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# The symptom to assessment pathway for suspected chronic limb-threatening ischaemia (CLTI) affects quality of care: a process mapping exercise

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## ABSTRACT

**Background** Delays in the pathway from first symptom to treatment of chronic limb-threatening ischaemia (CLTI) are associated with worse mortality and limb loss outcomes. This study examined the processes used by vascular services to provide urgent care to patients with suspected CLTI referred from the community.

**Methods** Vascular surgery units from various regions in England were invited to participate in a process mapping exercise. Clinical and non-clinical staff at participating units were interviewed, and process maps were created that captured key staff and structures used to create processes for referral receipt, triage and assessment at the units.

**Results** Twelve vascular units participated, and process maps were created after interviews with 45 participants. The units offered multiple points of access for urgent referrals from general practitioners and other community clinicians. Triage processes were varied, with units using different mixes of staff (including medical staff, podiatrists and s) and this led to processes of varying speed. The organisation of clinics to provide slots for 'urgent' patients was also varied, with some adopting hot clinics, while others used dedicated slots in routine clinics. Service organisation could be further complicated by separate processes for patients with and without diabetes, and because of the organisation of services regionally into vascular networks that had arterial and non-arterial centres.

**Conclusions** For referred patients with symptoms of CLTI, the points of access, triage and assessment processes used by vascular units are diverse. This reflects the local context and ingenuity of vascular units but can lead to complex processes. It is likely that benefits might be gained from simplification.

## BACKGROUND

Chronic limb-threatening ischaemia (CLTI) is the most severe form of peripheral arterial disease (PAD) and is defined as the presence of PAD with symptoms of rest pain, gangrene or non-healing ulceration over a period longer than 2 weeks.<sup>1</sup> In the UK, endovascular procedures required for managing

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Delays in treatment of chronic limb-threatening ischaemia (CLTI) are associated with increased risk of mortality and limb loss.

⇒ There has been recent focus on improving care for these patients but little is known about current care pathways.

## WHAT THIS STUDY ADDS

⇒ This study maps processes for receipt of referral, triage and assessment in place in over 20% of English vascular surgery units.

⇒ We have demonstrated the complexity and variation of current processes for referral, triage and assessment.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides a description of different approaches to organising urgent access for patients with CLTI and suggests quality improvement interventions for CLTI pathways based on study findings that are within the control of individual vascular surgery units.

a patient with CLTI may be available at a district general hospital, but for lower limb arterial surgery, patients need to be treated at a specialist vascular centre. While patients with severe symptoms might be admitted after being seen as an emergency via the emergency department (ED), a significant number will also be referred by general practitioners or community services.

CLTI is associated with an increased risk of major limb amputation and mortality<sup>2–4</sup> and urgent treatment is required for an optimal prognosis. However, studies examining the care pathway from first symptom to intervention have described how delays can occur at each stage of the process,<sup>5</sup> starting with the identification and referral of patients with CLTI<sup>6</sup> and also at the time of assessment by



vascular services.<sup>7</sup> To avoid these, organisations have introduced various initiatives, such as regular ‘hot clinics’ (which are for emergency referrals only) and streaming patients to specific services such as podiatry. However, this increases the complexity of the care pathway and there is limited evidence for services to draw on when considering how to organise vascular services so that they meet the needs of the local population and ensure patients with CLTI have rapid access to endovascular or open surgery. The evolving hub-and-spoke organisation of English NHS vascular services into regional networks<sup>8</sup> provides an opportunity for vascular units to implement different approaches and for others to learn from their experiences.

