

National Diabetes Foot Care Audit Fourth Annual Report



England and Wales
01 April 2015 to 31 March 2018

Foreword

The National Diabetes Foot Care Audit (NDFA) was launched in July 2014 and this 4th Annual Report summarises the findings derived from all foot ulcers registered up to March 2018 and followed for up to 6 months. The numbers registered each year are accelerating and this is only because of the commitment of many, many staff. The total number of ulcers now stands at well over 30,000.

The findings in the last 12 months have reinforced those of earlier years in confirming that ulcers undergoing expert assessment within two weeks are less likely to be severe, more likely to heal by 12 weeks, and less likely to lead to hospital admission and to amputation.

There are, however, quite large differences in clinical outcome in different areas and there is now increasing evidence to link this variation with the structure of the local care pathway.

For the first time this year the total number registered has also allowed modelling to identify those risk factors which link most closely to different clinical outcomes. In the future this will allow the routine use of case-mix adjustment in comparing performance of different services.

By identifying aspects of the care pathway which link to variation between localities and services, the aim is to improve clinical outcome for all people across England and Wales.

William Jeffcoate, Clinical Lead, NDFA



Contents

Section		Slide	
	Introduction	4	
	Recommendations	9	
1	Participation and case ascertainment	12	
2	Results	a. Care Structures	16
		b. Outcomes	23
3	Associations	a. Care Structures	32
		b. Time to first expert assessment	37
		c. Modelling outcomes	42
4	Provider variation	a. Risk-adjusted variation	49
		b. Time to first expert assessment	58
	Appendix: Modelling	63	
	Footnotes	80	
	Glossary	86	
	Further information	101	

Acronyms

The following acronyms and abbreviations are used throughout the report and are not always defined on the slide:

FPS = Foot Protection Service

MDFT = Multi-disciplinary Foot Care Team

NDA = National Diabetes Audit

NDFA = National Diabetes Foot Care Audit

NICE = The National Institute for Health and Care Excellence

QIC = Quality Improvement Collaborative

RRT = Renal replacement therapy

Introduction: Aims and background

- The National Diabetes Foot Care Audit (NDFA) measures the outcomes and treatment structures/processes for newly occurring foot ulcers affecting people with diabetes.
- The aim is to determine variation in clinical outcomes across England and Wales and the extent to which they can be explained by differences in aspects of care.
- The NDFA is part of the National Diabetes Audit (NDA) portfolio within the National Clinical Audit and Patient Outcomes Programme (NCAPOP), commissioned by the Healthcare Quality Improvement Partnership (HQIP).
- The NDFA started in July 2014; previous reports were published in March 2016, March 2017, October 2017 and March 2018.

Prepared in collaboration with:



Digital



Supported by:



Public Health
England



Introduction: Why is this audit important?

- In 2014-15 the annual cost of diabetic foot disease to the NHS in England was estimated at around £1 billion, approximately 1% of the total NHS budget, in addition to the personal/social costs of reduced mobility and sickness absence.
- More than 64,000 people with diabetes in England and Wales are thought to have foot ulcers at any given time (derived from Kerr 2017).
- Treatment for diabetic foot disease may involve amputation. There are around 7,000 minor (below the ankle) and major (above the ankle) amputations in people with diabetes in England each year.
- Only around three in five people with diabetes who have had a diabetic foot ulcer survive for five years, dropping to half for those having a major amputation.

Findings and recommendations in this report support the audit questions:

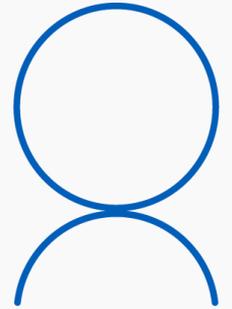
1. **Structures:** Are NICE-recommended care structures in place for the management of diabetic foot disease?
2. **Processes:** Does treatment of active diabetic foot disease comply with national recommended guidelines?
3. **Outcomes:** Are the outcomes of diabetic foot disease optimised?



Introduction: Patient perspective

People living with diabetes should be confident that foot care services can provide early diagnosis and effective treatment of foot problems to give the best possible outcome. It is unacceptable that the care you can expect to receive can be dependent on where you live.

It is also important for services to work closely with people with diabetes to prevent foot disease. The cost to the NHS of diabetes care is headline news, but improvement of foot care services has shown that the financial and human cost can be reduced.



NDFA patient representatives, 2019

Everyone involved in the care of people with diabetes should strive to address the concerns raised by our patient representatives. It is hoped that this report will be an important part of this process.

NDFA team



Introduction: Quality improvement

A **Quality Improvement Collaborative** (QIC) has been incorporated into the NDFA programme for 2018/19 with the aim of focusing on improvement activity. The power of this approach is in the collaboration between teams, sharing ideas of how they are undertaking their projects, what they learn and how they can implement changes.



21 NHS provider organisations across England and Wales are participating, with each service developing a tailored improvement plan to address local needs. The collaborative is developing quality improvement work around the following diabetes footcare topics:

- Reducing the interval to the first expert assessment
- Reducing the severity of ulcers
- Reducing emergency admissions
- Reducing amputations and other complications
- Upskilling the wider team
- Improving the care pathways



A report on the improvements made and lessons learned will be produced at the end of the NDFA Quality Improvement Collaborative (QIC) year.



Introduction: Analysis in 4th Annual Report 2019

Cohort: The NDFA Fourth Annual Report covers patients in England and Wales with ulcers that underwent first expert assessment by a specialist foot care service between April 2015 and March 2018. Data from July 2014 onwards was used to build the models for the casemix adjustment.

Updated figures on...

The following **clinical outcomes**:

- 1) Being alive and ulcer free at 12 weeks.
- 2) Having a foot disease-related admission within 6 months.
- 3) Having a major amputation (above the ankle) within 6 months.

Associations between clinical outcomes and:

- Patient demographics e.g. age, sex, smoking status.
- Health factors e.g. hospital admission for heart failure.
- Ulcer characteristics e.g. SINBAD elements, ulcer severity, Charcot disease.
- Care processes and structures of care e.g. time to first expert assessment, NICE recommendations.

New analyses of...

Caseload estimates provided by NDFA submitters.

Deaths within 6 months.

A new **provider survey** of six key care structures, with comparisons to the earlier **commissioner survey**.

Risk-adjusted outcomes at area/provider level for four key clinical outcomes:

- Alive and ulcer free
- Foot disease-related admissions
- Major amputation (above the ankle)
- Mortality



National Diabetes Foot Care Audit Fourth Annual Report

Recommendations

For the NDFA fourth Annual Report



Recommendations: People with diabetes

For people with diabetes

- If you have poor circulation (peripheral artery disease or **ischaemia**) or experience loss of feeling (**neuropathy**), seek advice from your GP or usual diabetes carer about how to prevent foot ulcers.
- If you get a new foot ulcer, seek **quick referral** from a healthcare professional, to a local specialist diabetes foot care service.

