National Vascular Registry

Supplementary Materials for the 2024 Report

November 2024

Royal College of Surgeons of England
ADVANCING SURGICAL CARE

VASCULAR SOCIETY
OF GREAT BRITAIN AND IRELAND

BSIR British Society of Interventional Radiology

Commissioned by:

HQIP
Healthcare Quality Improvement Partnership

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, and the Royal College of Nursing. 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 recognise the considerable time they have devoted to data collection.

We would also like to thank:

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Foreword

It was a great pleasure to see the state of the nation report this year and be invited to write a forward. The data collected represent the efforts of our complex teams working from different multi-disciplinary backgrounds coming together to deliver excellent care for our patient group. I reflect on how this data has driven us to improve outcomes for our patients over a number of years. Looking at this year's report some outcomes are truly excellent. The report of course does highlight those areas where we can improve. This year's report reflects that our time to treatment remains a challenge and we have made little progress since the COVID-19 pandemic. We have rightly set ambitious targets for our patients to get the treatment they deserve. We do need to reflect on these and consider if they remain correct and relevant. For those that remain relevant need close attention to the pathways we use. This document gives us the information we need to work with colleagues at those who are responsible for the commissioning and resourcing across the four nations to develop our services.

This year as well as access times, the team have highlighted a substantial increase in the number of patients undergoing major lower limb amputation since 2020. Limb salvage surgery is the biggest proportion of our work, and this must be a signal for us to research the reasons for this and address them.

Our patient group remains in need of expedient care with most of the conditions we treat needing urgent or emergency care. Our vascular patients deserve the same priority of access to urgent care as those with other conditions such as cancer care.

The report demonstrates substantial variations in practice, and it is my hope that as a community we can look at those areas and units that are performing well and understand what we can do in each unit in the country to get that level of care for our patients.

The National Vascular Registry collects data that is important to our patients, but it relies on the expert team in the Clinical Effectiveness Unit and the clinical leadership across the Vascular Society and BSIR to turn this into useable information that is both digestible for the specialist and public. I would like to thank them personally and on behalf of the Vascular Society of Great Britain and Ireland for their dedication to deliver this report. I would like to offer our thanks to Sam Waton who expertise provides a constant presence for the NVR and Arun Pherwani who has come to the end of his term after 4 years, having agreed to extend his term unexpectedly providing excellent leadership for the Vascular Society with the NVR. I am delighted to welcome Colin Bicknell as our quality and audit chair and look forward to the ongoing work he will take on with the team.

Mr Andrew Garnham
President of the Vascular Society of Great Britain & Ireland

Data on the outcomes of what we do are an essential component of our work as vascular specialists in 2024. This 2024 iteration of the United Kingdom National Vascular Registry (NVR) provides up to date quality outcomes of UK specialist work in lower limb, carotid and aortic vascular disease. The document is testament to the successful collaboration between the Royal College of Surgeons, the Vascular Society and the British Society of Interventional Radiology.

The 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. We are thankful HQIP (Healthcare Quality Improvement Partnership) for continuing to support this worthy endeavour.

The annual NVR report is the highlight of the NVR annual calendar. It is always interesting to see how strategic goals in vascular therapy have progressed over the preceding 12 months. Some data points have improved, others not as much as was hoped. The NVR data serve as a reminder that as vascular specialists we must strive ever harder to provide consistent and excellent care for our patients.

The 2024 data also provides substantial material to excite research in vascular disease. I hope that vascular researchers will assess these data and will engineer research projects to further improve our knowledge of UK vascular disease and outcomes for our patients with vascular disease.

As the President of the British Society of Interventional Radiology, I would like to thank everybody on the NVR team who have been involved in the production of this report, including Sam Waton, Amandeep Johal, Qiuju Li, Panagiota Birmpili, and Professor David Cromwell. I would also like to highlight the work done by Professor Arun Pherwani and Dr Robin Williams in constantly driving the NVR project forward. This will be Arun's and Robin's final report and I know that Mr Colin Bicknell and Dr James Harding who will replace them as clinical leads will do an excellent job in carrying the NVR flame forward.

Prof Rob Morgan
President of the British Society of Interventional Radiology

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 2024 State of the Nation Report (available at: https://www.vsqip.org.uk/reports-publications/2024-nvr-state-of-the-nation-report/)

Information is presented on clinical practice in the calendar year of 2023, and on surgical outcomes for the previous three-year period (2021-23). 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) or dissection**
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 2024 NVR Report Supplementary Materials

The aim of this 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/patient_info/

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, waiting times for treatment and the complications that may occur as part of treatment.

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 People with Vascular Disease" published by the Vascular Society [VSGBI 2021]. Standards of care specific to the various vascular conditions 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-publications/2024-nvr-state-of-the-nation-report/

These include the main state of the nation 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 how to access your NVR data
- 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 2021 and 31 December 2023. 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 2024. 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 2021-23 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 1 provides a list of NHS vascular units for which results are published.

Unless stated otherwise, results are presented for all four UK nations (England, Wales, Scotland and Northern Ireland). 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.

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. Lower limb revascularisation for PAD

2.1 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 2023 and December 2023 and which cover:

- 9,447 endovascular procedures,
- 7,114 open surgical procedures, of which 4,841 were bypass procedures and 2,273 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 2.1 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 improved slightly over the three years for all procedures (Table 2.1). 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.

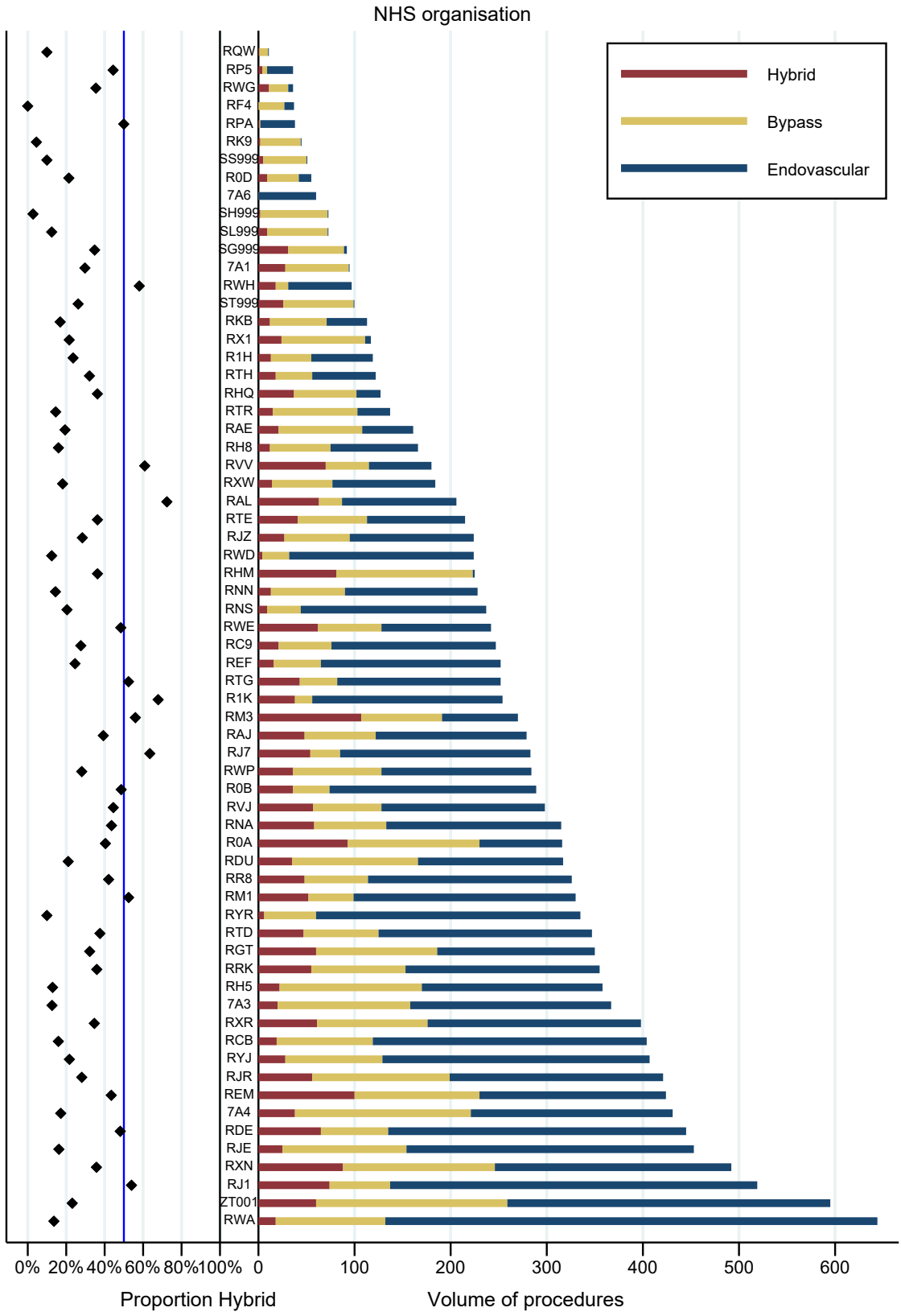
Table 2.1: Estimated case ascertainment for lower limb revascularisation procedures, by year

	Open surgical procedures			Endovascular procedures		
	2021	2022	2023	2021	2022	2023
NVR procedures	6,149	6,576	7,114	7,260	8,316	9,447
Expected procedures	7,223	7,210	7,627	14,942	14,782	15,685
Estimated case ascertainment	85%	91%	93%	49%	56%	60%

Table 2.2: Estimated case ascertainment rates in 2023 by UK country

	Open surgical procedures	Endovascular procedures
England	98%	64%
Wales	100%	89%
Scotland	42%	1%
Northern Ireland	100%	40%

Figure 2.1 Frequency of each type of revascularisation procedure by NHS trust for 2023



2.2 Patient characteristics

Table 2.3: Characteristics of patients undergoing lower limb revascularisation in 2023

	Elective				Non-elective			
	Endovascular		Open surgical		Endovascular		Open surgical	
	No.	%	No.	%	No.	%	No.	%
Total procedures	5,956	63.0	4,066	57.2	3,491	37.0	3,048	42.8
Age group (years)								
Under 60	907	15.3	732	18.1	505	14.5	527	17.4
60 to 69	1,669	28.1	1,367	33.7	912	26.2	961	31.7
70 to 79	2,038	34.3	1,445	35.6	1,164	33.4	1,073	35.4
80 and over	1,320	22.2	511	12.6	901	25.9	473	15.6
Men	4,168	70.0	3,029	74.5	2,466	70.6	2,209	72.5
Women	1,788	30.0	1,037	25.5	1,025	29.4	839	27.5
Smoking status								
Current smoker	1,432	24.1	1,324	32.6	828	23.8	1,283	42.2
Ex-smoker	3,099	52.2	2,283	56.2	1,637	47.1	1,387	45.6
Never smoked	1,401	23.6	458	11.3	1,014	29.2	371	12.2
Comorbidities								
None	664	11.2	464	11.4	214	6.1	335	11.0
Diabetes	3,032	51.0	1,469	36.2	2,368	67.9	1,389	45.7
Hypertension	3,732	62.8	2,764	68.0	2,168	62.2	1,996	65.7
Chronic lung disease	1,020	17.2	1,019	25.1	658	18.9	768	25.3
Ischaemic heart disease	1,639	27.6	1,223	30.1	1,129	32.4	992	32.6
Chronic heart failure	543	9.1	251	6.2	479	13.7	281	9.3
Chronic renal disease	971	16.3	371	9.1	844	24.2	359	11.8
Stroke	562	9.5	309	7.6	380	10.9	281	9.3
Medication								
None	215	3.6	<5	0.1	113	3.2	13	0.4
Antiplatelet	4,500	75.7	3,441	84.6	2,431	69.7	2,221	72.9
Statin	4,183	70.4	3,365	82.8	2,479	71.1	2,283	75.0
Beta blocker	1,704	28.7	1,139	28.0	1,215	34.8	885	29.1
ACE inhibitor	2,068	34.8	1,579	38.8	1,313	37.6	1,105	36.3

2.3 Procedure characteristics

Most endovascular procedures in 2023 (90.0%) were performed under local anaesthetic, with 3.0% under regional and 7.0% under general anaesthetic.

The procedures involved interventions in 15,486 vessels in 2023, a small increase from 13,472 in 2022 (Table 2.4). The increase could reflect an increase of the number of procedures performed in 2023, or an improvement of case ascertainment.

Half of the endovascular procedures involved treatment of a single vessel (53.3%), with 32.7% treating two, 11.5% treating 3 and 2.5% treating 4 or more vessels.

Balloon angioplasty alone was the most common type of intervention (11,785 vessels, 76.1%), while 3,701 (23.9%) 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.

Table 2.4: Treated vessels during lower limb endovascular procedures between 2021 and 2023

	2021		2022		2023	
Artery	Number	%	Number	%	Number	%
Aorta	67	0.6	75	0.6	86	0.6
Common iliac	1,516	12.8	1,692	12.6	1,923	12.4
External iliac	1,260	10.6	1,424	10.6	1,584	10.2
Superficial femoral	3,516	29.6	3,985	29.6	4,367	28.2
Common femoral/ profunda femoral	390	3.3	474	3.5	605	3.9
Popliteal	2,278	19.2	2,528	18.8	2,901	18.7
Tibial/pedal	2,404	20.2	2,781	20.6	3,434	22.2
Within graft	447	3.8	513	3.8	586	3.8
Total vessels	11,878		13,472		15,486	

Table 2.5: Characteristics of lower limb endovascular procedures undertaken in 2023 by anatomical location

	Vessels treated		Stent insertion		Non-occlusive[1]		Procedure success[2]	
	n	%	n	%	n	%	n	%
Aorta	86	0.6	53	61.6	-	-	-	-
Common iliac	1,923	12.4	1336	69.5	1,266	65.8	1,862	96.8
External iliac	1,584	10.2	778	49.1	1,175	74.2	1,518	95.8
Superficial femoral	4,367	28.2	843	19.3	2,567	58.8	4,112	94.2
CFA, PFA	605	3.9	93	15.4	402	66.4	561	92.7
Popliteal	2,901	18.7	420	14.5	1,710	59.3	2,709	93.4
Tibial/pedal	3,434	22.2	151	4.4	1,574	45.8	2,927	85.2
Within graft	586	3.8	27	4.6	504	86.0	542	92.5

[1] The other indication for intervention was occlusion.

[2] The other outcomes were residual stenosis and failure.

Table 2.6: Characteristics of lower limb revascularisation procedures undertaken in 2023

	Elective		Non-elective	
	Endovascular	**Open**	**Endovascular**	**Open**
Chronic limb ischaemia				
Asymptomatic	340 (5.7%)	40 (1.0%)	60 (1.7%)	17 (0.6%)
Intermittent claudication	1,790 (30.1%)	998 (24.6%)	118 (3.4%)	49 (1.6%)
Nocturnal/resting pain	1,011 (17.0%)	1,358 (33.4%)	433 (12.4%)	589 (19.3%)
Necrosis/gangrene	2,506 (42.1%)	1,133 (27.9%)	2,568 (73.6%)	1,610 (52.9%)
Acute limb ischaemia	206 (3.5%)	177 (4.4%)	263 (7.5%)	610 (20%)
Trauma	6 (0.1%)	5 (0.1%)	14 (0.4%)	45 (1.5%)
Aneurysm	94 (1.6%)	355 (8.7%)	35 (1%)	126 (4.1%)

VSGBI: PAD QIF

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

Endovascular

Overall, 97.4% 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 two NHS trust among those that submitted 10 or more procedures in 2023. This suggests that, among those Trusts with high case ascertainment, most met the VSGBI PAD QIF target of at least 75% during the 2023 audit period (64 out of 66 NHS trusts, 98.4%).

Open surgical (bypass/hybrid)

There were 4,066 elective open procedures in 2023, which was an increase of about 11% compared to 3,647 in 2022, and of 21% compared to 3,348 in 2021. There was also a small increase in non-elective procedures, with 3,048 in 2023 compared to 2,929 procedures in 2022 and 2,801 in 2021. For open procedures in 2023, 87.3% were performed under general anaesthetic, 10.3% under regional and 2.4% under local.