The aim of this study was to examine the care pathways implemented by vascular services in a sample of locations within England. This was exploratory work, carried out in order to understand the current situation with respect to CLTI pathways, so future interventions can be targeted at appropriate areas of the pathway. The study focused on the various structures and processes adopted by the units to offer rapid access for patients with CLTI, as per the Donabedian model,<sup>9</sup> and used process mapping to compile representations of a patient’s journey through the care pathway.<sup>10</sup> Process mapping is recommended for use in the planning and design of healthcare services and has been used to identify potential causes of delays along care pathways in gynaecological malignancies,<sup>11</sup> peripheral neuropathy<sup>12</sup> and rheumatoid arthritis.<sup>13</sup>

## METHODS

This study was undertaken as part of the evaluation of the Peripheral Arterial Disease Quality Improvement Programme (PAD-QIP) that was developed to support the National Health Service (NHS) trusts to implement the Peripheral Arterial Disease Quality Improvement Framework (PAD-QIF) published by the Vascular Society of Great Britain and Ireland.<sup>14</sup> The PAD-QIP was a quality improvement collaborative that ran from May 2020 to May 2022 and included 13 NHS vascular surgery units. The primary aim of the PAD-QIP was to reduce the time-to-revascularisation from date of referral for inpatients with CLTI.

Fourteen NHS English vascular surgery units were invited to participate in the process mapping exercise. These units were selected from 56 English vascular surgery units based on three principal criteria: (1) whether they participated in PAD-QIP (yes or no), (2) geographical location and (3) size of the vascular unit catchment population. The size of the vascular unit catchment population was calculated from the Public Health England NHS Acute (Hospital) Trust Catchment Populations Dashboard.<sup>15</sup> The minimum recommended population for a UK vascular network is 800 000, and network reconfiguration is still underway in various areas to achieve this aim.<sup>16</sup>

The selection process resulted in a sample that contained a similar number of units which did or did not

**Table 1** Characteristics of centres invited to participate in process mapping

Vascular surgery unit	Catchment population	Involved in PAD-QIP?	North/south
Unit A	2.2 million	Yes	North
Unit B	0.7 million	Yes	North
Unit C	0.7 million	No	South
Unit D	1.2 million	No	North
Unit E	1.0 million	No	South
Unit F	1.4 million	No	North
Unit G	0.4 million	No	North
Unit H	0.4 million	No	South
Unit I	1.2 million	No	North
Unit J	1.3 million	Yes	South
Unit K	1.8 million	No	South
Unit L	1.6 million	Yes	North
Unit M	1.7 million	Yes	South
Unit N	2.8 million	No	South

PAD-QIP, Peripheral Arterial Disease Quality Improvement Programme.

participate in the PAD-QIP (table 1). Among the 14 units, 4 were included with a catchment population of <800 000, used as a proxy to reflect practice prior to any network reconfiguration. At least one unit was located within each of the nine Government Office Administrative regions to ensure even national coverage, with even numbers in the north and the south which was judged important given the north-south divide on various social and economic measures.<sup>17</sup>

## Process mapping

Our approach to process mapping followed the recommended practice of using simple diagrammatic representation; seeking input from groups of multiple stakeholders; having a facilitator for appropriate communication; and providing straightforward training on the process mapping method.<sup>18</sup> Patients and the public were not involved in the design, conduct, reporting or dissemination plans for this research.

An email invitation was sent to the clinical leads of all selected units, describing the project aims and the time commitment required. Subsequently, preliminary meetings were held with the unit clinical lead or deputy during which the project was explained in detail and any questions answered. Once a unit had agreed to participate, a process mapping meeting was arranged, either face to face or over Microsoft Teams. The research team suggested the initial process mapping session included a vascular surgery consultant, a vascular specialist nurse (VSN (throughout this study, ‘VSN’ is used as an umbrella term to refer to nurse consultants, VSNs and advanced clinical practitioners working in vascular surgery)) and a member of podiatry staff, but as the relevant personnel

### Box 1 Topic guide for process mapping sessions, illustrating initial and follow-up questions

- Q: How are referrals for suspected CLTI received from:
- ⇒ Primary care (different staff groups)
  - ⇒ Emergency departments
  - ⇒ In-hospital podiatry services
  - ⇒ Self-referral
- Q: Are there variations in the referral process across the network?
- Q: How are the referrals triaged?
- ⇒ How is this different for a patient in a spoke catchment as opposed to the hub?
  - ⇒ How is this different if the patient has diabetes?
- Q: How is the patient assessed (eg, hot clinic, urgent slots, podiatry clinic)
- ⇒ How is this different for a patient in a spoke catchment as opposed to the hub?
  - ⇒ How is this different if the patient has diabetes?
- Q: What are the timings between referral receipt and triage, and triage and assessment?
- Q: Which staff are involved in referral receipt, triage, patient liaison and assessment?

would depend on the unit's own process, the units could have whoever they felt to be useful attend the meeting. All meetings were audio recorded, transcribed and anonymised. Each participant read an information sheet about how their data would be stored and used, and signed a consent form. If further detail was required after the initial meeting and process mapping, either secondary meetings were arranged with the appropriate individual or an email was sent with the same process followed. **Box 1** provides an example of questions asked in the process mapping sessions.