The following resources will provide you with further information to help with managing your feet:

- Taking care of your feet: <https://www.diabetes.org.uk/Guide-to-diabetes/Complications/Feet/Taking-care-of-your-feet/>
- Tips for everyday foot care: <https://www.diabetes.org.uk/Guide-to-diabetes/Complications/Feet/Taking-care-of-your-feet#Annual>
- Diabetes and foot problems: <https://www.diabetes.org.uk/Guide-to-diabetes/Complications/Feet/>
- The 'Putting Feet First' campaign: https://www.diabetes.org.uk/get_involved/campaigning/putting-feet-first



Recommendations:

For healthcare professionals and commissioners

For healthcare professionals

Including podiatrists, diabetes specialist nurses, diabetes consultants and any healthcare professional that works with people with diabetes.

- Use the audit findings to encourage commissioners and service managers to ensure a **NICE-recommended diabetes foot care service** is in place¹.
- Create simple and rapid **referral pathways**.
- **Participate** in the NDFA to collaborate in this nationwide drive to improve the outcomes for diabetic foot disease.

For commissioners

- Work with providers to ensure that in every locality the **NICE-recommended diabetic foot care structures** are implemented¹ and that the delivery of care is effectively integrated between all those involved.
- Ensure that your local diabetes specialist foot care services **participate** in the NDFA so that measurement of care processes and outcomes can support continuous quality improvement in all services.



National Diabetes Foot Care Audit Fourth Annual Report

1. Participation and case ascertainment

Results and Findings



1. Participation and Case Ascertainment:

Overview

Audit questions:

- **Participation:** How many providers participate in the NDFA?
- **Case ascertainment:** What proportion of people with diabetic foot ulcers are recorded in the NDFA?

How is NDFA case ascertainment assessed?

The **numerator** is the number of people with foot ulcers submitted to the audit.

The exact number of people with foot ulcers in England and Wales is not known. Therefore the **denominator** is estimated from various sources:

- a) Annual caseload estimates provided by NDFA submitters, collected for the first time in 2018.
- b) Estimates derived from Abbott et al (2002) and Kerr (2017), which indicate that more than 64,000 people with diabetes in England and Wales have a foot ulcer at any given time.
- c) Comparison of the number of amputations reported in NDFA (patients with new foot ulcers) and NDA (all patients with diabetes).

Key findings

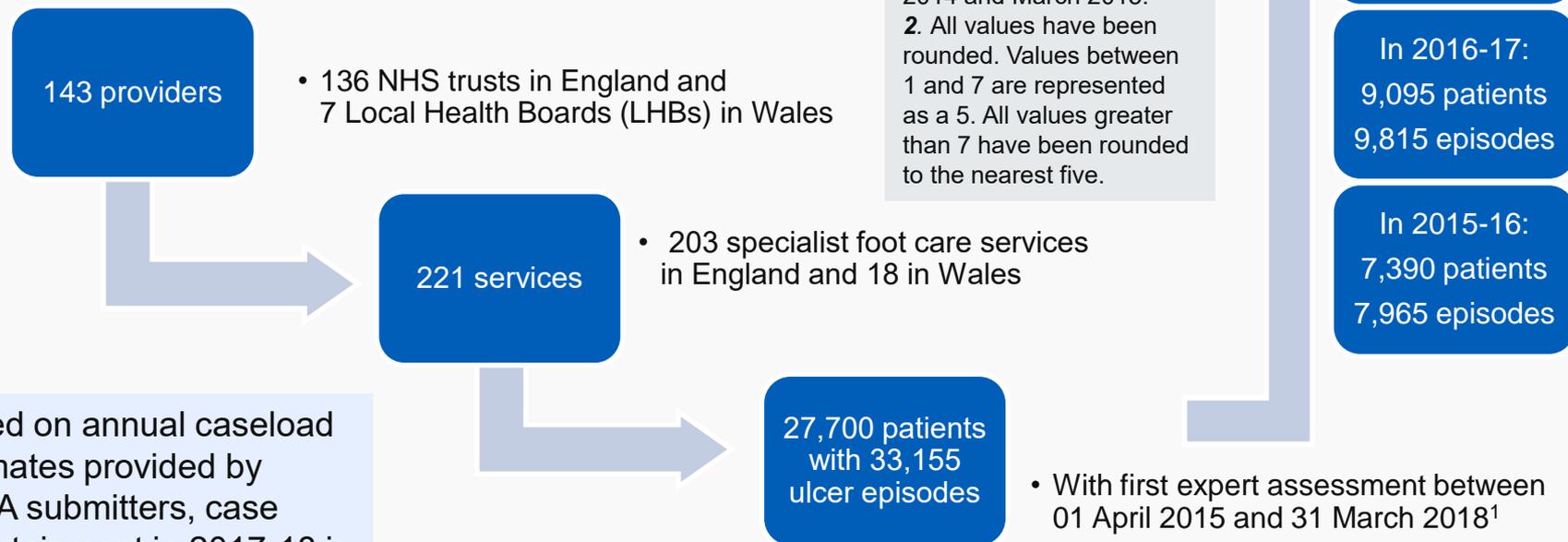
- 221 specialist foot care services have submitted 33,155 ulcer episodes to NDFA since April 2015.
- Annual submissions have almost doubled in the last three years (from 7,965 to 15,370), with case ascertainment rising from approximately 10 to 20 per cent.



1. Participation and Case Ascertainment: Foot care providers



Figure 1.1: Participation in the NDFA process and outcomes collection, England and Wales, 2015-18



Based on annual caseload estimates provided by NDFA submitters, case ascertainment in 2017-18 is approximately **20 per cent**.



1. Participation and Case Ascertainment: Commentary

The NDFA team would like to thank all the teams who have worked hard to contribute to this unique and valuable insight into the care and outcomes of people with diabetic foot ulcers.

It is reassuring that case ascertainment is continuing to rise, almost doubling from 2015-16 to 2017-18. Teams should continue to work to make sure this improvement continues, ensuring comprehensive coverage in future years.

NDFA team

Recommendations

Healthcare professionals: Participate in the NDFA to collaborate in this nationwide drive to improve the outcomes for diabetic foot disease.

Commissioners: Ensure that your local diabetes specialist foot care services participate in the NDFA so that measurement of care processes and outcomes can support continuous quality improvement in all services.



National Diabetes Foot Care Audit Fourth Annual Report

2a. Results: Care structures

Results and findings



2a. Results: Care structures

Commissioner and provider surveys



The audit conducts surveys of structures of care relevant to people with diabetic foot disease.

In 2015-17, we asked...



Clinical Commissioning Groups
and Local Health Boards

about **3** care structures they commissioned.

- Routine foot examination training
- Foot Protection Service (FPS)
- Urgent referral pathway⁶

This year, we asked...



NHS Trusts, Local Health Boards and
Independent Healthcare Providers

about **6** care structures they provided.