There were 6,574 (93.9%) open procedures undertaken in 2023 that were performed between 8am and 6pm. This was 98.6% for elective and 87.7% for non-elective procedures. The percentage of open surgical procedures performed on planned lists was at least 75% for all but one NHS trusts that submitted 10 or more procedures in the NVR in 2023 (62 out of 63 NHS trusts, 95.5%).

VSGBI: PAD QIF

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

Endovascular

There were 6,518 patients presenting with CLTI who underwent endovascular revascularisation in 2023, of whom 3,001 (46.0%) were admitted non-electively. Among these non-elective patients:

- 48.6% were revascularised within 5 days in 2023,
- 48.6% in 2022, and
- 54.2% in 2021.

The median time from admission to intervention was:

- 6 days (IQR 3-9 days) in 2023
- 6 days (IQR 3-9 days) in 2022, and
- 5 days (IQR 2-9 days) in 2021.

Open surgical

The amount of open surgical procedures (n=4,690) for CLTI in 2023 was about an increase of 400, compared to the number of procedures in 2022 (n=4,281). Among the 2023 cohort, 46.9% (2,199) were admitted non-electively, compared to 49.5% (2,118) in 2022. Among these non-elective patients with CLTI:

- 52.6% were revascularised within 5 days in 2023,
- 53.9% in 2022, and
- 53.6% in 2021.

The median time from admission to intervention was:

- 5 days (IQR 2-9 days) in 2023,
- 5 days (IQR 2-8 days) in 2022, and
- 5 days (IQR 2-8 days) in 2021.

All revascularisation procedures

Overall, 5,200 patients were admitted non-electively with CLTI and underwent revascularisation in 2023 (vs. 4,624 in 2022). The proportion of patients revascularised within 5 days from admission was:

- 50.3% in 2023,
- 51.1% in 2022, and
- 53.9% in 2021.

The median time from admission to intervention was:

- 5 days (IQR 3-9 days) in 2023,
- 5 days (IQR: 3-9 days) in 2022, and
- 5 days (IQR 2-9 days) in 2021.

The proportion of patients revascularised within 5 days from admission has deteriorated slightly.

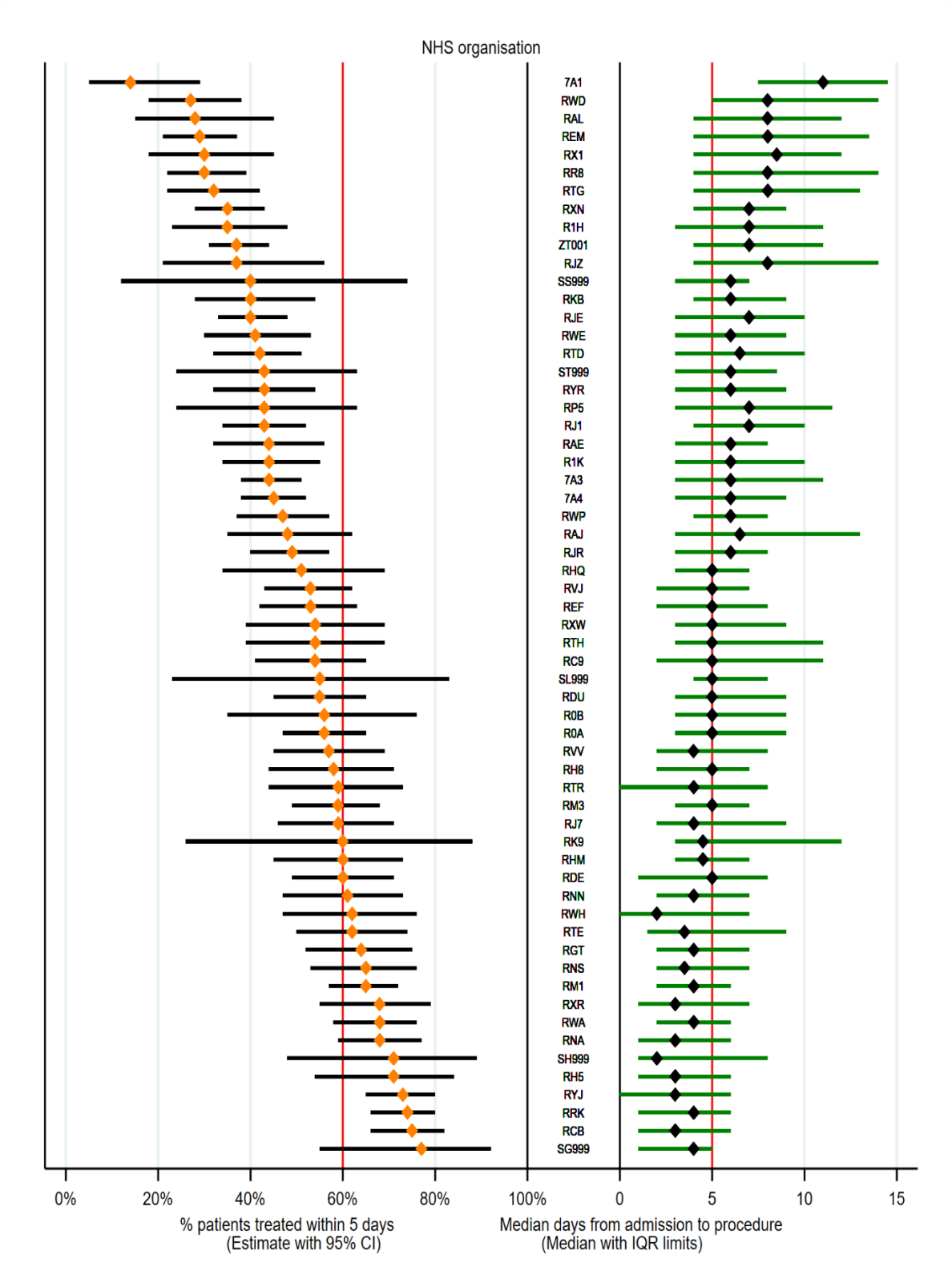
Figure 2.2 depicts the proportion of patients revascularised within 5 days from admission (left panel) across the 60 NHS trusts that performed 10 or more revascularisation procedures for non-elective CLTI admissions in 2023. The right panel summarises the median (IQR) time from admission to procedure for the same NHS trusts. The figure shows considerable variation between NHS trusts in terms of the proportion of patients with timely revascularisation in 2023.

In summary:

- at 27 vascular units, the pathway from admission to surgery took more than five days for half of patients with CLTI,
- at 16 vascular units, the pathway took longer than 10 days for a quarter of patients,
- 20 vascular units had more than half of their non-elective CLTI patients operated on within 5 days.

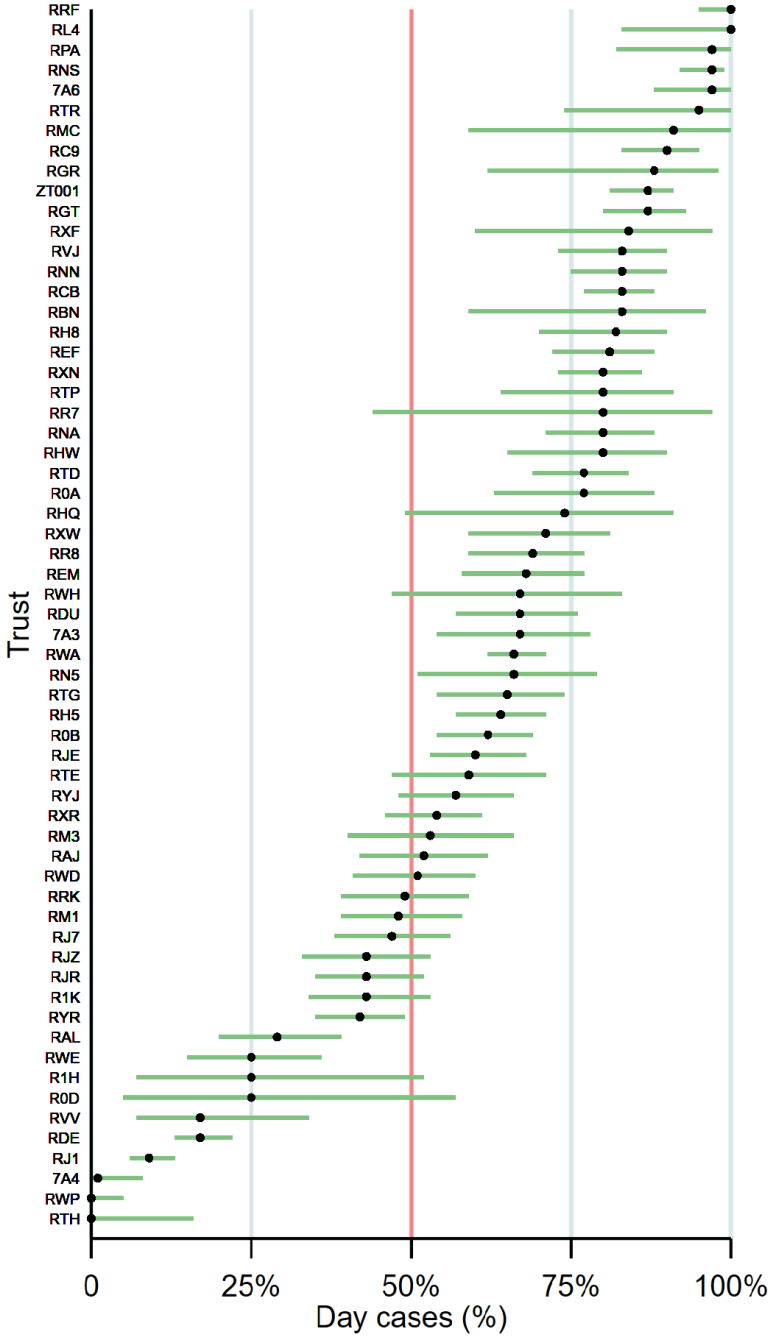
More in-depth analysis of delays to revascularisation in patients with chronic limb-threatening ischaemia can be found in Birmpili et al [2021] and Li et al [2022].

Figure 2.2: 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 2023.



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 2023 revealed substantial variation in the proportion of elective procedures done as day cases (Figure 2.3). Overall, 59.6% of elective endovascular procedures were performed as day cases in 2023, compared to 60.6% in 2022 and 59.6% in 2021.

Figure 2.3: Proportion of elective endovascular procedures performed as day cases, by NHS trust with a volume of ≥10 elective cases per year in 2023.



2.4 Outcomes of lower limb revascularisation procedures

Table 2.7 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, with an in-hospital mortality rate of 1.8% (95% CI 0.7-3.7) for elective and 7.1% (95% CI 5.5-9.0) for non-elective admissions, compared to 0.9% (95% CI 0.7-1.2) and 3.4% (95% CI 2.9-3.9) for CLTI patients with elective and non-elective admissions, respectively.

Table 2.7: Postoperative outcomes after lower limb revascularisation for 2023 by procedure type

	Elective		Non-elective	
	Endovascular	**Open**	**Endovascular**	**Open**
Total procedures	5,956	4,066	3,491	3,048
Post-op destination	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Ward	2,583 (43.4%)	2,902 (71.4%)	3,289 (94.4%)	2,224 (73.0%)
Level 2 (HDU/PACU)	66 (1.1%)	909 (22.4%)	59 (1.7%)	605 (19.9%)
Level 3 (ICU)	9 (0.2%)	215 (5.3%)	31 (0.9%)	217 (7.1%)
Died in theatre	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Day-case unit	3,290 (55.3%)	39 (1.0%)	106 (3.0%)	<5 (0.0%)
Complications	**Rate**	**Rate**	**Rate**	**Rate**
None	94.3	85.5	84.9	72.9
Cardiac	0.4	1.9	1.5	4.0
Respiratory	0.2	2.1	2.0	4.4
Limb ischaemia	0.5	2.3	3.6	7.3
Renal failure	0.1	0.5	0.7	1.7
Further procedures				
None	95.4	93.1	77.4	80.0
Angioplasty/stent	1.7	1.4	6.8	3.0
Bypass	1.0	1.8	3.3	3.7
Minor amputation	1.4	0.9	11.5	5.1
Major amputation	0.5	0.9	5.7	6.9
30-day major amputation	1.3	1.1	8.3	8.0
In-hospital mortality	0.4	1.2	3.0	5.1
Re-admission to higher level care	0.5	1.9	1.8	3.1
Re-admission within 30 days	10.0	10.0	18.1	14.6
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Overall LOS (days)	0 (0 - 1)	5 (3 - 8)	13 (7 - 26)	14 (9 - 25)
Admission-to-procedure (days)	0 (0 - 0)	0 (0 - 0)	5 (2 - 9)	4 (1 - 8)
Post-op LOS (days)	0 (0 - 1)	4 (3 - 7)	6 (2 - 15)	9 (5 - 18)

Patients admitted non-electively and undergoing endovascular procedures had a significantly lower mortality rate (3.0% [95% CI 2.5-3.6]) compared to open procedures (5.1% [95% CI 4.3-5.9]). However, a higher readmission rate within 30 days (18.1% [95% CI 16.9-19.5] for endovascular vs 14.6% [95% CI 13.3-15.9] for open surgical revascularisation) (Table 2.7).

The outcomes of the revascularisation procedures for patients with CLTI admitted non-electively are summarised in Table 2.8 for 2023, 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 2.8: Postoperative outcomes following lower limb revascularisation, for patients with CLTI[1] undergoing non-elective revascularisation in 2023, by admission-to-procedure time in days

	Admission-to-procedure ≤5 days		Admission-to-procedure >5 days	
	Endovascular	**Open**	**Endovascular**	**Open**
Procedures	1,447 (48.6%)	1,153 (52.6%)	1,532 (51.4%)	1,040 (47.2%)
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Overall length of stay (LOS)	8 (4 - 16)	11 (7 - 18)	19 (12 - 33)	21 (15 - 34)
Post-op LOS	5 (1 - 14)	8 (4 - 15)	7 (2 - 19)	11 (6 - 21)
Complications	**Rate**	**Rate**	**Rate**	**Rate**
None	88.1	75.8	82.3	72.3
Cardiac	0.9	3.6	2.0	3.8
Respiratory	1.2	3.2	2.7	5.2
Limb ischaemia	2.6	6.1	4.4	7.7
Renal	0.6	1.4	0.8	1.0
Further unplanned procedures				
None	77.5	80.9	75.5	78.9
Angioplasty/stent	6.1	3.6	8.1	3.4
Bypass	4.0	3.9	2.5	3.5
Minor amputation	12.4	6.6	12.3	6.3
Major amputation	4.6	5.5	6.6	7.6
30-day major amputation	7.5	6.4	9.1	8.9
In-hospital mortality	2.4	3.9	3.1	4.7
Re-admission to higher level care	1.5	2.3	1.8	3.5
Re-admission within 30 days	17.2	14.8	20.2	16.9

[1] Fontaine score 3 or 4

There were 2,273 hybrid procedures in 2023, of which 1,192 had endovascular elements above the surgical element angioplasties (745 elective, 447 non-elective), and 479 hybrid procedures in which the endovascular element was below (245 elective, 234 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 13.7% for proximal and 9.8% for distal elective cases and 25.1% for proximal and 28.6% for distal non-elective cases. The rates of unplanned procedures after proximal and distal angioplasties were 5.6% vs 4.9% for elective and 16.1% vs 23.9% for non-elective procedures. The reasons for this requires further exploration.

