chronic limb ischaemia. For AKA patients, acute or chronic limb-threatening ischaemia were also common. Over half of the patients had undergone a previous ipsilateral limb procedure, with attempt(s) to save limb prior to amputation.

Table A3.3: Characteristics of patients undergoing major unilateral lower limb amputation in 2021

	Below knee	%	Above knee	%
Total procedures	1,532		1,536	
Age group (years)				
Under 60	438	28.6	277	18.1
60 to 64	246	16.1	186	12.1
65 to 69	208	13.6	231	15.1
70 to 74	231	15.1	267	17.4
75 to 79	216	14.1	232	15.1
80 and over	191	12.5	339	22.1
Sex				
Men	1,196	78.1	1,070	69.7
Women	336	21.9	466	30.3
Smoking				
Current smoker	462	30.7	586	38.4
Ex-smoker	712	47.2	717	47.0
Never smoked	333	22.1	223	14.6
Presenting problem				
Acute limb ischemia	164	10.7	353	23.0
Chronic limb ischemia	323	21.1	361	23.5
Neuropathy	17	1.1	12	0.8
Tissue loss	649	42.4	585	38.1
Uncontrolled infection	375	24.5	218	14.2
Aneurysm	4	0.3	6	0.4
Previous ipsilateral limb procedure	882	63.7	738	52.8
Type of previous ipsilateral limb procedure				
Minor amputation only	160	18.4	30	4.2
Angioplasty/stent	415	47.6	162	22.6
Surgical revascularisation	262	30.1	349	48.6
Major amputation	34	3.9	177	24.7

Preoperative risk factors are summarised in Table A3.4. The majority of patients had one or more defined comorbid conditions. The most common comorbidities in both BKA and AKA groups were hypertension, diabetes and ischaemic heart disease. A large majority of patients in both groups were taking antiplatelet medication or statins, and about a quarter to a third of the patients were on beta blockers, ACE inhibitors or Angiotensin II receptor blockers (ARBs).

Table A3.4: Preoperative risk factors among patients undergoing lower limb amputation in 2021

	Below knee	%	Above knee	%
Total procedures	1,532		1,536	
Pre-op ASA grade				
Normal	9	0.6	10	0.7
Mild disease	130	8.5	65	4.2
Severe, not life-threatening disease	1,088	71.1	909	59.3
Severe, life-threatening disease, or moribund patient	303	19.8	550	35.9
Comorbidities				
None	121	7.9	150	9.8
Diabetes	1,040	67.9	709	46.2
Hypertension	947	61.8	957	62.3
Chronic lung disease	302	19.7	436	28.4
Ischaemic heart disease	496	32.4	595	38.7
Chronic heart failure	173	11.3	209	13.6
Chronic renal disease	339	22.1	277	18.0
Stroke	137	8.9	207	13.5
Active/managed cancer	75	4.9	130	8.5
Medication				
None	14	0.9	23	1.5
Anti-platelet	1,066	69.6	1,031	67.1
Statin	1,090	71.1	1,019	66.3
Beta-blocker	435	28.4	464	30.2
ACE inhibitor/ARB	523	34.1	502	32.7
Antibiotic prophylaxis	1,269	82.8	1,281	83.4
DVT prophylaxis	1,107	72.3	1,101	71.7
Oral anticoagulant	291	19.0	321	20.9

Elective repair of infra-renal AAAs

The characteristics of patients who underwent an elective repair of an infra-renal AAA during 2021 are summarised in Table A3.5.

Table A3.5: Characteristics of patients who had elective infra-renal AAA repair between January and December 2021

		Open repair	%	EVAR	%	Total
Total procedures		1,116		1,628		2,744
Age group (years)	Under 66	222	20.0	94	5.8	316
	66 to 75	642	57.8	618	38.1	1,260
	76 to 85	239	21.5	778	48.0	1,017
	86 and over	8	0.7	132	8.1	140
Male		1,030	92.3	1,438	88.3	2,468
Female		86	7.7	190	11.7	276
Current smoker		287	25.7	317	19.5	604
Previous AAA surgery		22	2.0	106	6.5	128
Indication	Screen detected	579	52.9	683	44.8	1,262
	Non-screen	406	37.1	671	44.1	1,077
	Other	109	10.0	169	11.1	278
AAA diameter (cm)	Under 5.5	76	6.8	182	11.2	258
	5.5 to 6.9	899	80.6	1,221	75.1	2,120
	7.0 and over	140	12.6	223	13.7	363
ASA fitness grade	1,2	336	30.1	324	19.9	660
	3	738	66.1	1,201	73.8	1,939
	4,5	42	3.8	102	6.3	144
Comorbidities	Hypertension	738	66.1	1,140	70.0	1,878
	Ischemic heart disease	322	28.9	597	36.7	919
	Chronic heart failure	20	1.8	96	5.9	116
	Stroke	68	6.1	135	8.3	203
	Diabetes	143	12.8	290	17.8	433
	Chronic renal failure	133	11.9	276	17.0	409
	Chronic lung disease	250	22.4	495	30.4	745