- Routine foot examination training
- Foot Protection Service (FPS)
- Urgent referral pathway⁶
- Step-down protocol between MDFT and FPS
- Urgent vascular assessment
- Vascular service discussion time



2a. Results: Care structures



Overview

Audit questions: Providers were asked to complete a survey of the following care structures in place for the management of diabetic foot disease:

1. Training for routine diabetic foot examinations³.
2. An established Foot Protection Service (FPS) pathway⁴.
3. An established pathway for new referrals - if needed - for an assessment within 24 hours⁵.
4. Step-down or shared care between the Multi-Disciplinary Foot Team and the FPS.
5. Urgent vascular assessment within 24 hours.
6. Time dedicated to discuss patients with vascular services.

Participation

- 108 of 143 NDFA providers (76 per cent) participated in the 2018 NDFA Provider Survey. A further 2 providers responded, making 110 participants in total.
- Of the 108 NDFA provider participants, 90 represented all services in their area, with the remainder representing only some local services.

Key findings

- Less than a third (31 per cent) of participating providers reported that all six care structures were in place.
- 9 in 10 providers had a Foot Protection Service pathway in place.
- Almost half of providers did not report having a pathway in place for the assessment of urgent referrals within 24 hours (46 per cent).



2a. Results: Care structures



Why are care structures important?

Optimised structures and pathways of care are necessary to achieve the best outcomes for people with diabetic foot ulcers. Without this care infrastructure it is not possible to treat diabetic foot disease efficiently and effectively.

2018 NDFA ‘Success Factors’ Survey

The ten services in the Third Annual NDFA report (2018) with the highest proportion of severe (SINBAD 3+) ulcer patients that were alive and ulcer free at 12 weeks were asked to identify factors they thought contributed to their relative success. All 10 services responded. The factors suggested by a high proportion of these services are shown on the right:

All 10 services reported:

- Direct access to a Multi-disciplinary Foot Care Team (MDFT).
- Good community podiatry/MDFT integration.

At least 80% of services reported:

- Fuss free referrals accepted from any healthcare professional or patient.
- Option for next working day appointments.
- Prompt access to a vascular service.



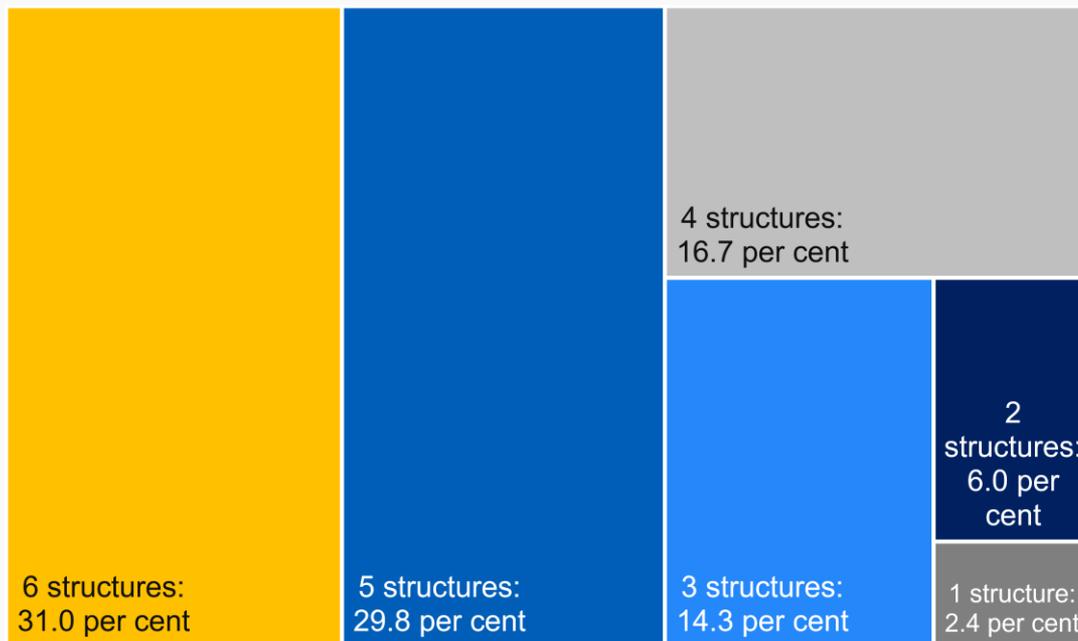
2a. Results: Care structures



2018 NDFA Provider Survey responses

Figure 2.1: Per cent of providers with care structures in place: number of structures

Providers, England and Wales, 2018



Key findings

Less than a third (31 per cent) of participating providers reported that all six care structures were in place.

Notes: Participating responders (those that completed the 2018 NDFA Provider Survey and entered ulcer episodes in 2015-18) are included in this analysis if they responded “yes” or “no” to each of the six survey questions about their care structures (76 per cent of all the organisations that responded to the 2018 NDFA Provider Survey).

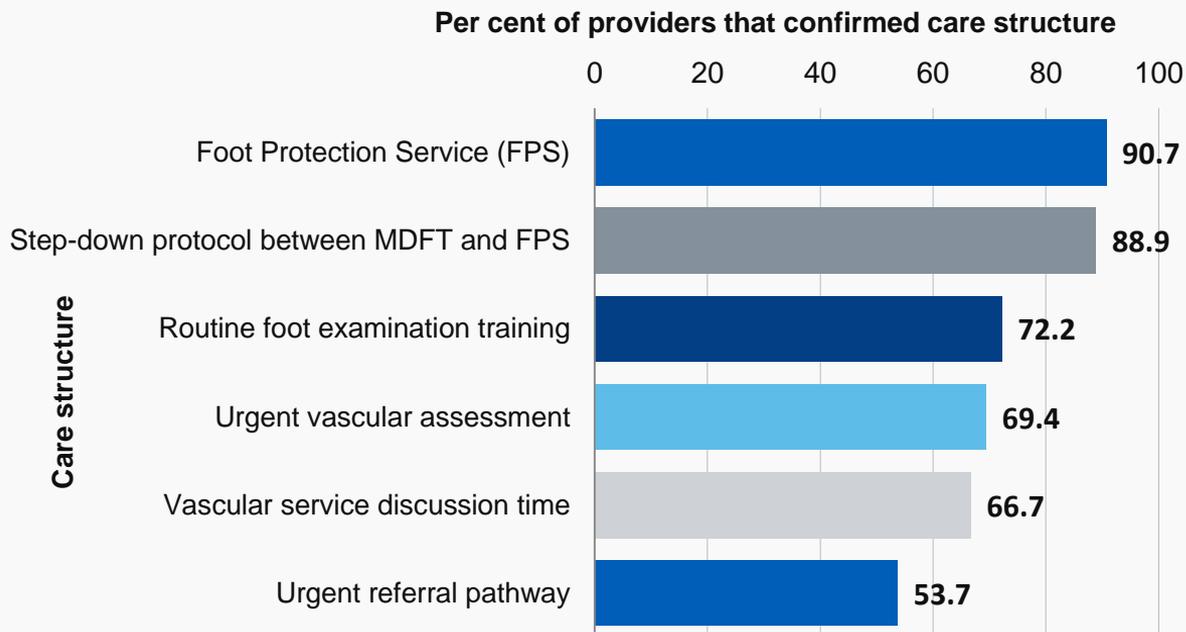


2a. Results: Care structures

Care structures missing



Figure 2.2: Per cent of providers with care structures in place,
Providers, England and Wales, 2018



9 in 10
providers had a
**Foot Protection
Service** in place



Almost **half**
of providers
had **no**
urgent referral
pathway



2a. Results: Care structures

Commentary



Optimised structures and pathways of care are necessary to achieve the best outcomes for people with diabetic foot ulcers. Without this care infrastructure it is not possible to treat diabetic foot disease efficiently and effectively.