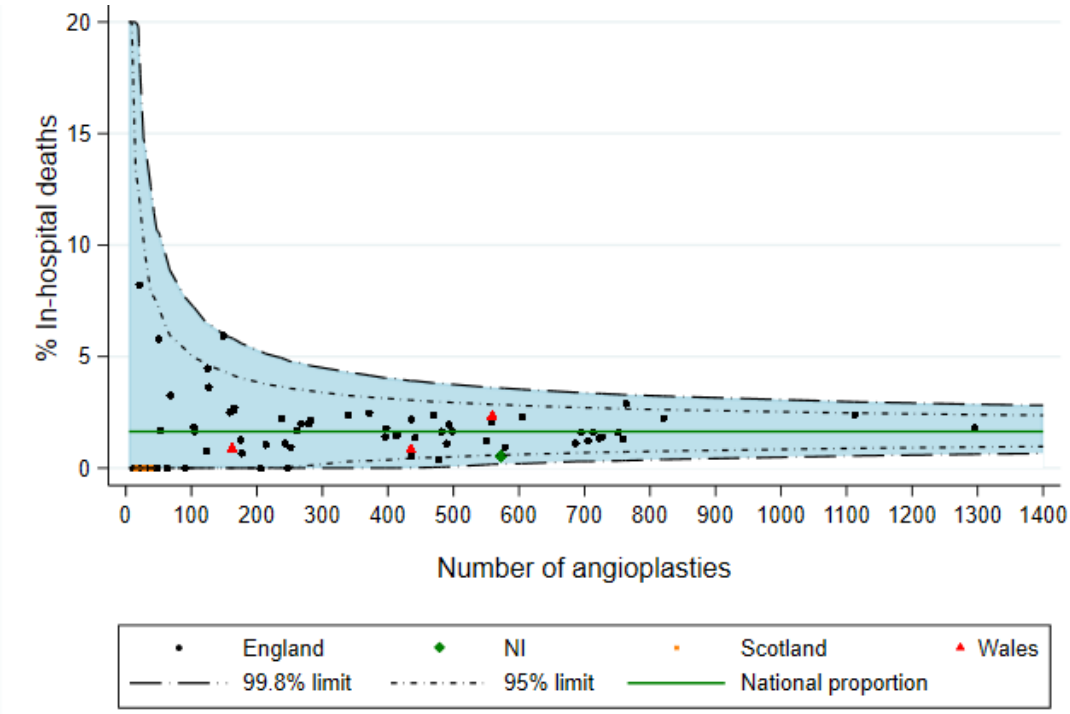
2.5 Postoperative mortality rates for lower limb revascularisations

Figure 2.5 presents the risk-adjusted mortality rates for each NHS trust that submitted 10 or more endovascular revascularisations between January 2021 and December 2023. 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 1.6% (95% CI: 1.5 to 1.8).

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, Ischaemic heart disease, chronic renal disease, chronic heart failure and smoking status.

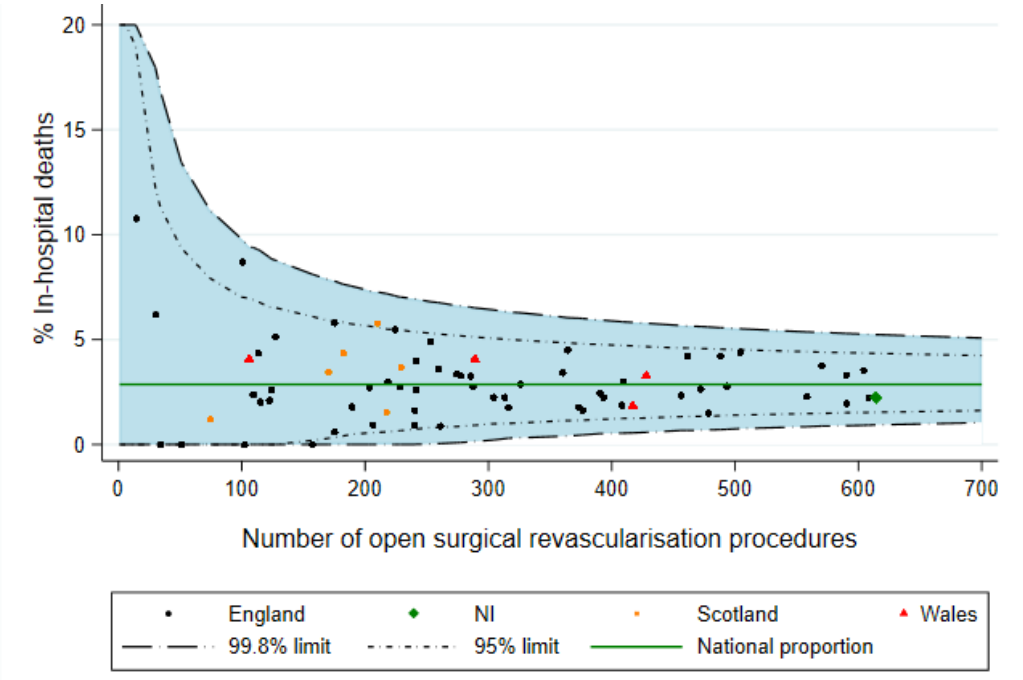
The funnel plot for open surgical procedures is shown in Figure 2.6. All NHS trusts had risk-adjusted mortality rates that were within the expected range of the national average (=2.9%, 95% CI: 2.6 to 3.1). The risk adjustment model accounted for age, sex, procedure type, Fontaine score, mode of admission, ASA grade, chronic lung disease, use of antiplatelets, white blood count and haemoglobin, creatinine, sodium and potassium levels.

Figure 2.5: Funnel plot of risk-adjusted in-hospital deaths after lower limb endovascular revascularisation for NHS trusts from January 2021 to December 2023.



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 2.6: Funnel plot of risk-adjusted in-hospital deaths from lower limb bypass for NHS trusts, shown for procedures performed between January 2021 and December 2023.



3. Major lower limb amputation

3.1 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 2023 to December 2023.

During this period, 3,688 primary major unilateral amputations were recorded in the NVR, which consisted of 1,993 (54.0%) below the knee amputations (BKAs) and 1,695 (46.0%) above the knee amputations (AKAs). Through knee amputations (TKAs) have been analysed as part of the BKA group. TKAs accounted for 3.1% of all major amputations recorded on the NVR during the 1-year audit period.

In addition, NHS hospitals submitted information on 1,417 minor amputations, and other types of major amputation (65 bilateral, 35 due to trauma and 584 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 of other types of procedure were not included in the analysis.

An increase trend in the number of unilateral major amputations were undertaken between 2020 and 2023 within the NHS (Table 3.1). Explanation for this requires further investigation, although partly it could be an indirect impact from COVID 19.

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

Case ascertainment	2021	2022	2023
NVR procedures	3,652	4,118	4,258
Expected procedures	4,348	4,613	4,828
Estimated case ascertainment	84%	89%	88%

Table 3.2: Estimated case ascertainment rates in 2023 by UK country

	Major Lower Limb Amputation
England	90%
Wales	100%
Scotland	45%
Northern Ireland	100%

3.2 Patient Characteristics

Table 3.3: Characteristics of patients undergoing major unilateral lower limb amputation in 2023

	Below knee	%	Above knee	%
Total procedures	1,993		1,695	
Age group (years)				
Under 60	571	28.8	315	18.6
60 to 64	339	17.1	234	13.8
65 to 69	311	15.7	295	17.4
70 to 74	271	13.7	256	15.1
75 to 79	242	12.2	293	17.3
80 and over	250	12.6	300	17.7
Sex				
Men	1,567	78.6	1,177	69.4
Women	426	21.4	518	30.6
Smoking				
Current smoker	529	26.9	632	37.5
Ex-smoker	889	45.2	764	45.3
Never smoked	550	27.9	291	17.2
Presenting problem				
Acute limb ischemia	149	7.5	284	16.8
Chronic limb ischemia	550	27.6	519	30.6
Neuropathy	39	2.0	21	1.2
Tissue loss	742	37.2	588	34.7
Uncontrolled infection	512	25.7	268	15.8
Aneurysm	<5	0.1	14	0.8
Previous ipsilateral limb procedure	1,089	61.2	850	56.4
Type of previous ipsilateral limb procedure				
Minor amputation only	218	20.6	36	4.3
Angioplasty/stent	479	45.2	203	24.2
Surgical revascularisation	318	30.0	386	46.1
Major amputation	45	4.2	213	25.4

Table 3.4: Preoperative risk factors among patients undergoing lower limb amputation in 2023

	Below knee	%	Above knee	%
Total procedures	1,993		1,695	
Pre-op ASA grade				
Normal	14	0.7	5	0.3
Mild disease	118	5.9	68	4.0
Severe, not life-threatening disease	1,439	72.2	1,043	61.6
Severe, life-threatening disease, or moribund patient	422	21.2	578	34.1
Comorbidities				
None	131	6.6	146	8.6
Diabetes	1,461	73.3	819	48.3
Hypertension	1,201	60.3	1,011	59.6
Chronic lung disease	369	18.5	451	26.6
Ischaemic heart disease	648	32.5	613	36.2
Chronic heart failure	241	12.1	249	14.7
Chronic renal disease	480	24.1	336	19.8
Stroke	174	8.7	205	12.1
Active/managed cancer	113	5.7	141	8.3
Medication				
None	10	0.5	10	0.6
Anti-platelet	1,302	65.3	1,132	66.8
Statin	1,435	72.0	1,169	69.0
Beta-blocker	640	32.1	545	32.2
ACE inhibitor/ARB	708	35.5	515	30.4
Antibiotic prophylaxis	1,868	93.7	1,570	92.6
DVT prophylaxis	1,362	68.3	1,096	64.7
Oral anticoagulant	428	21.5	406	24.0

3.3 Care Pathways

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. The median time from vascular assessment to amputation in 2023 was:

- 7 days (IQR: 3 to 19 days) for non-elective patients,
- 39 days (IQR: 12 to 98 days) for elective patients, and
- 9 days (IQR: 3 to 28 days) for all patients.

Figure 3.1 describes the median and interquartile range (IQR) of the time to amputation from vascular assessment for patients admitted non-electively between 2021 and 2023. Similar distributions of times from vascular assessment to non-elective amputation were observed over the past three years.

Figure 3.1: Distribution of times from vascular assessment to non-elective amputation by month between January 2021 and December 2023. 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

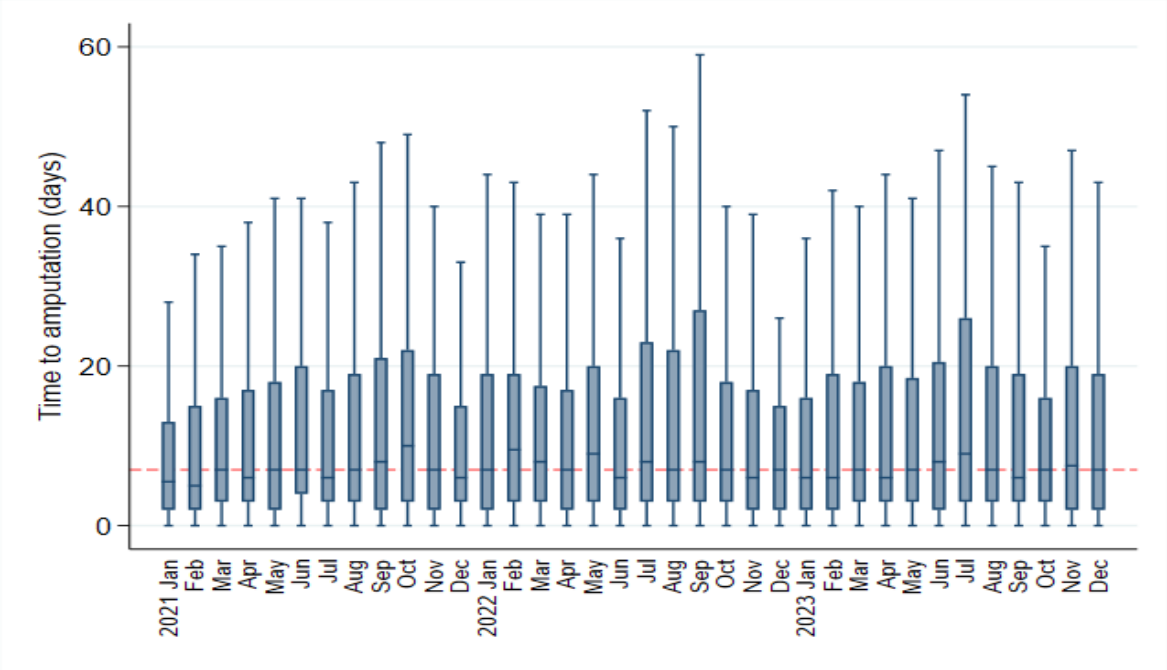


Figure 3.2 describes the times from vascular assessment to amputation by NHS trust for patients admitted non-electively in 2023. The graph shows some variation across NHS trusts in the median wait, but among the 25% of patients at each trust who have the longest waits, there was a considerably greater variation across NHS trusts.

At 13 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 3.2. Vascular units should investigate the cause of this and attempt to reduce the longer times as much as possible.

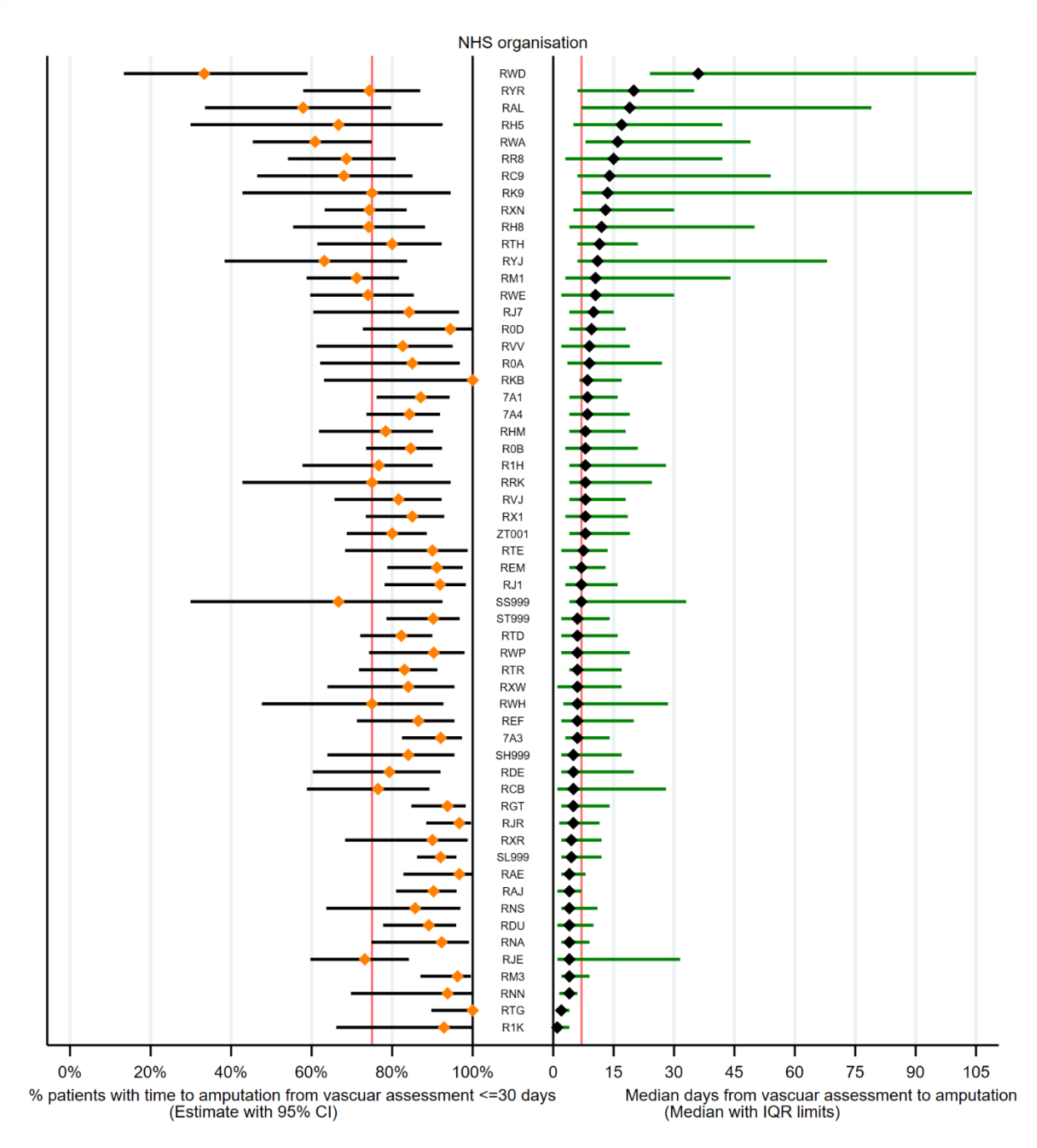
VSGBI: Amputation QIF

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

Figure 3.3 describes the volume of activity and the AKA:BKA ratio in 2023, by NHS trust. Nationally, the AKA:BKA ratio was 0.85 (95% CI: 0.80 to 0.91) in 2023, showing a continued decrease compared with 0.90 (0.85 to 0.97) in 2022 and 1.01 (0.94 to 1.08) in 2021. Most of the NHS trusts had a ratio of less than one (43 out of 61 trusts). No units had a ratio above 2 in 2023.