A graphical representation of the processes described by the unit staff was drawn using MURAL online software (Tactivos),<sup>19</sup> a digital whiteboard collaboration space. Once the map for a unit was complete, it was shared with the clinical lead and all participants in the process mapping exercise. An iterative process of feedback on the maps and editing was then followed until all parties were satisfied with the completed map.

An analysis of all the completed process maps was undertaken to capture where the various care pathways differed, including methods of referral, triage processes, procedures for assessment of patients with suspected CLTI, differences in management of patients with or without diabetes, and patients local to arterial or non-arterial centres. These data were summarised in a Microsoft Excel spreadsheet. A summary map was created to visualise all potential processes in place in the included units.

## RESULTS

Twelve of the 14 invited arterial centres agreed to participate; centres M and N did not (**table 1**). The reasons for this included insufficient time for the process mapping

exercise within the project timeframe and lack of engagement after the preliminary meeting.

### Process mapping

Process mapping interviews took place between 1 June 2022 and 2 September 2022, and these results represent practice at that time. In total, 45 participants from the 12 units were interviewed. This included 12 consultant surgeons, 2 vascular surgery registrars, 1 surgical care practitioner, 14 VSNs, 13 podiatrists, 1 diabetologist, 1 member of administration staff and 1 vascular scientist. Further information was received via email from three podiatrists, one surgeon and one member of administration staff. The median number of staff contributing to a process map per centre was 3 (range 2–7); this included a vascular surgeon in 11 centres, a podiatrist in 10 centres and a VSN in 9 of the 12 centres.

The process maps of each arterial centre were summarised into one diagram (**figure 1**). This demonstrates the complexity of pathways for referral of patients with CLTI. Each constituent part of this diagram was present in at least one of the arterial centres.

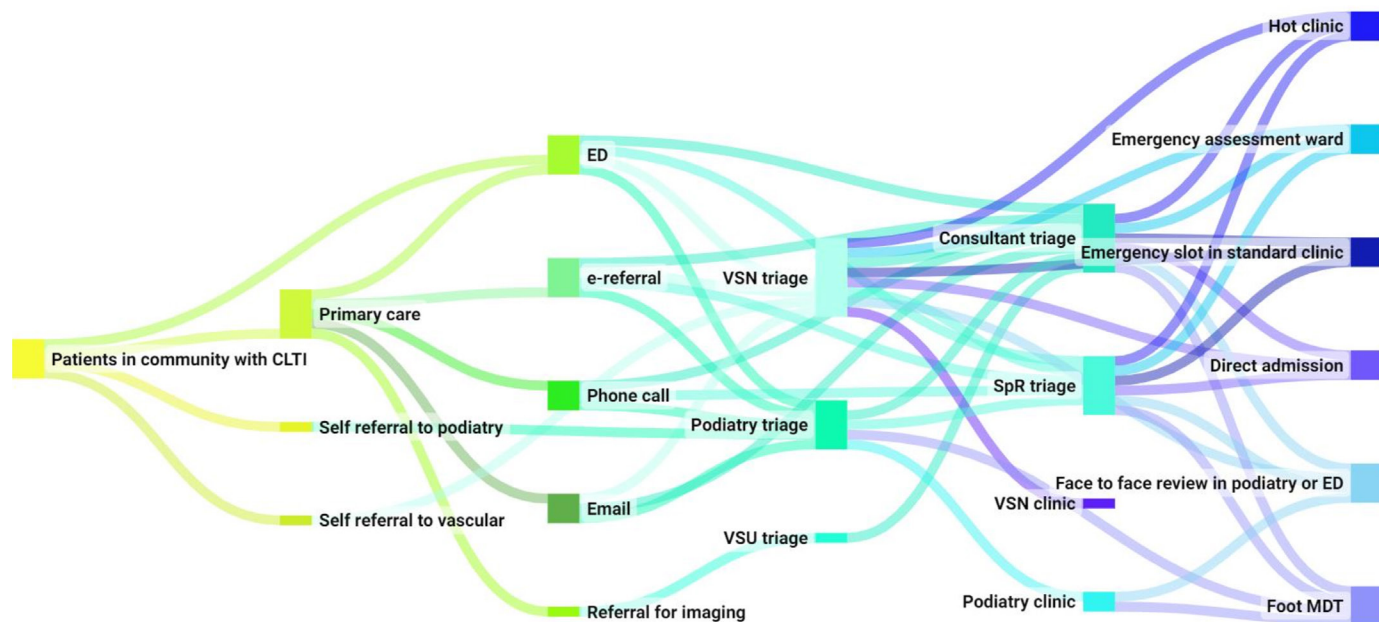
### Participating centre characteristics