The findings of the 2018 NDFA 'Success Factors' Survey (see [Slide 19](#)) confirm the importance of efficient care structures in achieving successful outcomes for people with diabetic foot ulcers.

However, only one third of participating providers confirmed that all six care structures are in place, with only half of providers having an urgent referral pathway.

NDFA team

Recommendations

All those responsible for **commissioning** footcare services in England and Wales should:

1. Work with providers to ensure that in every locality these diabetic foot care structures are implemented and that the delivery of care is effectively integrated between all those involved.
2. Have a Foot Protection Service (FPS) which has primary responsibility for the care of people at high risk of new ulceration. The FPS will work in close liaison with specialist services for the care of established ulcers with particular accent on 'step-up' and 'step-down' care.
3. Provide education for non-specialist healthcare professionals, who play a key role in the delivery of diabetes care.



National Diabetes Foot Care Audit Fourth Annual Report

2b. Results: Outcomes

Results and findings



2b. Results: Outcomes



Overview

Audit questions: What are the outcomes for people with diabetic foot ulcers?

- How many are alive and ulcer free after twelve weeks of their first assessment?
- How many patients have a major amputation (above the ankle) within six months?
- How long do patients stay in hospital with conditions related to diabetic foot disease?
- How likely is it that a patient with a diabetic foot ulcer will have died within one year?

How does ulcer severity affect outcomes?

New analysis: For the first time, mortality data have been traced from the Office for National statistics for all NDFA patients seen from 1 April 2017 onwards, allowing survival curves to be produced.

Key findings

Alive and Ulcer Free

One third of patients with severe ulcers (SINBAD 3+) were alive and ulcer free at 12 weeks (35 per cent).

Major amputation (above the ankle)

In the 6 months after first expert assessment 3 per cent of patients with severe ulcers had a major amputation.

Foot disease admission

One in three patients with severe ulcers had a foot disease-related admission within 6 months of their first expert assessment. The median length of stay for each admission varied between 7 and 12 days in networks.

Mortality

1 in 10 patients died within 1 year of first expert assessment. Death rates for people with severe ulcers were almost twice those of people with less severe ulcers (SINBAD 0-2).



2b. Results: Outcomes



Alive and ulcer free

Table 2.1: Alive and ulcer-free² at 12 weeks, by ulcer severity,
England and Wales, 2015-18 (rounded¹)

12 week outcome	All ulcers (33,155 episodes)		Less severe ulcer SINBAD 0-2 (18,365 episodes)			Severe ulcer SINBAD 3+ (14,790 episodes)		
	Number	Per cent ⁸	Number	Per cent ⁸		Number	Per cent ⁸	
Alive and ulcer-free ²	14,520	48.7	9,850	59.9	*	4,675	34.9	*
Persistent ulceration	14,400	48.3	6,215	37.8	*	8,185	61.1	*
Deceased ¹⁶	915	3.1	375	2.3	*	540	4.0	*
Lost to follow up ⁷	2,010	-	1,215	-	z	795	-	z
Unknown ⁷	1,305	-	705	-	z	600	-	z

* = statistically significant at the 0.05 level (Less severe vs Severe).

n = not statistically significant (Less severe vs Severe). z = not applicable. Not used in cohort.



Less than **half** of all ulcers were healed at **12 weeks**



Only **one third** of **severe** ulcers were healed at **12 weeks** (35 per cent)

Notes: 1, 2, 7, 8, 16. Please refer to list of footnotes in the [Footnote](#) section. Please see [Glossary](#) for explanation of terms.



2b. Results: Outcomes



Major amputations

Table 2.2: Major amputations within 6 months of first expert assessment, England and Wales, 2015-18⁹ (rounded¹)

Patient having...	All ulcers (24,200 patients)		Less severe ulcer SINBAD 0-2 (13,210 patients)			Severe ulcer SINBAD 3+ (10,995 patients)		
	Number	Per cent	Number	Per cent		Number	Per cent	
One or more major amputation (above the ankle)	385	1.6	90	0.7	*	295	2.7	*

Notes: 1, 9. Please refer to list of footnotes in the [Footnote](#) section. Please see [Glossary](#) for explanation of terms.

* = statistically significant at the 0.05 level (Less severe vs Severe). n = not statistically significant



Severe ulcers are **four times** as likely to lead to **major amputation** (above the ankle) than **less severe** ulcers.



2b. Results: Outcomes



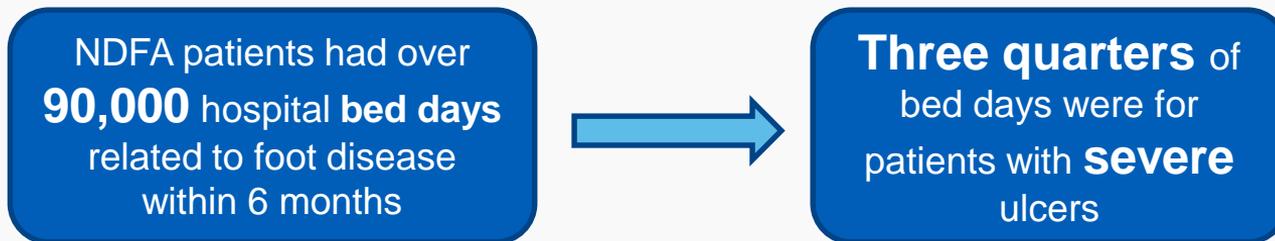
Foot disease-related admissions

Table 2.3: Foot disease-related admissions¹⁰ within 6 months of first expert assessment: length of stay¹², by ulcer severity, by network England and Wales, 2015-18⁹

Ulcer severity	Number of patients	Number of hospital admissions	Number of bed days ¹¹	Length of stay ¹²	
				Median	Mean
Less severe (SINBAD 0-2)	1,540	2,205	22,255	8.0	13.7
Severe (SINBAD 3+)	3,690	6,230	71,370	10.0	16.3
All ulcers	5,230	8,435	93,625	9.0	15.6

Context

NDFA case ascertainment of 10-20 per cent means that the total number of bed days across the NHS could be 5 to 10 times that reported in the audit.