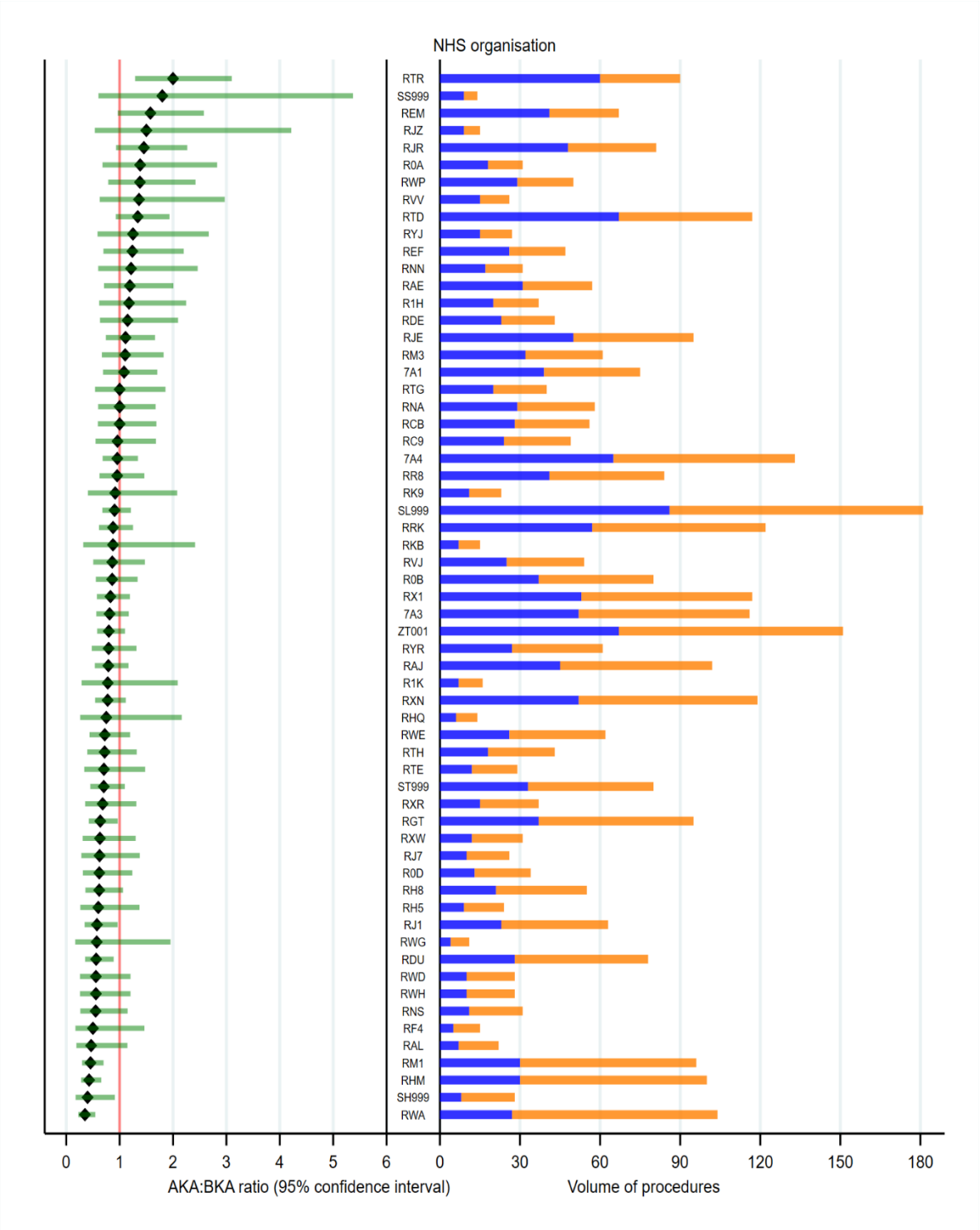
It is possible that the high ratios relate to some NHS trusts treating more severely ill patients, although it is not possible to confirm this with the data collected in the NVR.

Figure 3.2: Median (IQR) time from vascular assessment to non-elective amputation for procedures performed in 2023, 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 2023.

Figure 3.3: Volume and ratio of above knee to below knee amputations for procedures performed in 2023, 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 2023.

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 3.5 summarises some key aspects of perioperative care for BKA and AKA patients. Performance against these standards was generally reasonable in 2023, but the figures suggest there is potential for improvement:

- The proportion of below knee and above knee major amputations performed during the day was 91.4% and 90.9%, respectively, which were similar to annual rates in years 2020 to 2022.
- A consultant surgeon was present for just over 75% of the procedures. The consultant presence rates were improved slightly than in 2022 (BKA=75.1%; AKA=73.3%) and in 2021 (BKA=72.9%; 72.2%).
- Overall, prophylactic antibiotics were recorded for more than 93% of patients in 2023, and DVT medication were recorded for more than 65% of patients.

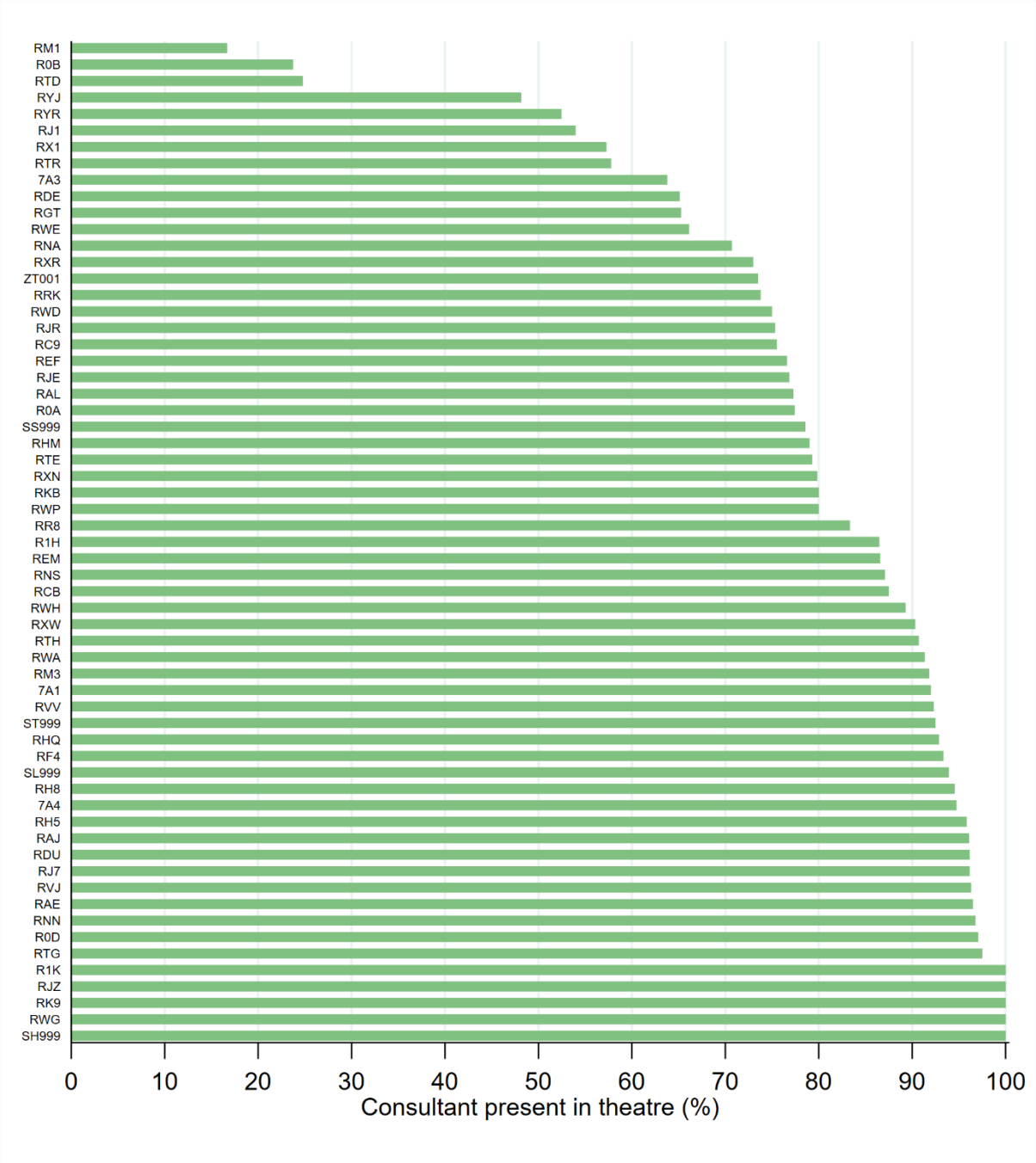
While many NHS trusts followed the recommendation that a consultant should be present in theatre during the audit period, there is some variation in practice across NHS organisations (Figure 3.4). Vascular units should investigate the reasons for this variation.

The NVR IT system was updated in July 2021 to make the collection of prophylaxis medication data more intuitive. The observed levels of prophylactic antibiotics were significantly improved ever since. More specifically, overall 93.2% of patients in 2023 were recorded having prophylactic antibiotics vs 90.1% in 2022, 83.0% in 2021 and 68.5% in 2020. The increase in the reported rates largely reflects the change of NVR IT system.

Table 3.5: Perioperative care of patients undergoing lower limb major amputation in 2023

	Below knee	%	Above knee	%
Procedures	1,993		1,695	
Mode of admission				
Elective	395	19.8	260	15.3
Non-elective	1,598	80.2	1,435	84.7
Time procedure started				
8am to 6pm	1,822	91.4	1,540	90.9
6pm to midnight	153	7.7	130	7.7
Midnight to 8am	18	0.9	25	1.5
Consultant present in theatre	1,527	76.6	1,295	76.4
Prophylactic medication				
Antibiotic prophylaxis	1,868	93.7	1,570	92.6
DVT prophylaxis	1,362	68.3	1,096	64.7

Figure 3.4: Percentage of major amputations where a consultant surgeon was present in theatre in 2023, by NHS trust[1]



[1]Figure presents NHS trusts reporting ≥10 lower limb major amputations performed in 2023

3.4 In-hospital outcomes following major amputation

Patient outcomes immediately following a major lower limb amputation are summarised in Table 3.6.

The overall rate of in-hospital death in 2023 was 7.2% (95% CI: 6.4% to 8.1%), similar to the rate of 7.8% (95% CI: 6.9% to 8.8%) in 2022 and 7.5% (95% CI: 6.6% to 8.5%) in 2021.

The 30-day in-hospital mortality was 5.6% (95% CI: 4.9% to 6.4%) in 2023, which appears to be slightly less than the rate of 6.3% (95% CI: 5.5% to 7.2%) in both 2022 and 2021.

The overall median length of hospital stay in 2023 associated with major lower limb amputations was 21 days (IQR: 13 to 37).

Most patients returned to the ward following a major amputation, while 11.3% of BKA patients and 15.8% of AKA patients were admitted to critical care (level 2 or level 3).

Overall, 25.4% of patients in 2023 suffered at least one of the reported complications following a major amputation. Respiratory complications occurred in 6.2% of BKAs and 8.2% of AKAs for procedures performed in 2023, which were similar to the rates in 2022 (5.9% BKAs and 9.5% AKAs) and 2021 (6.3% BKAs and 8.9 AKAs), whilst a marked reduction from the rates of 8.0% and 11.3% for BKAs and AKAs, respectively, in 2020.

Table 3.6: Patient outcomes following major lower limb amputations undertaken in 2023

	Below knee		Above knee	
Procedures	1,993		1,695	
Post-op destination				
Ward	1,764	88.7%	1,422	84.0%
Level 2 (HDU/PACU)	152	7.6%	167	9.9%
Level 3 (ICU)	68	3.4%	100	5.9%
	Median	**IQR**	**Median**	**IQR**
Days in level 2 critical care	2	1 to 3	2	1 to 4
Days in level 3 critical care	4	2 to 9	5	2 to 8
Overall length of stay (days)	22	13 to 37	21	13 to 36
Postoperative length of stay (days)	15	9 to 26	15	9 to 26
	Rate	**95% CI**	**Rate**	**95% CI**
Overall in-hospital mortality	5.2	4.3 to 6.3	9.5	8.2 to 11.1
30-day in-hospital mortality	3.9	3.0 to 4.8	7.8	6.5 to 9.2
Procedure complications				
Respiratory	6.2	5.2 to 7.4	8.2	6.9 to 9.6
Cardiac	3.6	2.8 to 4.5	5.1	4.1 to 6.2
Limb ischaemia	3.5	2.7 to 4.4	2.8	2.0 to 3.7
Renal failure	1.3	0.9 to 1.9	1.8	1.2 to 2.6
Surgical site infection	4.7	3.8 to 5.7	2.8	2.0 to 3.7
Postoperative confusion	1.9	1.4 to 2.6	2.7	2.0 to 3.6
Haemorrhage	0.4	0.2 to 0.8	0.6	0.3 to 1.2
Cerebral	0.4	0.2 to 0.8	0.9	0.5 to 1.5
No defined complications	75.4	73.4 to 77.2	73.7	71.5 to 75.8
Return to theatre	8.5	7.3 to 9.8	5.6	4.5 to 6.8
Re-admission to higher level care	2.3	1.7 to 3.0	2.1	1.5 to 2.9

Table 3.7: Patient outcomes following major lower limb amputation performed in 2023

	Admission-to-procedure ≤5 days		Admission-to-procedure >5 days	
	No.		**No.**	
Procedures	2,217	60.1%	1,471	39.9%
Days in critical care	**Median**	**IQR**	**Median**	**IQR**
Level 2	3	1 to 4	2	1 to 3
Level 3	4	2 to 8	4	2 to 8
Overall length of stay (days)	16	10 to 26	33	22 to 52
Post-op length of stay (days)	14	8 to 24	17	10 to 30
	Rate	**95% CI**	**Rate**	**95% CI**
Overall in-hospital mortality	6.8	5.8 to 7.9	7.8	6.4 to 9.3
30-day in-hospital mortality	5.6	4.7 to 6.6	5.7	4.6 to 7.1
No defined complications	75.4	73.5 to 77.2	73.4	71.1 to 75.7
Return to theatre	7.1	6.1 to 8.2	7.3	6.0 to 8.7
Re-admission to higher level care	2.3	1.7 to 3.0	2.1	1.4 to 2.9

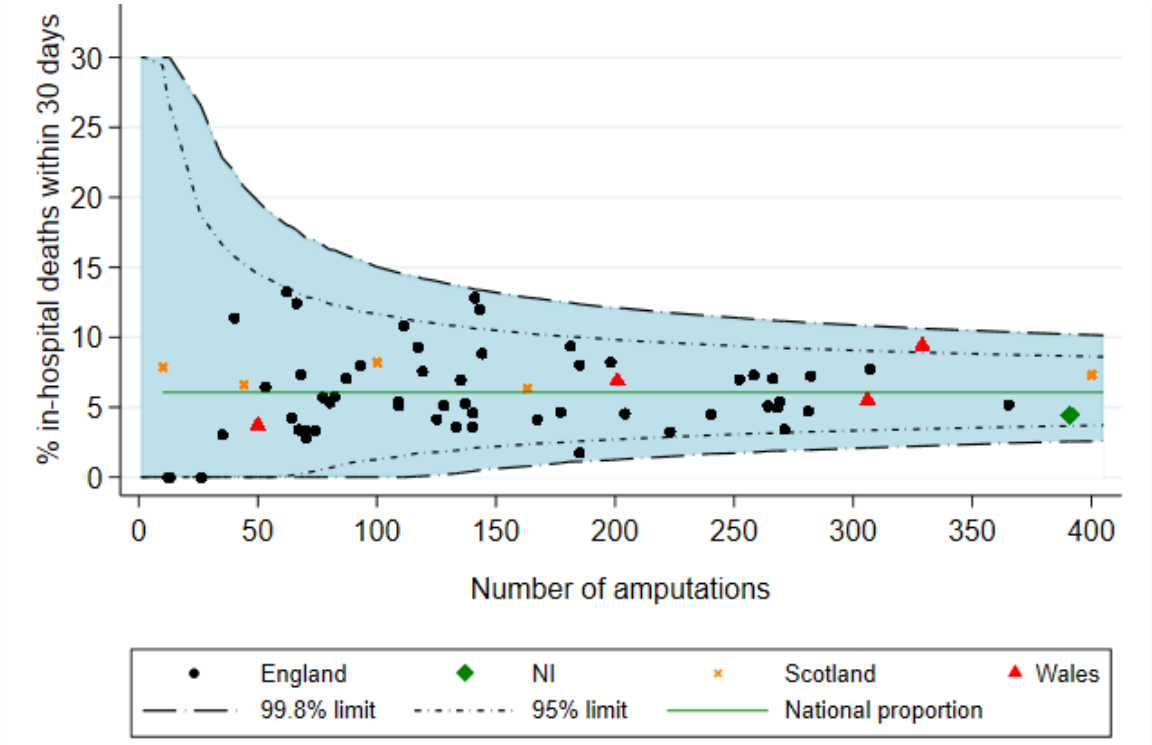
Outcomes for patients undergoing major amputations, by preoperative length of stay, are summarised in Table 3.7. About 60% of the patients underwent amputation within 5 days of admission. In comparison with the results for lower limb bypass and endovascular revascularisation, the differences in outcomes were small between patients with comparatively short and long times from admission to surgery.