Preoperative care pathway for elective infra-renal AAA

Table A3.6 describes the overall performance of NHS vascular units against the VSGBI AAA QIF standards over the past three years. The figures in Table A3.6 might be approximate because patients for whom the dates were unknown or contradictory were counted as equivalent to patients who did not receive these elements of care.

Table A3.6: Overall compliance with standards related to the elective AAA care pathway

	Percentage of patients meeting standard		
	2021	**2020**	**2019**
Elective patients were discussed at MDT meetings	86.5 2,373/2,744	85.4 1,989/2,328	85.5 2,974/3,480
Patients with an AAA diameter ≥5.5cm deemed suitable for repair had a preoperative CT/MR angiography assessment	91.8 2,280/2,483	91.1 1,923/2,112	90.4 2,815/3,115
Patients underwent a formal anaesthetic review	97.2 2,666/2,744	97.2 2,263/2,328	94.7 3,294/3,480
Patients whose anaesthetic review was done by a consultant vascular anaesthetist	92.0 2,453/2,666	92.0 2,081/2,263	91.4 3,011/3,294
Patients who had their fitness measured	82.9 2,272/2,742	80.4 1,869/2,326	83.2 2,889/3,472
Most common assessment methods:			
CPET	51.4 1,168/2,272	52.4 980/1,869	59.5 1,719/2,889
Echocardiogram	46.1 1,048/2,272	42.2 788/1,869	36.1 1,042/2,889

Repair of ruptured abdominal aortic aneurysms

Compared to patients who had an elective repair of an infra-renal AAA, the patients who had surgery for a ruptured AAA were older on average, with most aged over 76 years at the time of surgery, and tended to have a larger diameter of the aneurysm (Table A3.7). In comparison to patients undergoing an open repair, patients having EVAR had a smaller AAA diameter, on average, and a greater proportion had also undergone AAA surgery previously.

Table A3.7: Characteristics of patients who had a repair of a ruptured AAA between January 2019 and December 2021

		Open repair	%	EVAR	%	Total
Total procedures		1,052		638		1,690
Age group (years)	Under 66	160	15.2	60	9.4	220
	66 to 75	346	32.9	181	28.4	527
	76 to 85	478	45.5	304	47.7	782
	86 and over	67	6.4	92	14.4	159
Male		857	81.5	542	85.0	1,399
Female		195	18.5	96	15.0	291
Previous AAA surgery		77	7.3	106	16.6	183
AAA diameter (cm)	Under 5.5	62	5.9	94	14.9	156
	5.5 to 6.9	237	22.6	171	27.1	408
	7.0 and over	748	71.4	365	57.9	1,113
ASA fitness grade	1 or 2	41	3.9	27	4.2	68
	3	84	8.0	102	16.0	186
	4	651	61.9	418	65.5	1,069
	5	276	26.2	91	14.3	367

Carotid endarterectomy

Table A3.8: Characteristics of patients who had carotid endarterectomy in 2021, compared with characteristics from 2019 and 2020

Patient characteristics	No. of procedures	2021 %	2020 %	2019 %
Total procedures	3,171			
Age (years), (n=3,157)				
Under 66	887	28.1	28.1	26.8
66 to 75	1,141	36.1	35.6	35.8
76 to 85	994	31.5	31.5	32.4
86 and over	135	4.3	4.8	5.0
Male	2,195	69.2	69.2	69.3
Female	976	30.8	30.8	30.7
Asymptomatic	133	4.2	4.2	6.8
Patients symptomatic for carotid disease				
Index symptom if symptomatic: (n=3,038)				
Stroke	1,186	39.0	39.4	38.4
TIA	1,359	44.7	44.0	44.3
Amaurosis fugax	409	13.5	15.3	15.6
None of the three above	84	2.8	1.3	1.6
Grade of ipsilateral carotid stenosis* (n=3,170)				
<50%	49	1.5	1.1	0.9
50-69%	871	27.5	26.0	26.0
70-89%	1,290	40.7	41.9	41.1
90-99%	954	30.1	30.8	31.9
Occluded	6	0.2	0.2	0.1
Rankin score prior to surgery (n=3,170)				
0-2	2,817	88.9	91.5	91.9
3	319	10.1	7.6	7.0
4-5	34	1.1	0.8	1.2
Comorbidities (n=3,171)				
Diabetes	790	24.9	23.4	24.0
Cardiac disease	835	26.3	27.9	28.6