2b. Results: Outcomes



Mortality

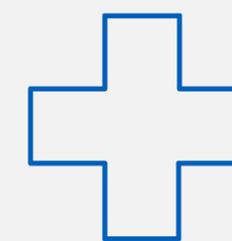
Table 2.4: Deaths after first expert assessment¹⁷, by ulcer severity, England and Wales, 2017-18¹³ (rounded¹)

Mortality ¹⁷ within ...	Number of ulcers	Number of patients	Traced ¹⁵ patients		Deceased patients	
			Number	Per cent	Number	Per cent
12 weeks	15,370	14,120	14,070	99.6	505	3.6
24 weeks	14,615	13,475	13,430	99.7	875	6.5
1 year	5,355	5,165	5,150	99.7	525	10.2

Mortality ¹⁷ within ...	Traced patients ^{14,15} Less severe SINBAD 0-2	Deceased patients		Traced patients ^{14,15} Severe SINBAD 3+	Deceased patients	
		Number	Per cent		Number	Per cent
12 weeks	8,015	210	2.6	6,475	300	4.6
24 weeks	7,635	360	4.7	6,165	525	8.5
1 year	2,860	205	7.2	2,345	325	13.9



1 in 10 patients **die** within **1 year** of expert assessment



Patients with **severe** ulcers were almost **twice** as likely to **die** within 1 year



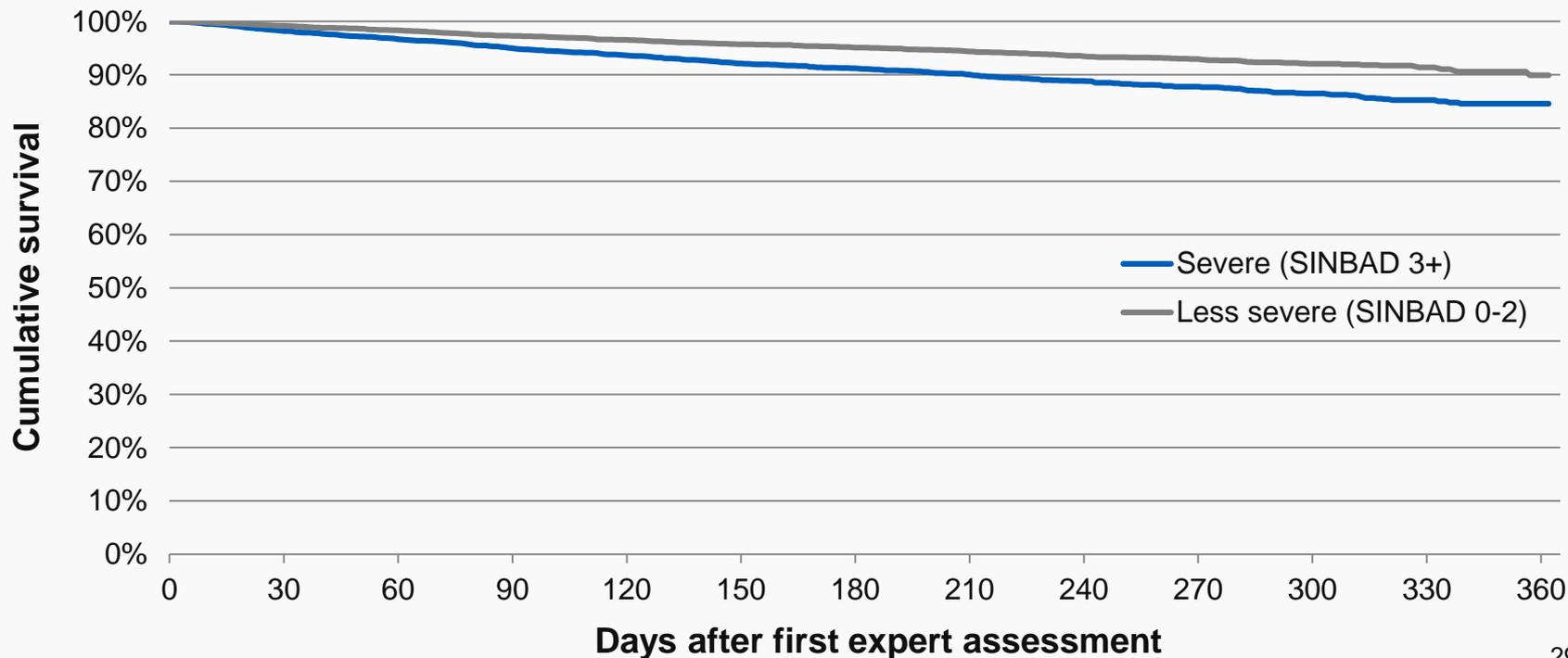
Notes: 1, 13, 14, 15, 17. Please refer to list of footnotes in the [Footnote](#) section. Please see [Glossary](#) for explanation of terms.

2b. Results: Outcomes



Survival curve by ulcer severity

Figure 2.3: Survival curve from date of first expert assessment, by ulcer severity, England and Wales, 2017-18^{13, 17}