The adjusted 30-day in-hospital mortality figures following a major unilateral lower limb amputation for NHS trusts are shown in Figure 3.5. All NHS trusts had an adjusted rate that fell within the expected range from the national average of 6.1%.

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 who had unilateral major lower limb amputations undertaken within 30 days after revascularisation in 2023 and were excluded from the main analysis, the overall rate of in-hospital death was 6.3% (95% CI: 4.5% to 8.6%) and the 30-day in-hospital mortality was 4.4% (95% CI: 2.9% to 6.4%). The mortality rates appear to be lower than those in 2022, where the corresponding mortality rates were 9.3% (95% CI: 7.0% to 12.0%) and 6.5% (95% CI: 4.6% to 8.9%), respectively.

Figure 3.5: Risk-adjusted 30-day in-hospital death rate following major amputation for procedures undertaken during January 2021 and December 2023[1], shown in comparison to the three-year overall national average of 6.1%



[1]Figure presents NHS trusts reporting ≥10 major lower limb amputations between January 2021 and December 2023.

3.5 Discharge and follow-up

Table 3.8: Discharge and follow-up of patients undergoing lower limb amputations in 2023, among patients discharged alive

	Below knee (n=1,831)	%	Above knee (n=1,520)	%
Wound healed at 30 days*	595	78.1	502	82.7
Referred to rehabilitation/limb fitting	1,582	86.8	1,122	73.9
Re-admission within 30 days*	166	9.1	146	9.6

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

4. Repair of elective infra-renal abdominal aortic aneurysm

4.1 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 71 in 2021 to 66 in 2023.

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 3,551 in 2019, but fell to 2,406 in 2020, a reduction of 32% from the previous year. In 2021 and 2022, the numbers increased again to nearly 2,900 procedures before falling to a little over 2,700 in 2023.

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.

Table 4.1: Estimated case ascertainment of elective infra-renal AAA repairs*

	2021	2022	2023
Audit procedures	2,876	2,889	2,711
NVR HES Equivalent Procedures	2,990	3,026	2,821
Expected procedures	3,097	3,174	3,216
Estimated case ascertainment	97%	95%	88%

*The numbers NVR-HES Equivalent Procedures are larger than the numbers in the rest of this chapter. This is because it includes fenestrated procedures for infra-renal or juxta-renal AAAs (with an infra-renal OPCS code) in order to directly compare with the HES data.

Table 4.2: Estimated case ascertainment rates in 2023 by UK country

	Elective infra-renal AAA repair
England	89%
Wales	100%
Scotland	55%
Northern Ireland	100%

Over the last three years, the proportion of EVAR procedures has been fairly stable, fluctuating around 60% (Table 4.3). 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 4.1). The majority of procedures were performed for patients with an AAA diameter between 5.5 and 7.0 cm.

Figure 4.2 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 2023 by NHS trust. 16 of the 62 (26%) 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.

Table 4.3: Split of open and endovascular elective infra-renal AAA procedures by year

Year	Open	EVAR	Total	% EVAR
2021	1,138	1,738	2,876	60.4
2022	1,170	1,719	2,889	59.5
2023	1,062	1,649	2,711	60.8
Total	3,370	5,106	8,476	60.2

Figure 4.1: Distribution of elective infra-renal AAA repairs by age group between 2021 and 2023

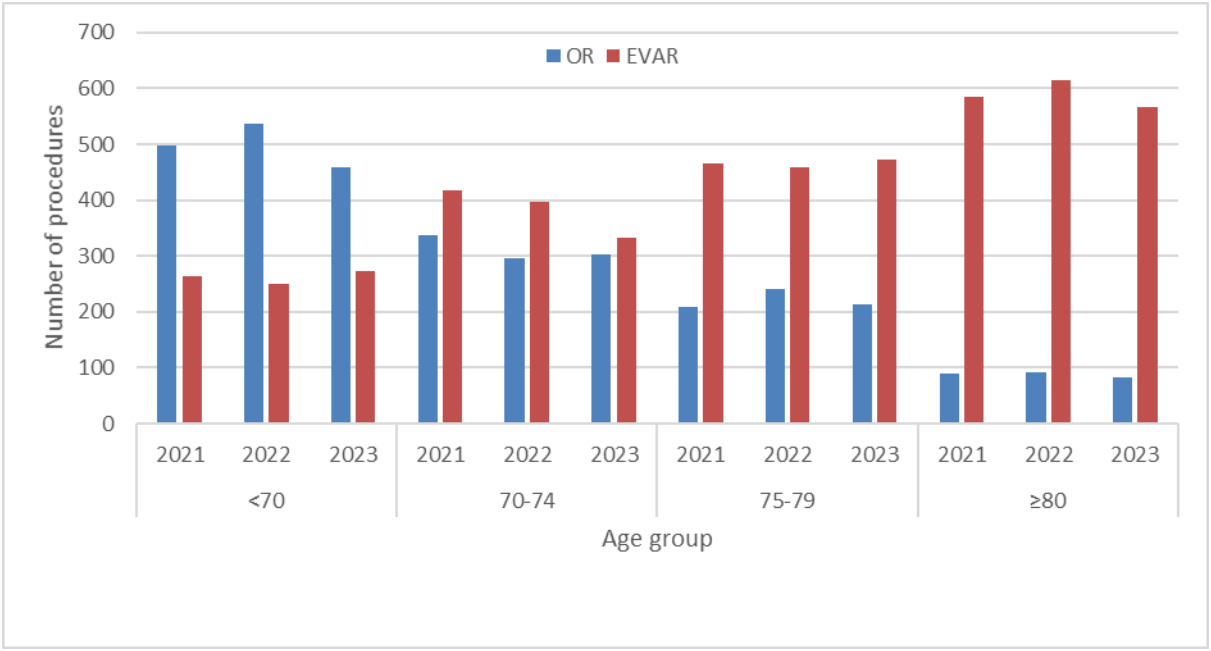
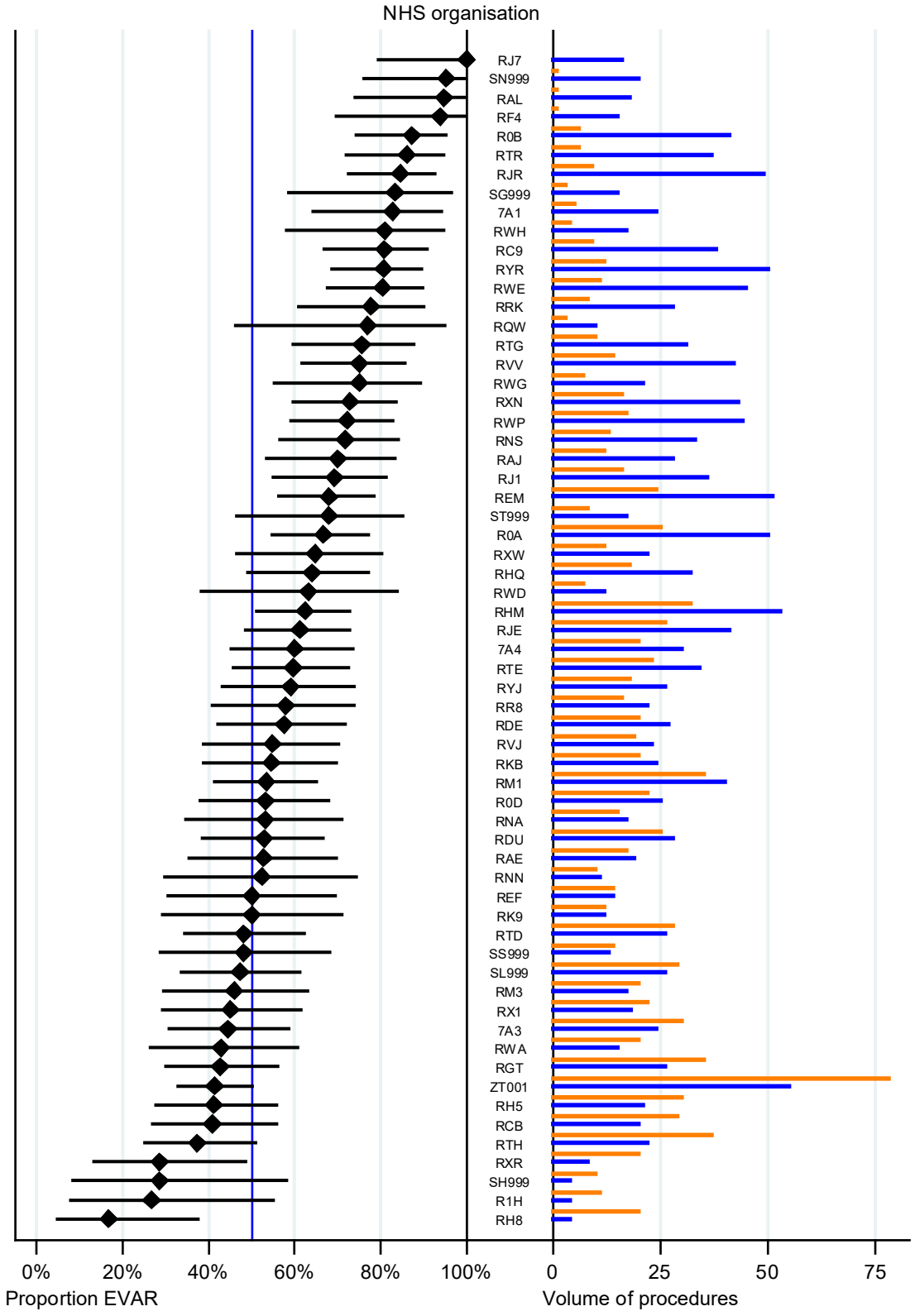


Figure 4.2: Percentage of EVARs (left panel) and number of open repairs and EVARs (right panel) by NHS trust in 2023 with at least 10 procedures. Orange bars show open repairs and blue bars show EVARs.



4.2 Patient Characteristics

Table 4.4: Characteristics of patients who had elective infra-renal AAA repair between January and December 2023

		Open repair	%	EVAR	%	Total
Total procedures		1,062		1,649		2,711
Age group (years)	Under 66	226	21.4	111	6.8	337
	66 to 75	598	56.5	599	36.4	1,197
	76 to 85	232	21.9	810	49.3	1,042
	86 and over	<5	0.2	124	7.5	126
Male		989	93.1	1,498	90.8	2,487
Female		73	6.9	151	9.2	224
Current smoker		240	22.6	299	18.2	539
Previous AAA surgery		21	2.0	121	7.3	142
Indication	Screen detected	638	61.2	745	48.7	1,383
	Non-screen	303	29.1	549	35.9	852
	Other	101	9.7	235	15.4	336
AAA diameter (cm)	Under 5.5	77	7.3	245	14.9	322
	5.5 to 6.9	877	82.6	1,217	73.9	2,094
	7.0 and over	108	10.2	184	11.2	292
ASA fitness grade	1,2	270	25.4	285	17.3	555
	3	752	70.8	1,252	75.9	2,004
	4,5	40	3.8	112	6.8	152
Comorbidities	Hypertension	679	63.9	1,087	65.9	1,766
	Ischemic heart disease	291	27.4	582	35.3	873
	Chronic heart failure	20	1.9	131	7.9	151
	Stroke	61	5.7	151	9.2	212
	Diabetes	152	14.3	303	18.4	455
	Chronic renal failure	92	8.7	262	15.9	354
	Chronic lung disease	239	22.5	471	28.6	710

4.3 Pre-operative pathway for elective infra-renal aneurysms

Table 4.5: Overall compliance with standards related to the VSGBI elective AAA care pathway

	Percentage of patients meeting standard		
	2023	2022	2021
Elective patients were discussed at MDT meetings	2,360/2,711 (87.1%)	88.0%	86.0%
Patients with an AAA diameter ≥5.5cm deemed suitable for repair had a preoperative CT/MR angiography assessment	2,232/2,386 (93.5%)	93.6%	91.7%
Patients underwent a formal anaesthetic review	2,647/2,711 (97.6%)	97.0%	97.1%
Patients whose anaesthetic review was done by a consultant vascular anaesthetist	2,416/2,645 (91.3%)	92.0%	92.2%
Patients who had their fitness measured	2,272/2,711 (83.8%)	83.2%	83.0%
Most common assessment methods:			
CPET	1,303/2,272 (57.4%)	57.3%	51.4%
Echocardiogram	1,007/2,272 (44.3%)	45.8%	46.2%

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].

Figure 4.3 (overleaf) summarises the variation among the 61 NHS organisations with 10 or more AAA repairs in the median (IQR) time from vascular assessment to surgery in 2023.

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 86: IQR 49-146). At four vascular units, a quarter of patients who had operations in 2023 waited more than 220 days.

In the left panel of Figure 4.3, the orange diamonds show the proportion of patients who had their procedure within 8 weeks after their CT/MR angiography assessment (31% nationally). 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 4.4 shows the distribution of patient times within each month between January 2021 and December 2023. The reduced level of activity led to an increase in the median time to surgery after April 2020. However, in the last three years, the time to surgery has stabilised.