The care pathways at all arterial centres involved similar types of staff, namely, vascular surgeons, VSNs and podiatrists, with differing degrees of involvement and in different configurations. Surgeons were involved in receipt and triage of referrals and assessment of patients in all units. VSNs were also often involved in triage and assessment processes, as well as being an initial contact point for certain types of referrals. In some centres, referrals deemed suitable by the triaging clinician were diverted at the point of triage to podiatry services, who assessed the patient. The vascular surgery team was then involved once the diagnosis of CLTI had been confirmed by objective measures of perfusion. Often, the use of non-surgical staff in patient triage and assessment was in addition to existing surgeon pathways, with the intention of reducing pressure on the surgeon role, or to capture patients who had been referred using a non-standard route.

**Table 2** demonstrates characteristics of the included units, and how incoming referrals were received and triaged. It also includes the PAD-QIF target achievement from 2021, demonstrating the proportion of patients admitted with CLTI whose time-to-revascularisation was within 5 days of admission.<sup>20</sup> While this process measure is only determined from the time of admission of the patient, it provides context in terms of how efficient the unit is in treating inpatients with CLTI.

All units indicated that they would accept referrals from all staff groups, although some referral modalities are only available to selected clinicians (eg, e-Referral Service (eRS) systems are only available to staff working in a general practitioner practice).

Three units were in vascular networks that had adopted the same procedure for the referral of patients with



**Figure 1** Summary process map for arterial centres. CLTI, chronic limb-threatening ischaemia; ED, emergency department; VSN, vascular specialist nurse; VSU, vascular studies unit; SpR, specialty registrar; MDT, multidisciplinary team.

suspected CLTI for all units within their network, that is, all referrals for suspected CLTI were directed to the arterial centre. Of the nine remaining units, two were not networked with any non-arterial centres, and one unit's interview was a partial map focusing on one non-arterial centre in particular, as they had a novel lower limb assessment service led by podiatrists. Of the remaining six, there was a range of one to three non-arterial centres within the networks.

### Methods of referral from primary care

All centres accepted urgent referrals from all primary care clinicians. All units used e-RS, a national electronic referral system provided by NHS Digital, enabling clinicians based in general practice to refer patients for specialist care. Two centres' e-RS systems included an embedded referral pro-forma, allowing them to collect information deemed necessary for triage. e-RS referrals can be marked as urgent or routine at the referring clinician's discretion. To complement this, individual centres had adopted additional options for urgent referrals, although these might be available only for specific primary care clinicians. For example, eight arterial centres had a direct email to the vascular team which tended to be used by community podiatrists, tissue viability nurses or district nurses who did not have access to e-RS. These emails were received by VSNs, members of the surgical team or administration staff.

All units had an on-call member of staff available via telephone to primary care clinicians in their catchment area. This was a registrar in all arterial centres, with VSNs available in addition in six centres. A consultant was always available in addition to the registrar in all arterial centres, and they were described as receiving direct phone referrals for CLTI in four centres. Six vascular units accepted

self-referral from patients previously known to the team, although they could present with a new problem.