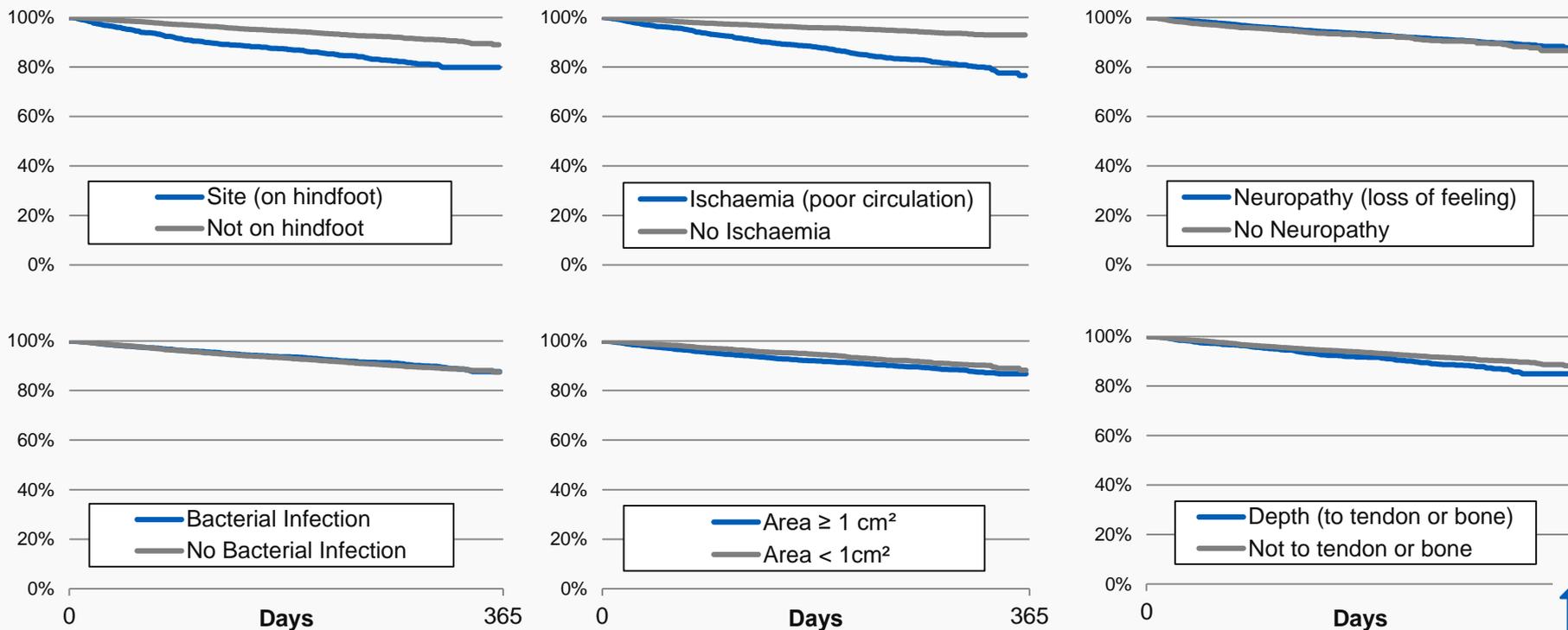


2b. Results: Outcomes



Survival curve by SINBAD element

Figure 2.4: Survival curve from date of first expert assessment, by SINBAD element, England and Wales, 2017-18^{13, 17} Notes: 13, 17. Please refer to list of footnotes in the [Footnote](#) section. Please see [Glossary](#) for explanation of terms.



2b. Results: Outcomes



Commentary

The audit has consistently found that ulcer severity is strongly associated with worse patient outcomes, including:

- Lower healing rates.
- More/longer hospital admissions.
- Higher major amputation rates (above the ankle).
- Higher mortality rates.

The NDFA survival curves show that 1 in 7 people with severe ulcers die within one year of assessment, rising to almost 1 in 4 for those with ischaemia.

NDFA team

Recommendations

To minimise the severity of diabetic foot ulcers at first expert assessment:

Patients with poor circulation (peripheral artery disease or **ischaemia**) or loss of feeling (**neuropathy**) should seek advice from their GP or usual diabetes carer about how to prevent foot ulcers.

Patients with **new foot ulcers** should seek **quick referral** from a healthcare professional to a local specialist diabetes foot care service.

Providers should ensure that people with diabetic foot ulcers are referred promptly for early specialist assessment, in line with NICE guidance.

Commissioners should ensure that NICE-recommended structures of care are in place.³¹



National Diabetes Foot Care Audit Fourth Annual Report

3a. Associations: Care structures

Results and findings



3a. Associations: Care structures



Overview

Audit questions: Are different care structures associated with care processes (time for patients to reach specialist assessment) and outcomes (being alive and ulcer free)?

How is this measured? Aspects of each assessment (including outcomes) were linked to the care – structures reported by their foot care service provider.

Why is this important? Although causation cannot be proven, consistent associations between care structures and outcomes may help inform organisations about how to manage their diabetic foot-care services more effectively.

Key findings

Associations were found between care structures and:

- Faster assessment
- Improved rates of healing

Associations	With care structure			
	Routine foot examination training	Foot Protection Service (FPS)	Urgent referral pathway	Step-down protocol between MDFT and FPS
Shorter waits (<2 weeks)	▲	▲	▲	▲
Longer waits (>2 months)	▲	▲	▼	▲
Being alive and ulcer free at 12 weeks:				
... less severe ulcers (SINBAD 0-2)	■	▲	▲	▲
... severe ulcers (SINBAD 3+)	■	■	▲	▲

Better outcomes where care structure is present ▲

Poorer outcomes where care structure is present ▼

Outcome unchanged where care structure is present ■



3a. Associations: Care structures vs time to first expert assessment



Table 3.1: Time to first expert assessment, by provision of care structures

England and Wales, 2015-18 (rounded¹)

Process: Time to assessment	Per cent of ulcers at providers with the following care structures...											
	Routine foot examination training ³			Foot Protection Service (FPS) ⁴			Urgent referral pathway ^{5, 6}			Step-down protocol between MDFT / FPS		
	% Yes	% No		% Yes	% No		% Yes	% No		% Yes	% No	
Self-referred	30.9	14.6	*	29.4	15.6	*	26.6	26.0	n	29.4	12.7	*
< 2 weeks ⁷	66.6	61.0	*	64.5	52.9	*	64.4	59.3	*	64.6	50.0	*
> 2 months ⁷	9.0	11.1	*	10.5	14.8	*	12.3	9.5	*	10.4	15.9	*

* = statistically significant at the 0.05 level (Yes vs No). n = not statistically significant



- Being seen in less than 2 weeks is associated with all four care structures
- Self-referral is associated with all care structures except urgent referral pathway



- Being seen after more than 2 months is associated with providers having an urgent referral pathway.



3a. Associations: Care structures vs alive and ulcer free



Table 3.2: Alive and ulcer free² at 12 weeks, by provision of care structures
 England and Wales, 2015-18 (rounded¹)

Outcome: Alive and ulcer free at 12 weeks	Per cent of ulcers at providers with the following care structures...											
	Routine foot examination training ³			Foot Protection Service (FPS) ⁴			Urgent referral pathway ^{5, 6}			Step-down protocol between MDFT / FPS		
	% Yes	% No		% Yes	% No		% Yes	% No		% Yes	% No	
... less severe ulcers (SINBAD 0-2)	59.3	57.7	n	59.6	55.8	*	60.8	56.6	*	60.0	52.1	*
... severe ulcers (SINBAD 3+)	34.2	35.1	n	34.9	32.5	n	35.8	33.5	*	35.1	31.0	*

* = statistically significant at the 0.05 level (Yes vs No). n = not statistically significant



Patients with **less severe** or **severe ulcers** are more likely to be alive and ulcer free at 12 weeks, where the provider has:

- Urgent referral pathway
- Step-down care between MDFT and FPS

Patients with **less severe ulcers only** are more likely to be alive and ulcer free at 12 weeks, where the provider has:

- Foot Protection Service



3a. Associations: Care structures

Commentary



Where care structures are not available, referral times are longer and clinical outcomes are worse.

However, the NDFA has already found that many providers are missing one or more of these key care structures (see [Slide 21](#)). There is appreciable concordance between the NDFA 'Success Factors' Survey ([Slide 19](#)) and the care structures audit.

Commissioners and providers should therefore focus on ensuring that every person with diabetes has access to all recommended diabetic foot ulcer care structures.

NDFA team

“People living with diabetes must be able to be confident that, locally, there are foot care services that they can rely on [and] that the best treatment is available at all stages of diabetic foot disease to ensure the best possible outcomes.”