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

Table A3.9: Operative details of carotid endarterectomies performed from 2019 to 2021

Operation details		Procedures (n=3,171)	2021 %	2020 %	2019 %
Anaesthetic	General	2,018	63.6	64.4	63.5
	GA + block	335	10.6	8.9	8.3
	Block or regional	568	17.9	17.9	16.4
	Local	250	7.9	8.9	11.8
Type of endarterectomy	Standard	270	8.5	7.6	8.2
	Standard + patch	2,757	86.9	87.4	85.9
	Eversion	144	4.5	5.0	5.9
Carotid shunt used		2,037	64.2	62.2	59.2
Ipsilateral patency check		2,100	67.6	71.0	68.1

Appendix 4: NHS organisations that perform procedures for type B aortic dissection

NHS Trust	2016	2017	2018	2019	2020	2021	Total
Barts Health NHS Trust	7	0	<5	<5	<5	0	12
Bedfordshire Hospitals NHS Foundation Trust	<5	5	<5	<5	0	<5	14
Belfast Health and Social Care Trust	0	0	<5	0	<5	0	<5
Cambridge University Hospitals NHS Foundation Trust	<5	<5	<5	<5	<5	<5	12
Cardiff and Vale University Health Board	<5	<5	<5	0	<5	<5	14
Guy's and St Thomas' NHS Foundation Trust	11	9	6	<5	<5	7	38
Hull University Teaching Hospitals NHS Trust	0	<5	0	5	<5	<5	10
Imperial College Healthcare NHS Trust	8	11	17	15	12	7	70
King's College Hospital NHS Foundation Trust	0	0	<5	0	0	0	<5
Lancashire Teaching Hospitals NHS Foundation Trust	0	0	0	0	<5	0	<5
Leeds Teaching Hospitals NHS Trust	6	6	<5	10	<5	<5	30
Liverpool Heart And Chest NHS Foundation Trust	0	0	0	0	0	<5	<5
Liverpool University Hospitals NHS Foundation Trust	<5	0	0	<5	0	0	<5
Manchester University NHS Foundation Trust	<5	0	0	0	0	0	<5
Mid and South Essex NHS Foundation Trust	0	0	0	<5	<5	<5	9
NHS Grampian	0	<5	<5	0	0	<5	6
NHS Greater Glasgow and Clyde	0	0	0	<5	0	0	<5
NHS Lothian	0	0	<5	0	<5	<5	5
Newcastle upon Tyne Hospitals NHS Foundation Trust	<5	<5	0	<5	<5	<5	11
Norfolk and Norwich University Hospitals NHS Foundation Trust	<5	0	0	0	<5	<5	<5
North Bristol NHS Trust	0	5	7	10	11	6	39
Nottingham University Hospitals NHS Trust	6	<5	<5	0	<5	<5	11
Oxford University Hospitals NHS Foundation Trust	<5	0	<5	0	<5	0	5
Royal Brompton & Harefield NHS Foundation Trust	0	16	9	8	8	6	47
Royal Free London NHS Foundation Trust	<5	<5	<5	<5	0	0	9
Sheffield Teaching Hospitals NHS Foundation Trust	0	<5	<5	0	<5	0	<5
South Tees Hospitals NHS Foundation Trust	0	<5	0	0	<5	0	<5
South Tyneside and Sunderland NHS Foundation Trust	<5	<5	0	0	0	0	<5
St George's University Hospitals NHS Foundation Trust	9	5	17	15	10	15	71
University Hospital Southampton NHS Foundation Trust	<5	<5	<5	6	<5	<5	17
University Hospital Sussex NHS Foundation Trust	0	<5	0	0	0	<5	<5
University Hospital of North Midlands NHS Trust	<5	7	8	<5	<5	<5	26
University Hospitals Birmingham NHS Foundation Trust	11	8	5	8	<5	<5	38
University Hospitals Coventry and Warwickshire NHS Trust	<5	<5	<5	<5	<5	<5	9
University Hospitals of Leicester NHS Trust	<5	0	0	<5	<5	7	13
Worcestershire Acute Hospitals NHS Trust	0	0	<5	0	0	0	<5

References

Birmpili P, Johal A, Li Q, Waton S, Chetter I, Boyle JR, Cromwell D. Factors associated with delays in revascularization in patients with chronic limb-threatening ischaemia: population-based cohort study. Br J Surg. 2021;108(8):951-959. doi: 10.1093/bjs/znab039.