All arterial centres were aligned with podiatry services for high-risk patients, which independently received, triaged and assessed referrals from primary and secondary care. Most podiatry services were located in the same hospital as the arterial centre, but community-based 'high-risk' services were also available in three networks. In 5 of the 12 arterial centres, podiatry clinics were exclusively for patients with diabetes. Commissioning of podiatry services was given as the reason for seeing or not seeing patients without diabetes.

In all of the units, podiatrists received and triaged referrals daily and saw urgent referrals in an assessment clinic within 48 hours of their receipt. Podiatrists escalated to vascular surgery once CLTI was diagnosed, usually by direct phone call or face-to-face discussion with an on-call vascular clinician, or by booking the patient into a multidisciplinary clinic including vascular surgery.

The speed and process of triage was dependent on route of referral. Podiatry teams carried out at least daily triage of phone, email, letter and e-RS referrals. Email and phone call referrals received by on call registrars, consultants or VSNs would also be triaged at within at most 24 hours. The speed of triage of e-RS referrals by consultants, registrars and VSNs was more variable between centres and could be anywhere from daily to weekly (table 3A, table 3B). The triage performed by one staff group could trigger a further triage process, with, for example, a VSN or podiatrist escalating a referral to a consultant or registrar if they felt the patient was unwell enough to require emergency assessment that same day. In the five arterial centres where podiatry exclusively saw patients with diabetes, these patients often benefited

**Table 2** Characteristics of networks, referral and triage processes

Characteristics		Referral options					Process measure	
Arterial centre	North/south	In network	e-RS triage	Self-referral accepted‡	ED referral goes to	Direct email referrals received by ~	Referrals to podiatry	PAD-QIF target achievement 2021
Unit A	North	Yes†	Consultant		Hub SpR	Vascular secretaries	e-RS/email/phone	44%
Spoke 1A			Podiatry		Hub SpR		e-RS/email/phone	
Unit B	North	Yes*	Consultant		Hub SpR		e-RS/phone	76%
Unit C	South	Yes	SpR		SpR		e-RS	53%
Spoke 1C			SpR		Hub SpR		e-RS/email	
Unit D	North	Yes	Consultant	Y	SpR/VSN	VSN	Email	38%
Spoke 1D			Consultant		Hub SpR/VSN		Email	
Unit E	South	Yes	Consultant	Y	SpR	VSN	Email/phone	51%
Spoke 1E			Consultant		Hub SpR		e-RS	
Spoke 1E			Consultant		Hub SpR		Email/phone/letter	
Unit F	North	Yes	Consultant	Y	SpR	VSN	Email/phone	33%
Spoke 1F			VSN		Hub SpR		e-RS	
Unit G	North	No	Consultant	Y	SpR/consultant		Email	<10 cases
Unit H	South	No	Consultant		SpR/consultant	VSN / consultant	Email/phone	88%
Unit I	North	Yes*	Consultant		Hub SpR/podiatry	MDT coordinator	Phone/email	42%
Unit J	South	Yes	Consultant	Y	SpR		Email/phone	59%
Spoke 1J			VSN	Y	Hub SpR	VSN	Email/phone	
Spoke 2J			Consultant		Hub SpR		Email/phone/letter	
Spoke 3J			Consultant		Hub SpR	Vascular secretaries	Email/phone (if urgent)	
Unit K	South	Yes	Consultant		SpR	SCP	Email	31%
Spoke 1K			Consultant		Hub SpR	VSN	Email	
Spoke 2K			Consultant		Hub SpR	Consultant	Email/phone	
Unit L	North	Yes*	VSN	Y	Hub SpR	VSN/consultant	Email/phone	66%

\*Unit I, unit B and unit L have the same process for triage of referrals from non-arterial centre catchment as those from arterial centre catchment area.  
 †Unit A non-arterial centres have not been fully mapped.  
 ‡All units accepting self-referral did so only from patients already known to the department. All were via VSNs.  
 e-RS, e-referral service; SCP, surgical care practitioner; SpR, register working in vascular surgery; VSN, vascular specialist nurse.

from faster triage than a patient without diabetes referred to the vascular surgeons via e-RS.