NDFA patient representatives, 2018

Recommendations

All those responsible for commissioning footcare services should ensure that:

- A system of **training** is available for all healthcare professionals undertaking routine foot screening in diabetes.
- A pathway is established so that all people with diabetes who are at increased risk of foot ulceration can – where needed – receive from a **Foot Protection Service (FPS)**:
 - Further assessment
 - Surveillance
 - Protective care

The FPS should work in close liaison with specialist services for the care of established ulcers with particular accent on '**step-up**' and '**step-down**' care.

- A **clear pathway** exists to ensure that people with new diabetic foot ulcers can be referred – according to NICE guidance – within one working day for expert assessment.



National Diabetes Foot Care Audit Fourth Annual Report

3b. Associations: Time to first expert Results and findings assessment



3b. Associations: Time to first expert assessment

Overview

Audit question:

Does the length of time to first expert assessment have an association with ulcer severity at presentation, and with being alive and ulcer free at 12 weeks?

How is this measured? For each ulcer, the interval from initial presentation to a health professional to first assessment by a specialist who assumes care of the foot is recorded.

NICE guidance: People with diabetes who have an active foot problem should be referred to a specialist team within one working day for triage within one further working day⁵.

Why is this important? A relationship between longer times to first expert assessment and severe ulceration (SINBAD 3+) emphasises the importance of ensuring prompt referral for specialist assessment – a linchpin of the NICE guidance⁵.

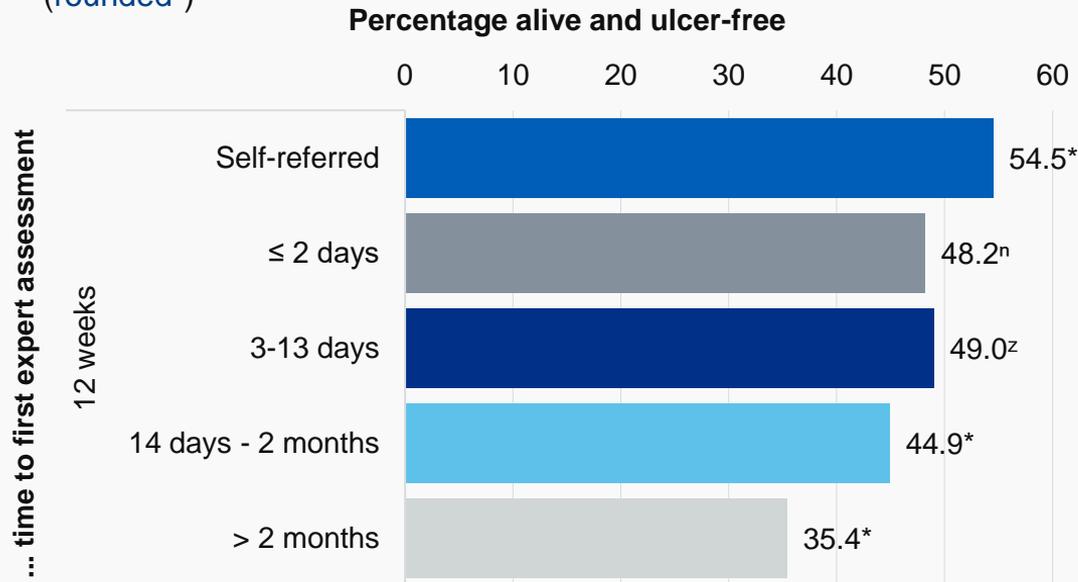
Key findings

- When time to assessment is 14+ days there are worse outcomes at 12 weeks.
- Self-referred ulcers are more likely to be healed at 12 weeks.
- Ulcers seen with time to expert assessment >2 months are most likely to be severe.
- There is little difference between the proportions of severe ulcers in the ≤ 2 month groups.



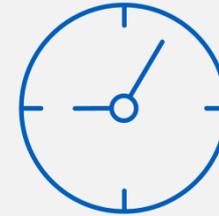
3b. Associations: Time to first expert assessment vs Alive and ulcer free

Figure 3.1: Alive and ulcer-free² at 12 weeks, by time to first expert assessment, England and Wales, 2015-18
(rounded¹)



* = statistically significant at the 0.05 level (vs 3-13 days).

ⁿ = not statistically significant (vs 3-13 days). ^z = not applicable. Used as comparison group.



A time to assessment of **14+ days** results in **worse** outcomes at 12 weeks

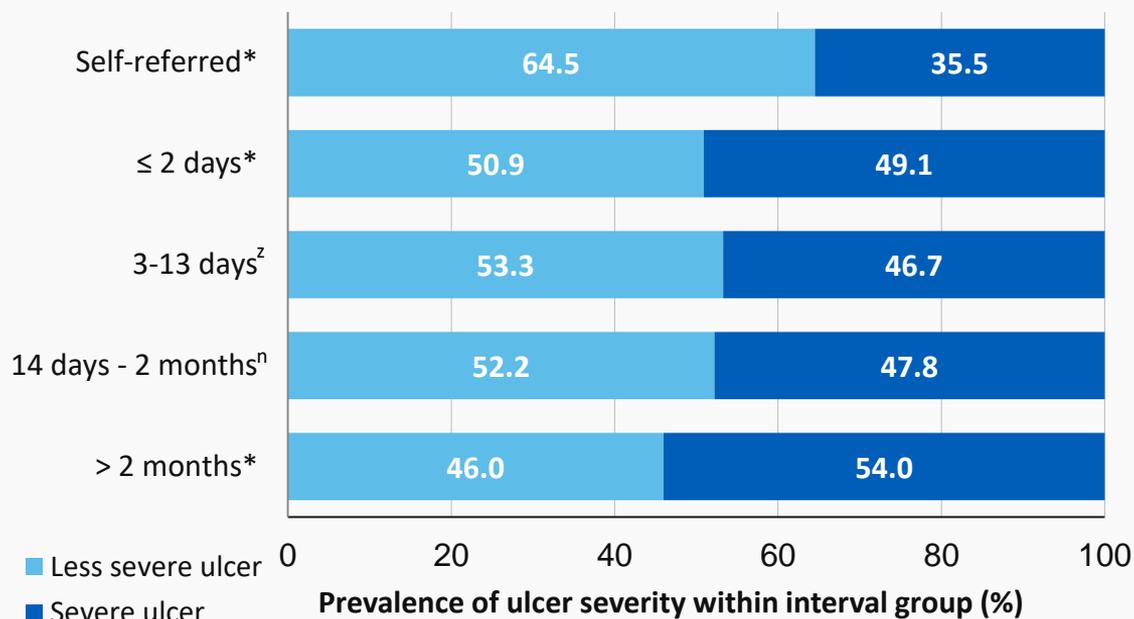
Context: People that **self-refer** have usually had a previous foot ulcer and know the foot care team, or may have been identified as high-risk and attend a foot protection service.

Most people cannot refer themselves directly to a specialist foot care service and **must be referred**.