Boyle JR. Is In Hospital Mortality Following EVAR Still a Valid Outcome Measure? *Eur J Vasc Endovasc Surg*. 2019;57(4):520. doi:10.1016/j.ejvs.2018.10.020

Conte MS, Bradbury AW, Kolh P, et al. Global vascular guidelines on the management of chronic limb-threatening ischemia [published correction appears in J Vasc Surg. 2019 Aug;70(2):662]. *J Vasc Surg*. 2019;69(6S):3S-125S.e40. doi:10.1016/j.jvs.2019.02.016

Cumberlege "First do no harm" The report of the Independent Medicines and Medical Devices Safety Review July 2020. https://www.immdsreview.org.uk/downloads/IMMDSReview_Web.pdf

Department of Health. National Stroke Strategy (December 2007) https://webarchive.nationalarchives.gov.uk/20130104224925/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_081059.pdf

Department of Health Stroke Policy Team. Implementing the National Stroke Strategy - an imaging guide (2008). Available at: https://webarchive.nationalarchives.gov.uk/20130123193818/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_085146

Horrocks M. Vascular Surgery GIRFT Programme National Specialty Report. March 2018. Available at: http://gettingitrightfirsttime.co.uk/vascular-surgery-report/

Johal AS, Loftus IM, Boyle JR, Naylor AR, Waton S, Heikkila K, Cromwell AS. Changing patterns of carotid endarterectomy between 2011 and 2017 in England. doi: 10.1161/STROKEAHA.119.025231. [Epub ahead of print]

Li Q, Birmpili P, Johal AS, Waton S, Pherwani AD, Boyle JR, Cromwell DA. Delays to revascularization for patients with chronic limb-threatening ischaemia. Br J Surg. 2022;109(8):717-726. doi: 10.1093/bjs/znac109.

Meecham L, Jacomelli J, Davis M, Pherwani A, Lees T, Earnshaw JJ. Outcomes in Men From the NHS Abdominal Aortic Aneurysm Screening Programme With a Large Aneurysm Referred for Intervention. Eur J Vasc Endovasc Surg. 2021 Feb;61(2):192-199. doi: 10.1016/j.ejvs.2020.09.009. Epub 2020 Oct 24. PMID: 33594980

National Confidential Enquiry into Patient Outcomes and Deaths. Lower Limb Amputation: Working Together 2014. London: NCEPOD, 2014

National Institute for Health and Clinical Excellence (NICE). Stroke: The diagnosis and acute management of stroke and transient ischaemic attacks. May 2019. Available at: https://www.nice.org.uk/guidance/ng128

National Institute for Health and Clinical Excellence (NICE). Guidance for peripheral arterial disease. August 2012. Available at: http://www.nice.org.uk/guidance/CG147

NHS Abdominal Aortic Aneurysm Screening Programme. Quality Standards and Service Objectives. April 2020. Available at: https://www.gov.uk/government/publications/aaa-screening-quality-standards-and-service-objectives/abdominal-aortic-aneurysm-screening-programme-standards-valid-for-data-collected-from-1-april-2020

Powell JT, Sweeting MJ, Thompson MM, et al. Endovascular or open repair strategy for ruptured abdominal aortic aneurysm: 30 day outcomes from IMPROVE randomised trial. BMJ. 2014; 348: f7661. doi: 10.1136

Vascular Society for Great Britain and Ireland. COVID-19 Virus and Vascular Surgery; 2020. www.vascularsociety.org.uk/professionals/news/113/covid19_virus_and_vascular_surgery.