### Patient assessment facilities and process

Arterial centres had adopted different combinations of hot clinics and standard outpatient clinics, both in terms of capacity and timing. Two arterial centres

had no dedicated urgent clinic slots for reviewing referrals with suspected CLTI, meaning the majority of patients were reviewed on emergency assessment wards. Two arterial centres had emergency slots in standard clinics available to review emergency patients. Nine arterial centres held hot clinics; in two of these, the clinics were held once per week. In the



other seven, hot clinics were held at least three times per week, aligning with PAD-QIF recommendations<sup>14</sup> (table 3A). One of these centres augmented their hot clinic capacity with emergency slots in standard clinics.

All but two arterial centres had an assessment unit available in hours for a vascular registrar, VSN or consultant to review patients with suspected CLTI who were perceived as unable to wait for an emergency clinic appointment, or where emergency clinic appointments were not available. Other available methods of assessment included face-to-face assessment in ED or podiatry clinics, including multidisciplinary foot clinics, VSN-led clinics and via direct admission to the vascular ward.

Patients referred to podiatry had access to faster assessment, with referrals triaged as urgent being assessed within 48 hours. In the five centres where podiatrists exclusively saw patients with diabetes, patients without diabetes referred to vascular surgery via e-RS would often need to wait longer for a review. Three arterial centres made use of the faster times to assessment provided by podiatrists, diverting suitable referrals to be seen initially by podiatry, with escalation to vascular surgery only once CLTI was confirmed with objective measures of perfusion. For one of the three arterial centres, this service was only available for patients with diabetes, creating a two-tier service to the detriment of patients without diabetes.

### Arterial versus non-arterial centres

Networked non-arterial centres had their processes mapped alongside the arterial centres. Three arterial centres had the same processes as their non-arterial centres for dealing with e-RS referrals—all were diverted to the arterial centre and managed centrally. There was overlap within the network pathways, and much of this depended on the perceived urgency of the patient's condition to the referring clinician, with the arterial centre direct phone call always being an option for all non-arterial centre patients. Timing of review in a non-arterial centre was slower, with triage taking place less frequently, and fewer formal emergency clinic slots being available, with reviews relying on overbooking or moving less urgent patients from standard consultant clinics. This can be seen in table 3B. All but one non-arterial centre had on-site podiatry services, offering similar time to triage and assessment as the arterial centre podiatry services. Of the 11 non-arterial centre podiatry services, 8 saw patients with diabetes exclusively.

## DISCUSSION

This study highlights the national variation in referral, triage and assessment processes for patients with suspected CLTI, aligning with GIRFT (Getting It Right First Time) findings of variation in the timeliness of care delivered to

vascular surgery patients with CLTI across the country.<sup>21</sup> We have demonstrated diversity and complexity in the ways vascular surgery networks have tackled the challenge of providing urgent care to these patients, both in terms of structure and process. Each vascular unit covers a unique population, employs different staff and has its own structural and organisational challenges, and the pathways we have described reflect all of these factors.<sup>22</sup> The adoption of the CLTI CQUIN (Commissioning for Quality and Innovation) scheme in May 2022, giving Trusts a financial incentive to reduce time-to-revascularisation for inpatients with CLTI,<sup>23</sup> may have encouraged units to make changes to pathways, which will have been captured in our work.

Primary care clinicians who refer these patients have many options for how to involve vascular surgery in their care. The multitude of ways patients can enter the pathway reflects the complexity of CLTI, and the range of symptoms with which it can present. Vascular services have thus developed the processes described in order to capture as many of these patients and assess them as quickly as possible. Attending ED is always an option and will be necessary for some patients presenting with CLTI. However, patients who may not require immediate admission are often better served by an emergency clinic model.<sup>1 24–26</sup> Such models are in place in 10 of the 12 participating units and were described as the preferred way of assessing emergency referrals, as often imaging is available alongside the clinic and they allow a faster review than a routine clinic appointment.