Figure 4.3: Median (IQR) time from assessment to treatment (days) for patients who had elective infra-renal AAA repair between January and December 2023 (black diamonds) and proportion seen within 8 weeks of assessment (orange diamonds)

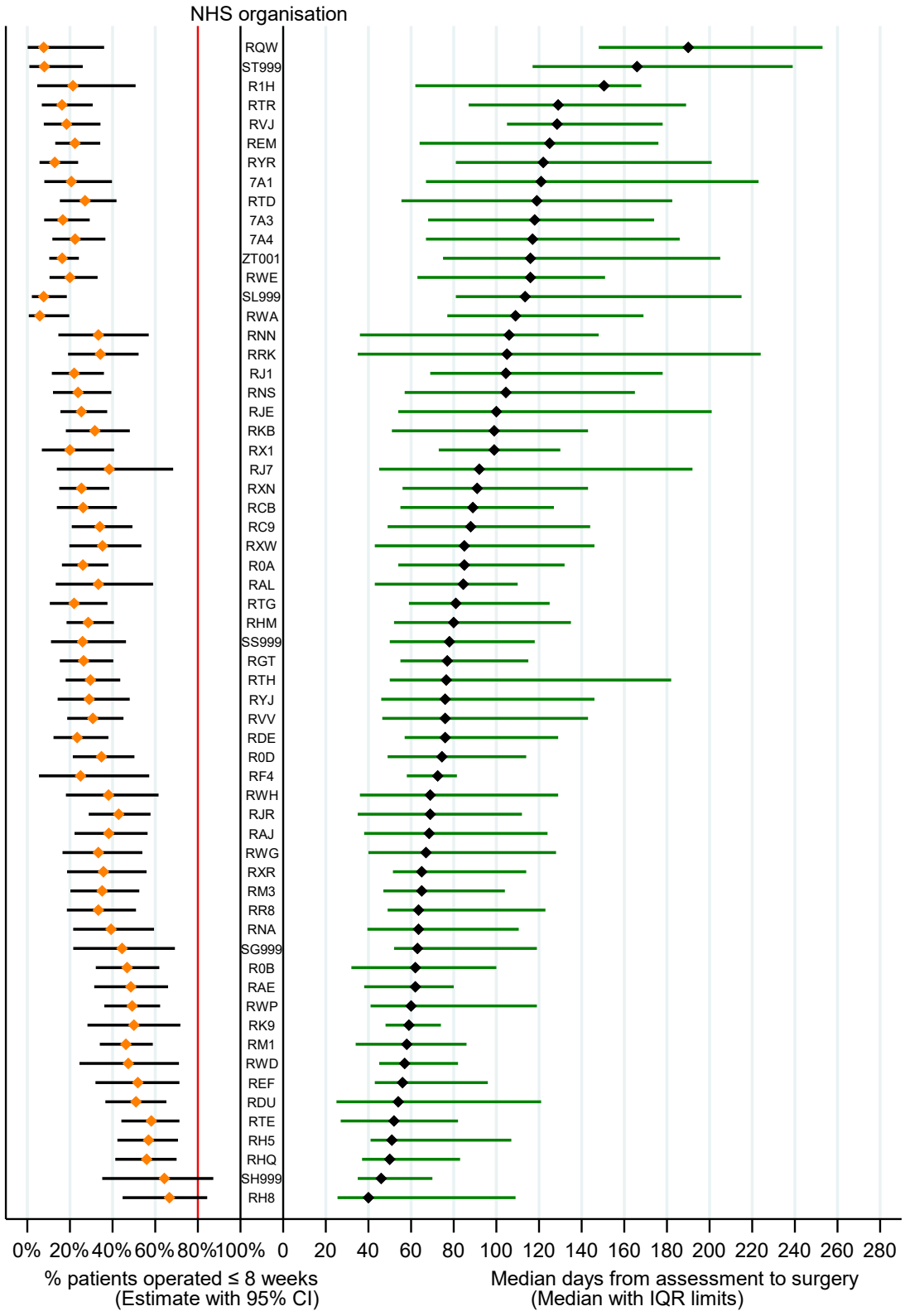
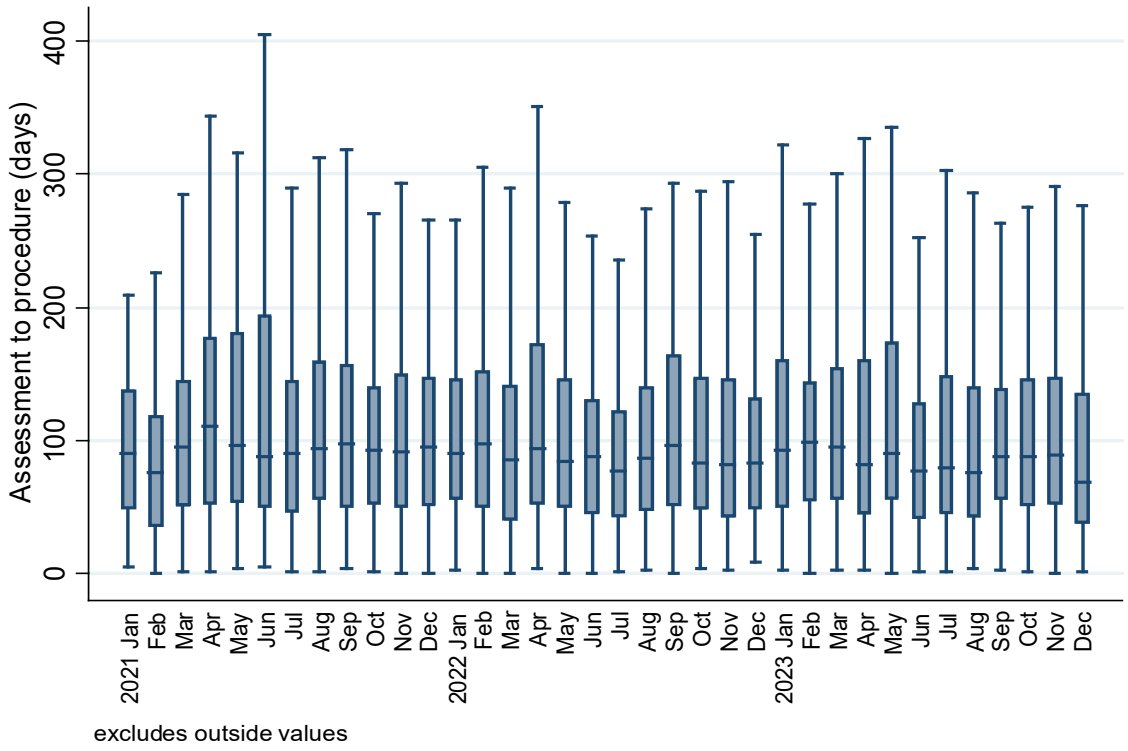


Figure 4.4: Distribution of times from assessment to treatment (days) by month for patients who had an elective infra-renal AAA repair between January 2021 and December 2023*. The median is shown as the bar within the blue box (whose outer limits are the 25th and 75th percentile)



*Excludes outlier values that exceed the upper whisker.

4.4 Postoperative outcomes after elective infra-renal AAA repair

Table 4.6 describes various aspects of postoperative care for 2023.

- For EVAR, 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 2-3 days and the median total postoperative stay was 7 days.

The in-hospital mortality rate for open repair in 2023 was 2.7% (95% CI 1.8 to 3.9), a little less than 2.9% (95% CI 2.0 to 4.0) for 2022. The in-hospital mortality rate for EVAR was 0.3% for 2023.

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 9.0% (95% CI 7.3 to 10.8) in 2023, a slight fall from 10.0% (95% CI 8.4 to 11.9) observed in 2021. For EVARs, respiratory complications remained around 1.3% between 2022 and 2023.

Table 4.6: Postoperative details of elective infra-renal repairs undertaken in 2023

		Open repair (n=1,062)		EVAR (n=1,649)	
Admitted to	Ward	2.1%		70.0%	
	Level 2	55.8%		26.8%	
	Level 3	42.0%		3.3%	
	Died in theatre	0.1%		0.0%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	2	1 to 4	1	0 to 1
	Level 3	3	2 to 5	1	1 to 2
Post-op length of stay (days)		7	6 to 10	2	1 to 2
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		2.7	1.8 to 3.9	0.3	0.1 to 0.7
Defined complications					
	Cardiac	2.9	2.0 to 4.1	1.0	0.6 to 1.6
	Respiratory	9.0	7.3 to 10.8	1.3	0.8 to 2.0
	Haemorrhage	1.2	0.7 to 2.1	0.9	0.5 to 1.5
	Limb ischaemia	2.3	1.5 to 3.3	0.9	0.5 to 1.5
	Renal failure	4.1	3.0 to 5.5	0.5	0.2 to 1.0
	Other	10.2	8.4 to 12.2	3.3	2.5 to 4.3
	None of the above	73.9	71.1 to 76.5	92.7	91.3 to 93.9
Return to theatre		6.7	5.3 to 8.4	1.8	1.2 to 2.6
Readmission within 30 days		3.9	2.8 to 5.2	4.9	3.9 to 6.1

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 2023, 85 (5.3%) patients were recorded as experiencing a type I endoleak. There were 120 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 88 (5.3%) type I endoleaks recorded in 2021 and 81 (4.8%) in 2022.

Among the 2023 cohort, there were 142 patients (5.2%) who had the indication for their procedure recorded as re-intervention. Among these, 85% had an EVAR.

The indication for re-intervention was sac expansion for 72 patients and a graft problem (migration/occlusion/infection) for 19 patients. Nineteen also had a new arterial disease. The most frequent re-intervention was a relining (23.1%) or distal procedure (37.8%).

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, 71% in 2022 and 66% in 2023. We encourage vascular units to identify at risk 'frail' patients and ensure their degree of frailty is submitted to the NVR.

4.5 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 2021 to 31 December 2023 to give robust outcome estimates.

The risk-adjusted mortality rates for individual NHS trusts are shown in a funnel plot in Figure 4.5. 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 4.5: Risk-adjusted in-hospital mortality rates after elective infra-renal AAA repair among NHS vascular units (January 2021 and December 2023). The overall in-hospital mortality rate was 1.4%.

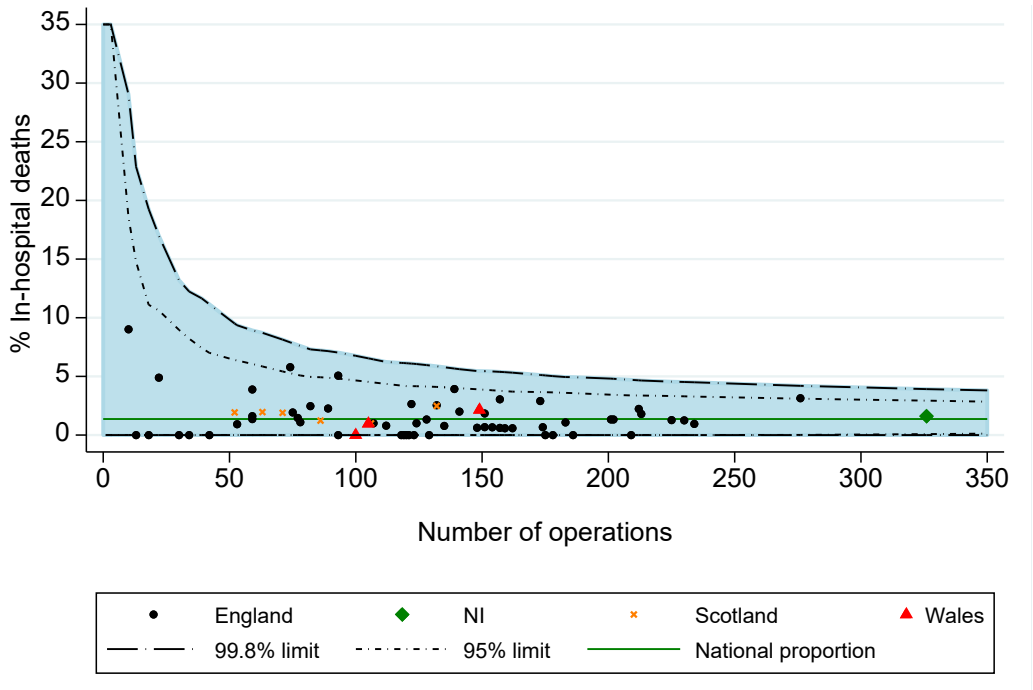
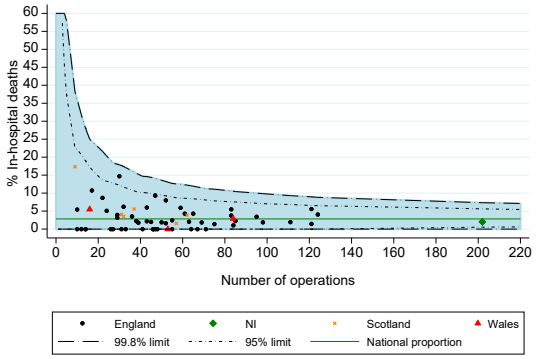
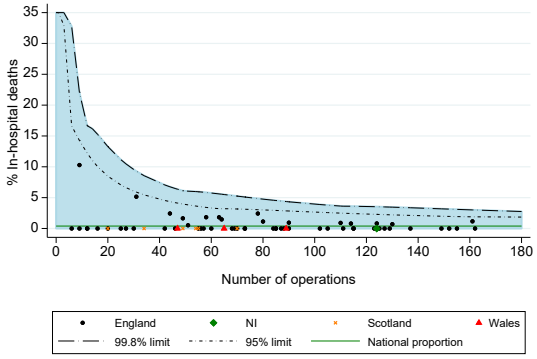


Figure 4.6: Funnel plot of risk-adjusted in-hospital mortality after elective AAA repair for open and EVAR procedures performed between 2021 and 2023.



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 4.6A and 4.6B 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 2021 and 2023 were 2.8% and 0.4%, respectively

Postoperative in-hospital mortality after open repair has remained stable with 2.9% in 2021 and 2022 and 2.7% in 2023. 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.

5. Other elective repair of aortic conditions

5.1 Background

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

- 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 two most common procedures are Fenestrated EVAR (FEVAR), performed when aneurysms are close to the renal arteries, and branched EVAR (BEVAR), performed when other arteries branching from the aorta are involved. For the period 2021-2023, 81% of the endovascular elective procedures were FEVARs and 16% were BEVARs. Furthermore, endovascular cases tended to be older and less likely to smoke.

5.2 Patient Characteristics

Table 5.1: Characteristics of patients who had other primary open elective and endovascular repairs between January 2021 and December 2023

Other elective procedures		Open repair	%	Endovascular	%	Total
Total procedures		278		1,328		1,606
Age group (years)	Under 66	76	27.3	116	8.8	192
	66 to 75	144	51.8	600	45.3	744
	76 to 85	58	20.9	582	43.9	640
	86 and over	0	0.0	27	2.0	27
Male		243	87.4	1,163	87.6	1,406
Female		35	12.6	165	12.4	200
Current smoker		102	36.7	302	23.0	404
AAA diameter (cm)	Under 5.5	12	4.3	64	4.8	76
	5.5 to 6.9	203	73.0	954	72.3	1,157
	7.0 and over	63	22.7	302	22.9	365
ASA fitness grade	1,2	63	22.7	200	15.1	263
	3	194	69.8	1,028	77.5	1,222
	4,5	21	7.6	99	7.5	120
Comorbidities	Hypertension	183	65.8	965	72.7	1,148
	Ischemic heart disease	72	25.9	478	36.0	550
	Chronic heart failure	<5	0.4	89	6.7	90
	Stroke	20	7.2	124	9.3	144
	Diabetes	41	14.7	225	16.9	266
	Chronic renal failure	26	9.4	228	17.2	254
	Chronic lung disease	72	25.9	477	35.9	549

Table 5.2: Postoperative details of other elective repairs undertaken between January 2021 and December 2023

Other elective procedures		Open repair (n=278)		Endovascular (n=1,328)	
Admitted to	Ward	1.8%		21.5%	
	Level 2	38.1%		59.6%	
	Level 3	59.7%		18.8%	
	Died in theatre	0.4%		0.0%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	3	2 to 5	2	1 to 2
	Level 3	3	2 to 6	2	1 to 3
Post-op length of stay (days)		9	7 to 14	4	2 to 7
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		10.1	6.8 to 14.2	1.3	0.7 to 2.0
Return to theatre		10.5	7.1 to 14.7	6.1	4.8 to 7.5
Readmission within 30 days		7.3	4.4 to 11.4	7.2	5.9 to 8.7

The median postoperative length of stay was 9 days for primary open procedures in the last three years compared with 4 days for any endovascular cases. Open repair mortality was significantly higher than endovascular cases. However, 30-day readmissions were similar for both patient groups. The higher rate in open repair mortality enforces caution in its use and possibly requires more granularity in the data to understand the causes.