Vascular Society of Great Britain and Ireland (VSGBI). Outcomes after Elective Repair of Infra-renal Abdominal Aortic Aneurysm. A report from The Vascular Society. London: The Vascular Society, March 2012. Available at: https://www.vascularsociety.org.uk/_userfiles/pages/files/Document%20Library/VSGBI-Mortality-Report.pdf

Vascular Society of Great Britain and Ireland (VSGBI). Abdominal Aortic Aneurysm Quality Improvement Programme (AAAQIP) Team. Delivering a national quality improvement programme for patients with abdominal aortic aneurysms. London: The Vascular Society, September 2012. Available at: https://www.vascularsociety.org.uk/_userfiles/pages/files/Document%20Library/Final-AAAQIP-Public-Report-_VSGBI-August-2012_310812.pdf

Vascular Society of Great Britain and Ireland (VSGBI). A Best Practice Clinical Care Pathway for Major Amputation Surgery. London: The Vascular Society, April 2016. Available at: https://www.vascularsociety.org.uk/_userfiles/pages/files/Resources/Vasc_Soc_Amputation_Paper_V2.pdf

Vascular Society of Great Britain and Ireland (VSGBI). The Provision of Services for Patients with Vascular Disease. London: The Vascular Society, November 2021. Available at: https://www.vascularsociety.org.uk/_userfiles/pages/files/Resources/FINAL%20POVS.pdf

Vascular Society of Great Britain and Ireland (VSGBI). A Best Practice Clinical Care Pathway for Critical Limb Ischaemia. London: The Vascular Society, March 2022. Available at: https://jvsgbi.com/wp-content/uploads/2022/04/PAD-QIF-2022-update-1.1.pdf

Vascular Society of Great Britain and Ireland (VSGBI). Acute Aortic Dissection Pathway Toolkit. Available at: https://www.vascularsociety.org.uk/_userfiles/pages/files/Resources/Acute%20Aortic%20Dissection%20Pathway%20Toolkit.pdf

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.
ACE inhibitors	Angiotensin-converting enzyme inhibitors are medications designed to decrease blood pressure.
ARBs	Angiotensin-receptor blockers are drugs designed to decrease blood pressure. They are similar to ACE inhibitors but work in a different way.
Angiography	Angiography is a type of imaging technique used to examine blood vessels. It may be carried out non-invasively using computerised tomography (CT) and magnetic resonance imaging (MRI).
Asymptomatic patient	A patient who does not yet show any outward signs or symptoms of plaque.
Cardiopulmonary exercise testing (CPET)	Cardiopulmonary exercise testing is a non-invasive method of assessing the function of the heart and lungs at rest and during exercise.
Carotid endarterectomy (CEA)	Carotid endarterectomy is a surgical procedure in which plaque build-up is removed from the carotid artery in the neck.
Carotid stenosis	Abnormal narrowing of the neck artery to the brain.
Complex AAA	A term used to describe aortic aneurysms that are not located below the arteries that branch off to the kidneys. These are categorised into three types: juxta-renal (that occur near the kidney arteries), supra-renal (that occur above the renal arteries) and thoraco-abdominal (more extensive aneurysms involving the thoracic and abdominal aorta).
Cranial nerve injury (CNI)	Damage to one of the 12 nerves supplying the head and neck.
Chronic limb-threatening ischaemia (CLTI)	The most severe form of peripheral arterial disease, where the blood flow to the legs becomes severely restricted, to such an extent that these parts of the limb are at risk of developing gangrene. CLTI is associated with severe pain at rest, which is often worse at night, and there may also be ulcers on the leg and foot.

Confidence interval (CI)	A statistical term used to describe the range of values that we are confident the metric lies within.
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.
Fontaine score	An internationally recognised scoring system or classification of the severity of peripheral arterial disease.
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 is collected by any of these national agencies.
Index case	The first procedure a patient underwent in their hospital admission.
Infra-renal AAA	An abdominal aneurysm that is located below the point where the arteries branch off the aorta to the kidneys.
Interquartile 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.
Hybrid operating theatre	An operating theatre with built-in radiological imaging capabilities. The imaging equipment is able to move and rotate around a patient and multiple monitors provide good visibility around the operating table.
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.
OPCS	Office of Population and Censuses Surveys. A procedural classification list for describing procedures undertaken during episodes of care in the NHS.

Peripheral arterial disease (PAD)	Peripheral arterial disease (PAD) is a restriction of the blood flow in the lower-limb arteries. The disease can affect various sites in the legs, and produces symptoms that vary in their severity from pain in the legs during exercise to persistent ulcers or gangrene.
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.
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 after a short time (e.g., 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 region.
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