Even within an emergency clinic model, wide variation was seen across arterial centres in the potential time period between receipt of referral and patient assessment (table 3A). Figure 2 is a reproduction of the PAD-QIF targets for time-to-revascularisation, indicating all patients should be seen within 7 days, and those that require admission within 2 days. It is not always possible to tell from a referral whether a patient will require admission, but only 5 of the 10 arterial centres who use an emergency clinic model are able to meet the 7-day target consistently following a referral received through e-RS, and only 2 of the 10 would meet the 2-day target consistently. This indicates that simply having access to emergency clinic slots is not enough—there needs to be appropriate capacity within the model and supporting triage processes of adequate urgency.

Structural factors affecting the process of triage and assessment include the vascular network configuration. Patients referred to non-arterial centres in the six networks where referrals are not diverted to the arterial centre are likely to have longer times from referral to revascularisation and, correspondingly, are more likely to have inferior outcomes.<sup>4</sup> Our work confirms that pathways where the patient with suspected CLTI is referred to a non-arterial centre have greater potential times to referral triage and patient assessment. This inequity of care across vascular networks must be a priority for future service improvement.

**Table 3A** Timing of emergency outpatient assessment for suspected CLTI—arterial centres

Name of arterial centre	Timing of e-RS triage	Frequency of hot clinic	Hot clinic led by	Frequency of emergency slots (consultant clinic)	Maximal timing for outpatient review via e-RS (days)
Unit A†	48 hourly (if urgent)	Weekly	Consultant	None	9
Unit B*	48 hourly	None	Consultant and VSN	2 per clinic (daily)	3
Unit C	Weekly	3 times weekly	VSN	None	9
Unit D	4 times weekly	None	–	None	–
Unit E	Daily	3 times weekly	Consultant	None	3
Unit F	Weekly	3 times weekly	Consultant and VSN	None	9
Unit G	Daily	None	–	None	–
Unit H	48 hourly	Weekly	Consultant	None	9
Unit I*	Weekly	4 times weekly	Consultant	None	9
Unit J	Daily	Up to 4 times weekly	Consultant and VSN	None	3
Unit K	Daily (if urgent)	Daily	SpR	None	2
Unit L*	Daily	Weekly	Consultant	1 per clinic (daily)	2

\*Unit I, unit B and unit L have the same process for triage of referrals from non-arterial centre catchment as those from arterial centre catchment area.  
 †Unit A non-arterial centres have not been fully mapped.  
 SpR, specialty registrar; VSN, vascular specialist nurse.

**Table 3B** Timing of emergency outpatient assessment for suspected CLTI—non-arterial centres

Name of arterial centre	Name of non-arterial centre	Timing of e-RS triage	Frequency of hot clinic	Hot clinic led by	Frequency of emergency slots (consultant clinic)
Unit J	Spoke 1J	Sporadic	Weekly	VSN	Overbook
	Spoke 2J	Daily	None		Move out less urgent
	Spoke 3J	Weekly	None		Overbook
Unit C	Spoke 1C	Weekly	None		Overbook
Unit E	Spoke 1E	Weekly	None		Move out less urgent
	Spoke 2E	Weekly	None		Overbook
Unit F	Unit 1F	3 times weekly	Weekly	VSN	6–8 per week
Unit K	Spoke 1K	Daily (if urgent)	None		Overbook
	Spoke 2K	Sporadic	Daily		Overbook
Unit D	Spoke 1D	4 times weekly	None		None

\*Unit I, unit B and unit L have the same process for triage of referrals from non-arterial centre catchment as those from arterial centre catchment area.  
 †Unit A non-arterial centres have not been fully mapped.  
 CLTI, chronic limb-threatening ischaemia; VSN, vascular specialist nurse.