5.3 Repair of thoracic aortic conditions

Patients who suffer from a thoracic aortic aneurysm or aortic dissection are increasingly treated using a thoracic endovascular aortic repair (TEVAR). This procedure is performed in either a cardiothoracic unit or specialist vascular unit. Within this section, thoracic repairs included records entered as a complex procedure with a TEVAR type of complex repair indicated or a standard EVAR with a TEVAR procedure code specified. Of the thoracic repairs, non-elective patients were younger and more likely to smoke. ASA fitness was worse for non-electives while elective cases had more comorbidities.

Table 5.3: Characteristics of patients who had TEVARs between January 2021 and December 2023

TEVARS		Elective	%	Non-elective	%	Total
Total procedures		423		422		845
Age group (years)	Under 66	107	25.3	190	45.2	297
	66 to 75	173	40.9	111	26.4	284
	76 to 85	133	31.4	108	25.7	241
	86 and over	10	2.4	11	2.6	21
Male		270	63.8	281	66.6	551
Female		153	36.2	141	33.4	294
Current smoker		72	17.1	124	29.9	196
AAA diameter (cm)	Under 5.5	125	30.0	270	67.8	395
	5.5 to 6.9	217	52.2	71	17.8	288
	7.0 and over	74	17.8	57	14.3	131
ASA fitness grade	1,2	61	14.4	44	10.5	105
	3	313	74.0	155	36.9	468
	4,5	49	11.6	221	52.6	270
Comorbidities	Hypertension	324	76.6	266	63.0	590
	Ischemic heart disease	99	23.4	66	15.6	165
	Chronic heart failure	20	4.7	16	3.8	36
	Stroke	28	6.6	22	5.2	50
	Diabetes	42	9.9	38	9.0	80
	Chronic renal failure	56	13.2	40	9.5	96
	Chronic lung disease	102	24.1	84	19.9	186
Indication	Asymptomatic	307	72.9	27	6.4	334
	Symptomatic unruptured	39	9.3	77	18.4	116
	Ruptured	0	0.0	78	18.6	78
	Transection	<5	0.5	51	12.2	53
	Acute dissection	26	6.2	178	42.5	204
	Chronic dissection	47	11.2	8	1.9	55

Table 5.4: Postoperative details of TEVARs undertaken between January 2021 and December 2023

TEVARS		Elective (n=423)		Non-elective (n=422)	
Admitted to	Ward	29.1%		10.1%	
	Level 2	56.0%		41.5%	
	Level 3	14.9%		47.2%	
	Died in theatre	0.0%		1.2%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	2	1 to 3	2	2 to 4
	Level 3	2	2 to 3	4	2 to 9
Post-op length of stay (days)		4	2 to 7	9	5 to 22
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		0.9	0.3 to 2.4	8.1	5.6 to 11.1
Return to theatre		3.6	2.0 to 5.8	14.7	11.4 to 18.4
Readmission within 30 days		8.5	6.0 to 11.6	8.1	5.6 to 11.3

For elective cases, over 50% were admitted to level 2 care where they stayed for 2 days. Nearly half of non-electives procedures were admitted to level 3 care with a median length of stay of 4 days. Median postoperative length of stay was 4 days for elective TEVARs in the last three years compared with 9 days for non-elective patients. Non-elective mortality was nine times more than elective cases. However, 30-day readmissions were similar for both admission modes.

The disparity in the coding practice of TEVAR procedures should be improved by designating all cases under one type of repair.

5.4 Patients with unruptured AAA admitted as an emergency procedure

There are a group of patients with an unruptured AAA who are admitted as an emergency admission. There are also some patients which can be entered under an emergency operative procedure but are recorded under an elective admission mode.

During the period between 2021 and 2023, the NVR received details of 1,471 such cases. Of these, 777 (52.8%) underwent an endovascular repair. Patients who had open repair, were younger and had lower ASA grades (Table 5.5).

Table 5.5: Characteristics of patients who had non-ruptured emergency open and endovascular repairs between January 2021 and December 2023

		Open repair	%	Endovascular	%	Total
Total procedures		694		777		1,471
Age group (years)	Under 66	188	27.2	75	9.7	263
	66 to 75	289	41.9	230	29.7	519
	76 to 85	202	29.3	365	47.1	567
	86 and over	11	1.6	105	13.5	116
Male		569	82.0	657	84.6	1,226
Female		125	18.0	120	15.4	245
Current smoker		240	34.7	162	21.0	402
AAA diameter (cm)	Under 5.5	92	13.3	153	19.8	245
	5.5 to 6.9	281	40.5	284	36.8	565
	7.0 and over	321	46.3	334	43.3	655
ASA fitness grade	1,2	120	17.3	76	9.8	196
	3	407	58.7	483	62.2	890
	4,5	166	24.0	217	28.0	383

The overall in-hospital mortality rate for this patient group was 4.8% (95% CI 3.8 to 6.0). For open repairs, the rate was 7.5% (95% CI: 5.6 to 9.7), while for EVAR, it was 2.4% (95% CI: 1.5 to 3.8). Among patients undergoing open repair, 97% were admitted to level 2 or 3 critical care where the median stay was 3 days (Table 5.6). Over half of EVARs were admitted to the ward.

Table 5.6: Postoperative details of non-ruptured emergency open and endovascular repairs undertaken between January 2021 and December 2023

		Open repair (n=694)		Endovascular (n=777)	
Admitted to	Ward	2.4%		61.3%	
	Level 2	46.5%		29.8%	
	Level 3	50.9%		8.8%	
	Died in theatre	0.1%		0.1%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care:	Level 2	3	2 to 4	1	0 to 2
	Level 3	3	2 to 6	2	1 to 4.5
Post-op length of stay (days)		9	6 to 14	3	2 to 7
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		7.5	5.6 to 9.7	2.4	1.5 to 3.8
Return to theatre		10.8	8.6 to 13.4	3.0	1.9 to 4.4
Readmission within 30 days		7.5	5.6 to 9.8	10.4	8.3 to 12.8

6. Repair of ruptured abdominal aortic aneurysms

6.1 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 2021 and 31 December 2023. Details of 1,386 procedures were submitted to the NVR, giving an estimated case ascertainment of 88%. In 2021 and 2022, there were 526 and 456 procedures recorded on the NVR, but for 2023, this reduced to 404 procedures.

The proportion of patients having an EVAR in recent years has changed over time (Figure 6.2). In 2018, around 30% of all procedures were EVARs; in 2020 and 2021, this has risen to around 40%. For 2023, it increased to 46%. Over the three years, a quarter of all NHS trusts performed more EVARs than open repairs for ruptured AAA (Figure 6.1).

Table 6.1: Characteristics of patients who had a repair of a ruptured AAA between January 2021 and December 2023

		Open repair	%	EVAR	%	Total
Total procedures		823		563		1,386
Age group (years)	Under 66	133	16.2	49	8.8	182
	66 to 75	239	29.1	141	25.2	380
	76 to 85	411	50.1	292	52.1	703
	86 and over	38	4.6	78	13.9	116
Male		679	82.5	477	84.7	1,156
Female		144	17.5	86	15.3	230
Previous AAA surgery		33	4.0	82	14.6	115
AAA diameter (cm)	Under 5.5	66	8.1	82	14.8	148
	5.5 to 6.9	205	25.1	166	29.9	371
	7.0 and over	546	66.8	307	55.3	853
ASA fitness grade	1 or 2	36	4.4	22	3.9	58
	3	74	9.0	95	16.9	169
	4	512	62.2	367	65.3	879
	5	201	24.4	78	13.9	279

Figure 6.1: Percentage of EVARs (left panel) and number of open repairs and EVARs (right panel) by NHS trust between January 2021 and December 2023 with at least 10 procedures. Orange bars show open repairs and blue bars show EVARs.

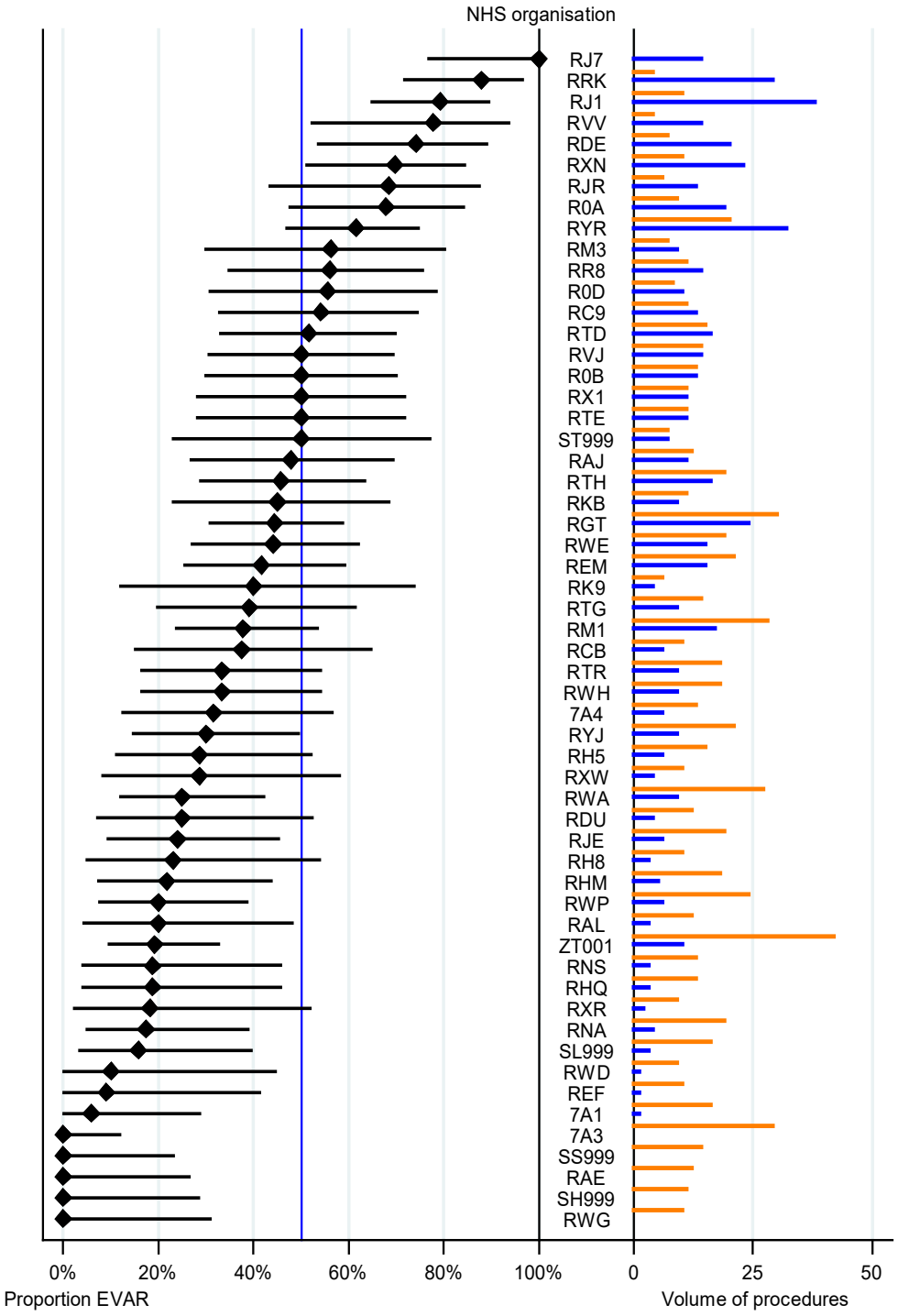


Figure 6.2: Number of open repairs and EVARs for ruptured AAAs between January 2021 and December 2023.

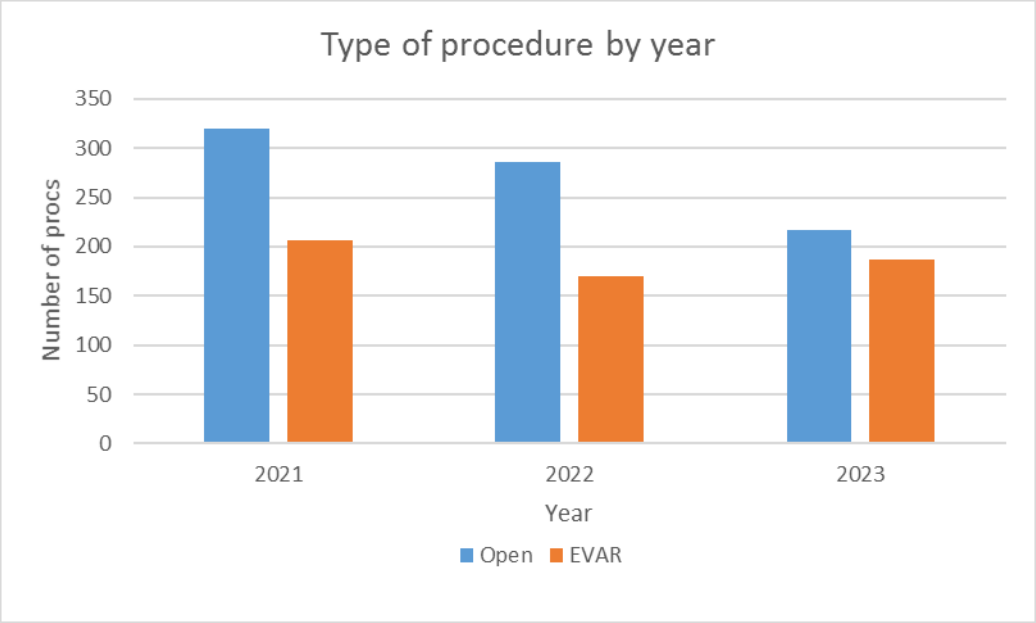


Table 6.2: Postoperative details of emergency repairs for ruptured AAAs undertaken between January 2021 and December 2023

2021-2023		Open repair (n=823)		EVAR (n=563)	
Admitted to	Ward	0.6%		16.6%	
	Level 2	9.0%		37.3%	
	Level 3	82.9%		42.4%	
	Died in theatre	7.5%		3.7%	
		Median	***IQR***	***Median***	***IQR***
Days in critical care: Level 2		4	2 to 7	2	1 to 3
Level 3		4	2 to 10	2	1 to 7
Post-op length of stay (days)		11	3 to 21	7	3 to 14
Post-op length of stay for patients discharged alive (days)		16	10 to 28	8	4 to 16
		Rate	***95% CI***	***Rate***	***95% CI***
In-hospital postoperative mortality		45.6	42.1 to 49.0	22.2	18.8 to 25.9
Defined complications					
	Cardiac	20.0	17.2 to 23.0	10.9	8.4 to 13.8
	Respiratory	31.9	28.6 to 35.4	15.9	12.9 to 19.3
	Stroke	2.6	1.6 to 4.0	0.9	0.3 to 2.1
	Haemorrhage	4.5	3.1 to 6.2	2.8	1.6 to 4.5
	Limb ischaemia	12.6	10.3 to 15.2	3.1	1.8 to 5.0
	Renal failure	25.0	21.9 to 28.2	9.2	6.9 to 12.0
	Ischaemic bowel	10.0	7.9 to 12.3	2.4	1.3 to 4.1
	None of predefined	28.1	25.0 to 31.5	57.7	53.4 to 61.9
Return to theatre		21.3	18.4 to 24.4	9.2	6.9 to 12.0
Readmission within 30 days		7.4	5.1 to 10.2	7.3	5.1 to 10.2

6.2 Postoperative in-hospital mortality for ruptured AAA repair

For NHS organisations undertaking repair of a ruptured AAA between 1 January 2021 and 31 December 2023, the risk-adjusted postoperative mortality rates are shown in Figure 6.3. The in-hospital postoperative mortality rates for the years 2021, 2022 and 2023 for open procedures were 45.0%, 46.2% and 45.6% respectively. For EVARs, the corresponding rates were 23.8%, 21.2% and 21.4%.

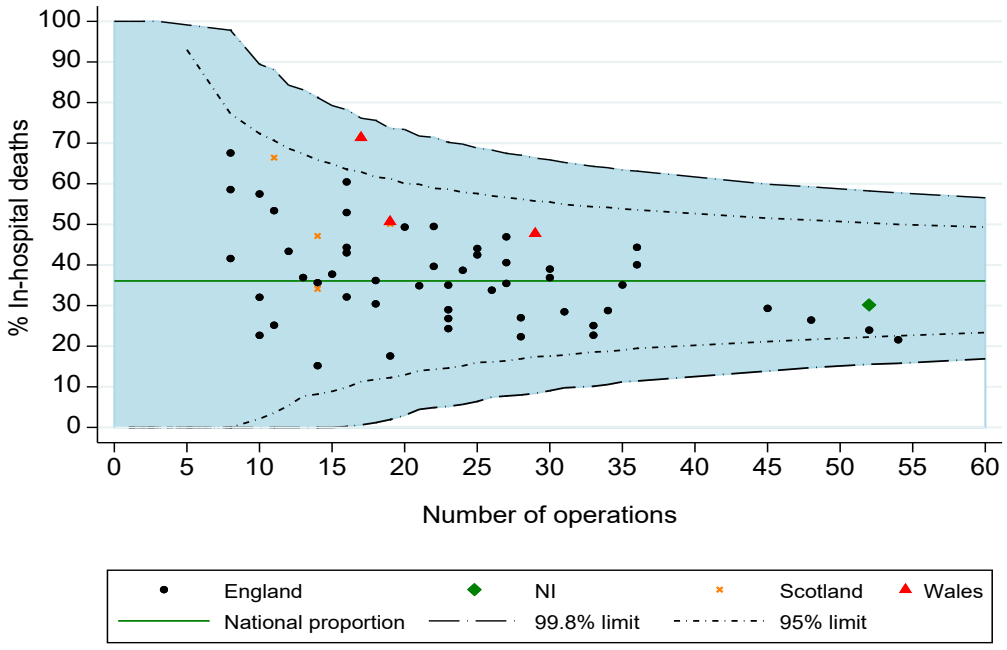
All NHS trusts had a risk-adjusted rate of in-hospital postoperative mortality that fell within the expected range around the national average of 36.1%, given the number of procedures performed.

The rates among NHS trusts typically ranged from 20% to 60%, which reflects the relatively low volumes used to calculate these rates.

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 6.3: Risk-adjusted in-hospital mortality for emergency repairs of ruptured AAAs between January 2021 and December 2023 by NHS trust. The overall mortality rate was 36.1%.



7. Carotid endarterectomy

7.1 Background

In the UK, around 3,000-3,500 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 2023 and 31 December 2023.

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, 2022 and 2023. 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 7.1: Estimated case ascertainment of carotid endarterectomy in the UK

	2021	2022	2023
Audit procedures	3,279	3,326	3,324
Expected procedures	3,559	3,547	3,578
Estimated case ascertainment	92%	94%	93%

Table 7.2: Estimated case ascertainment rates in 2023 by UK country

	Carotid endarterectomy
England	93%
Wales	100%
Scotland	60%
Northern Ireland	100%

7.2 Patient and Procedure Characteristics

Table 7.3: Characteristics of patients who had carotid endarterectomy in 2023, compared with characteristics from 2021 and 2022

Patient characteristics	No. of procedures	2023 %	2022 %	2021 %
Total procedures	3,324			
Age (years), (n=3,319)				
Under 66	982	29.6	28.9	28.1
66 to 75	1,170	35.3	35.7	36.0
76 to 85	1,034	31.2	31.2	31.5
86 and over	133	4.0	4.3	4.4
Male	2,277	68.5	69.6	69.1
Female	1,047	31.5	30.4	30.9
Asymptomatic	194	5.8	5.4	4.2
Patients symptomatic for carotid disease				
Index symptom if symptomatic: (n=3,130)				
Stroke	1,270	40.6	39.4	39.2
TIA	1,344	42.9	44.8	44.5
Amaurosis fugax	451	14.4	13.3	13.5
None of the three above	65	2.1	2.5	2.8
Grade of ipsilateral carotid stenosis* (n=3,323)				
<50%	41	1.2	1.5	1.5
50-69%	908	27.3	27.2	27.3
70-89%	1,346	40.5	40.9	40.8
90-99%	1,021	30.7	30.2	30.2
Occluded	7	0.2	0.2	0.2
Rankin score prior to surgery (n=3,321)				
0-2	3,053	91.9	90.3	88.7
3	255	7.7	9.0	10.3
4-5	13	0.4	0.8	1.1
Comorbidities (n=3,322)				
Diabetes	837	25.2	25.3	25.0
Cardiac disease	864	26.0	23.9	26.4

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

Table 7.4: Operative details of carotid endarterectomies performed from 2021 to 2023

Operation details		Procedures (n=3,324)	2023 %	2022 %	2021 %
Anaesthetic	General	2,171	64.4	63.7	64.5
	GA + block	412	11.9	10.6	8.8
	Block or regional	546	16.8	17.7	17.9
	Local	195	6.9	8.0	8.8
Type of endarterectomy	Standard	302	9.1	7.4	8.5
	Standard + patch	2,869	86.3	86.8	86.6
	Eversion	153	4.6	5.8	4.9
Carotid shunt used		2,190	65.9	64.7	63.8
Ipsilateral patency check		2,261	69.4	70.1	67.4

7.3 Treatment pathways

Patients may be referred for carotid endarterectomy from various medical practitioners. In 2023, the most common source of referral was the stroke physician (88.1%), vascular surgeons (2.9%), followed by neurologists (2.1%), and GP or ophthalmologists (1.4%).

- There were 3,130 patients (94.2%) with symptomatic disease. TIA was the most common symptom (42.9%), followed by stroke (40.6%).
- Over 70% of patients had at least 70% stenosis in their ipsilateral carotid artery at the time of operation.
- Only 0.8% of patients had a previous ipsilateral treatment.

Medication for cardiovascular conditions was common among patients prior to surgery. Overall:

- 91.1% were on antiplatelet medication
    - 48.1% on single and
    - 51.9% on dual therapy,
- 82.4% 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 2020, the proportion of patients who were treated within the 14-day target rose from 37% to 62%. In 2023, this decreased to 49% of patients.

The median time from symptom onset to surgery for symptomatic patients in 2023 was 15 days (IQR 9-26). For the three distinct phases within this pathway, the median time delays were:

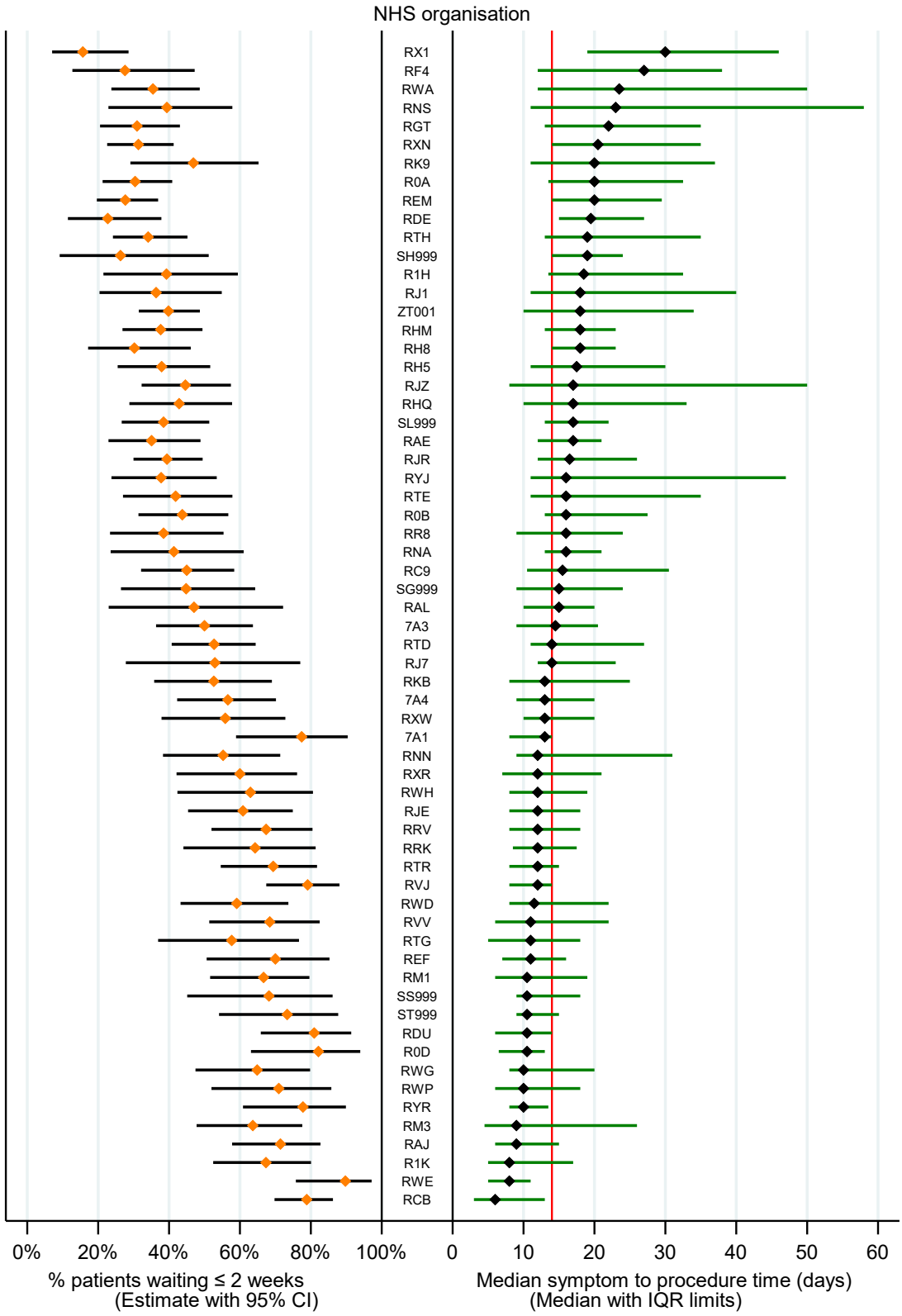
- 4 days (IQR 2-10) from symptom to first medical referral
- 1 day (IQR 0-5) from first medical referral to being seen by the vascular team, and
- 6 days (IQR 3-11) from being seen by the vascular team to undergoing CEA.

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 7.1. 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 2023 (right panel, Figure 7.1):

- 31 of the 63 NHS organisations had a median time of 14 days or less
- the median exceeded 20 days for 6 vascular units, an increase from 4 in 2021
- 31 Trusts had less than half of their patients operated on within 14 days.

Figure 7.1: Median time (and interquartile range) from symptom to procedure by NHS trust for procedures performed between January and December 2023 (black diamonds) and proportion waiting less than 2 weeks following symptoms (orange diamonds)



7.4 Outcomes after carotid endarterectomy

The complication rates for the 3,324 procedures performed in NHS hospitals in 2023 are summarised in Table 7.5. The rates of the different complications tended to be around 0.2-2.0% and have remained fairly consistent over the last few NVR Annual Reports.

Table 7.5: Postoperative outcomes following carotid endarterectomy for 2023

Procedures	**3,324**
Complication	**Complication rate (%) 2023**
Death and/or stroke within 30 days	1.9 (1.5 – 2.4)
Stroke within 30 days	1.6 (1.2 – 2.1)
Death within 30 days	0.5 (0.3 – 0.8)
Bleeding within admission	2.0 (1.5 – 2.5)
Myocardial infarct within admission	1.1 (0.8 – 1.5)
Cranial nerve injury within admission	1.7 (1.3 – 2.2)
TIA within admission	0.2 (0.1 – 0.4)
Post-operative confusion within admission	0.4 (0.2 – 0.7)

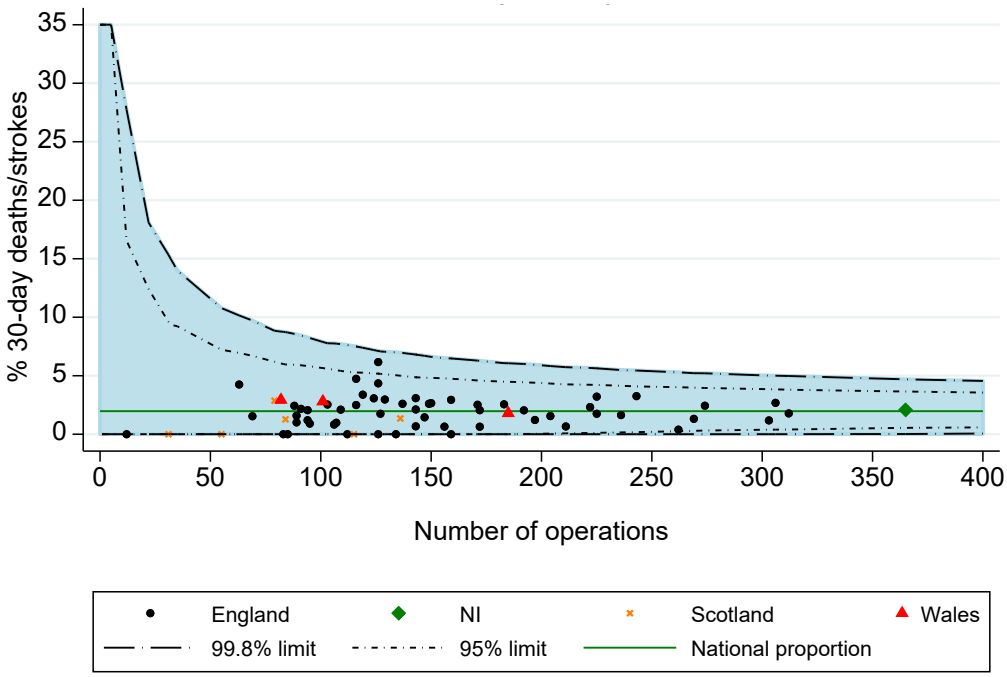
7.5 Rates of stroke/death within 30 days among NHS trusts

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 7.2. Between 2021 and 2023, all NHS organisations were within the expected distance of the overall national average rate of 2.0% (i.e., they were within the 99.8% control limits).

Over the 12 months in 2023:

- the median length of stay was 2 days (IQR: 1 to 4 days)
- the rate of return to theatre was 2.5% (95% CI 2.0 to 3.1), and
- the rate of readmission within 30 days was 4.2% (95% CI 3.6 to 5.0).

Figure 7.2: Funnel plot of risk-adjusted rates of stroke/death within 30 days for NHS trusts, for carotid endarterectomies between January 2021 and December 2023



The overall national average rate of stroke/death within 30 days = 2.0%

Appendix 1: 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	No	No	Yes	No	No
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	Mersey and West Lancashire Teaching Hospitals NHS Trust	No	No	Yes	No	No
RBQ	Liverpool Heart And Chest NHS Foundation Trust	Yes	No	No	No	No
RC9	Bedfordshire Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
RCB	York Teaching Hospital NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
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
RFS	Chesterfield Royal Hospital NHS Foundation Trust	No	No	Yes	No	No
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
RHQ	Sheffield Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes

Code	Organisation Name	AAA	CEA	Angio	Bypass	Amp
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
RJ6	Croydon Health Services NHS Trust	No	No	Yes	No	No
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

Code	Organisation Name	AAA	CEA	Angio	Bypass	Amp
RVR	Epsom and St Helier University Hospitals NHS Trust	No	No	Yes	No	No
RVJ	North Bristol NHS trust	Yes	Yes	Yes	Yes	Yes
RVV	East Kent Hospitals University NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
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
RXC	East Sussex Healthcare NHS Trust	No	No	Yes	No	No
RXF	Mid Yorkshire Hospitals NHS trust	No	No	Yes	No	No
RXN	Lancashire Teaching Hospitals NHS Foundation Trust	Yes	Yes	Yes	Yes	Yes
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	No	No	Yes	No	No
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	No	Yes	No	No
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

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.

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