Another element of structure affecting quality of care is the difference in pathways for patients with and without diabetes, related to commissioning of podiatry services. In 5 of the 12 arterial centres and 8 of the 11 non-arterial centres, podiatrists were not seeing patients who did not have diabetes, meaning that the swift times from referral to podiatry and assessment are only benefiting patients

with diabetes with suspected CLTI. This could add a further element of delay to patients with suspected CLTI without diabetes and contribute to the similar outcomes seen by patients with and without diabetes following revascularisation for CLTI, despite patients with diabetes presenting with a greater frequency of tissue loss and having less favourable anatomy for revascularisation.<sup>27</sup>

### Admitted patient - severe chronic limb threatening ischaemia and/or foot sepsis



### Non-admitted patient - stable disease, such as mummified toes



**Figure 2** PAD-QIF targets for time-to-revascularisation pathways.<sup>14</sup> Reproduced with permission of the *Journal of Vascular Societies of Great Britain and Ireland*. PAD-QIF, Peripheral Arterial Disease Quality Improvement Framework. MDT, multidisciplinary team

Our work exploring available processes in multiple vascular units helps clinicians, managers and commissioners understand how this variation and complexity in structure and process can lead to delays from referral to assessment of patients with CLTI. Benefits are likely to be gained from simplification, and three primary foci for quality improvement have been identified; the triage process, the way networked vascular services approach referrals for suspected CLTI and the provision of care for patients without diabetes compared with patients with diabetes.

Based on the findings of the study, we suggest the following three interventions would improve the speed at which patients with suspected CLTI are reviewed and management instituted:

1. Same day triage of all network eRS referrals at the arterial centre. This would ensure referrals from across the network are picked up swiftly and triaged appropriately, enabling organisation of suitably urgent review.
2. Institution of at least four times weekly emergency clinic slots at the arterial centre, ensuring patients can be reviewed and management commenced within national targets. Facility for emergency review at non-arterial

centres for patients unable to attend the arterial centre should be provided based on network context.

3. Expansion of podiatry services to cover patients without diabetes. Currently, patients with diabetes benefit from podiatrists' clinical expertise and close relationship with vascular surgery, to the detriment of patients without diabetes. This inequality should be eliminated from CLTI pathways.

These complex interventions will require different implementation strategies in the varying contexts of vascular units across the country.

Further work to do has been identified, not least in reducing inequalities in the care offered to English patients with suspected CLTI. Patient-level data can identify the pathways from the community to vascular surgery assessment associated with the best outcomes. Initial work has been carried out by individual vascular units, showing swift access to a limb salvage clinic can improve long-term outcomes compared with alternative pathways,<sup>26</sup> but this may not be effective in all contexts. Qualitative research can investigate the experiences of patients, primary care clinicians and vascular surgery clinicians in order to define facilitators and barriers to timely, appropriate care.

Repeating the process mapping exercise in the future will demonstrate how pathways have evolved over the time period, and if any changes made were sustainable.

### Strengths and limitations

This unique national project demonstrates the variation in referral, triage and assessment processes that currently exists and highlights areas which could be simplified. Previous process mapping studies have focused only on individual patients and not pathway differences between different local contexts, with the majority considering only one centre.<sup>11–13</sup> The 12 participating centres represent over 20% of English vascular surgery units and the national coverage is a strength of our work.

This study was limited by the lack of available patient-level data to identify which pathways are used most frequently, and which are the most efficient processes in relation to patient timelines. The individual context of vascular units is likely to be a cause of variation in pathways, and therefore any exemplar pathways identified in this exercise may not function in an alternative context. While a significant proportion of vascular units in England were included in the process mapping exercise, it was impossible to include all vascular units and we are unlikely to have captured all pathways used nationally. Many factors exist outside these pathways that affect timely care and patient outcomes; from patient and primary care clinician recognition of symptoms, to availability of imaging, to surgical or endovascular treatment following assessment. The process mapped, however, is part of the patient journey that vascular surgery units have control over and thus an ability to carry out improvement work.

### CONCLUSION

There is a wide variation in processes demonstrated for the referral, triage and assessment of patients who experience symptoms of CLTI in the community, and associated variation in timing along pathways. Structural factors such as commissioning of services and network configuration contribute to processes available in each centre. The diversity of these pathways reflects the ingenuity of vascular surgery units in recognising and reacting to the urgency of providing care to patients with suspected CLTI, but there are opportunities to improve quality of care for this patient group.

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