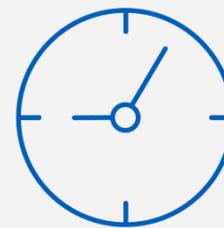
3b. Associations: Time to first expert assessment vs Ulcer severity

Figure 3.2: Time to first expert assessment, by ulcer severity, England and Wales, 2015-18 (rounded¹)



* = statistically significant at the 0.05 level (vs 3-13 days).

ⁿ = not statistically significant (vs 3-13 days). ^z = not applicable. Used as comparison group.



Ulcers seen with time to expert assessment **>2 months** are most likely to be **severe** (SINBAD 3+)

54 per cent vs. 35 to 49 per cent



There is **little difference** in the proportion of **severe** ulcers in the **≤ 2 month** groups

Between 46.7 and 49.1 per cent, excluding self-referrers



3b. Associations: Time to first expert assessment

Commentary

The evidence derived from over 33,000 new diabetic foot ulcers suggests that early referral is associated with better outcomes at 12 weeks; ulcer severity is higher amongst those that wait the longest.

NDFA team



Recommendation

All people with diabetic foot ulcers should be referred promptly for early specialist assessment, in line with NICE guidance⁵.



National Diabetes Foot Care Audit Fourth Annual Report

3c. Associations: Modelling

Results and findings



3c. Associations: Modelling

Overview

Audit question: What patient and ulcer characteristics are associated with the following outcomes, measured from date of first expert assessment?

- Being **alive and ulcer free**² at 12 weeks.
- Having a **foot disease-related admission** within 6 months.
- Having a **major amputation** of the lower limb (above the ankle) within 6 months.
- **Death** within 6 months^{10,11} (**6 month mortality**).

Why is this important? The above outcomes are key indicators of clinical performance across organisations. By identifying the characteristics associated with these outcomes, risk-adjusted outcomes can be produced which account for differences in the ‘casemix’ of patients seen at each organisation.

Key findings

- Models were strongest for ‘6 month mortality’ and ‘major amputation’ (above the ankle). The model for ‘alive and ulcer free’ was the weakest, meaning that much of the variation is unexplained by the selected variables.
- Ulcer characteristics are much more strongly associated than other factors with ‘alive and ulcer free’ and ‘major amputation’ but demographic factors were more important for ‘6 month mortality’.
- Of the ulcer characteristics, ischaemia (poor circulation) has the strongest associations with patient outcomes.
- Time to first expert assessment is associated with being ‘alive and ulcer free’ and ‘foot disease-related admissions’, but not with ‘major amputation’ or ‘6 month mortality’.



3c. Associations: Modelling

Alive and ulcer free²: Summary



Developed
using data on
27,140 ulcers¹

Which variables were selected? [15 variables](#) had consistent associations with the outcome, including time to first expert assessment and all 8 ulcer characteristics.

How strong is the model? The model strength is just below [reasonable](#).

Which variables had the strongest [associations](#)? Ulcer factors have much stronger associations than other variable types (see below left).

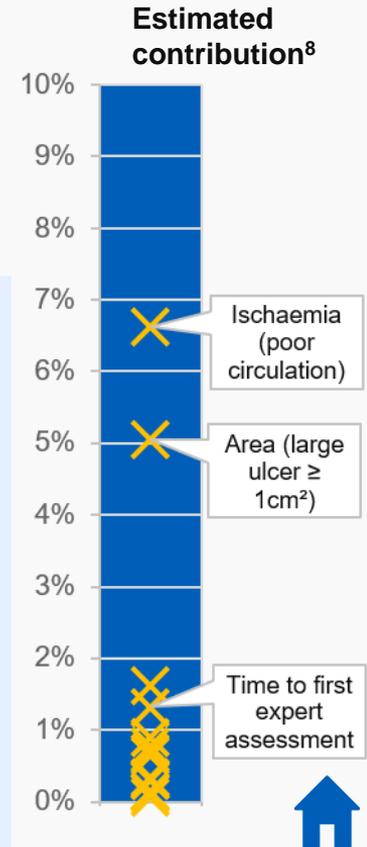
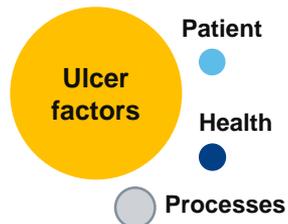
Worse outcomes are most-strongly associated with:

- All six SINBAD elements, particularly **ischaemia** (poor circulation) and having a **large ulcer** (see chart on right), inactive Charcot and multiple ulcers.
- Waiting over 2 months for first expert assessment.
- Admissions for myocardial infarction, renal replacement therapy or heart failure.
- Having diabetes for ≥ 10 years, being current smoker or male.

Better outcomes are most-strongly associated with:

- Single ulcers and being female.

Estimated
contribution^{8,9}



3c. Associations: Modelling

Foot disease admission: Summary



Developed
using data on
26,705 ulcers¹

Which variables were selected? [12 variables](#) had consistent associations with the outcome, 11 of which were also selected for the alive and ulcer free model.

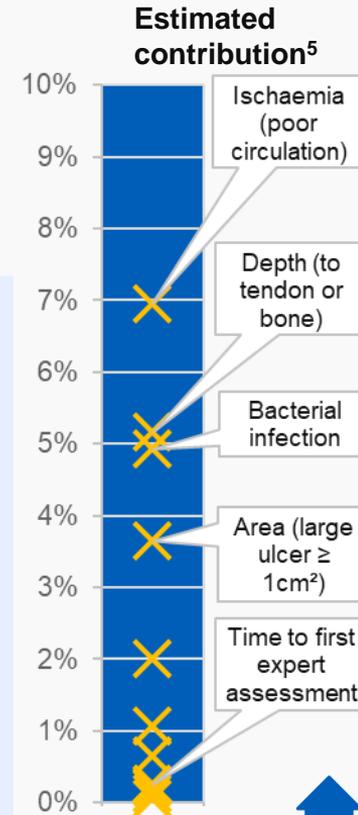
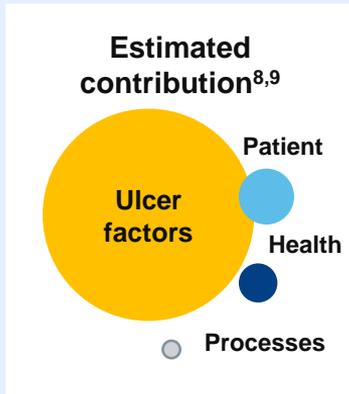
How strong is the model? The model strength is [reasonable](#) (c-statistic = 0.74).

Which variables had the strongest [associations](#)? Ulcer factors have much stronger associations than other variable types (see below left).

An **increased** number of admissions are most-strongly associated with:

- All **SINBAD elements** except hindfoot ulceration, including the four strongest associations (see right).
- Having first **expert assessment** within 2 days.
- Hospital admissions for heart failure or renal replacement therapy.
- Having diabetes for ≥ 20 years.

A **decreased** number of admissions are most-strongly associated with being female and being aged 65 or above.



3c. Associations: Modelling

Major amputation: Summary



Developed using data on 26,705 ulcers¹

Which variables were selected? 9 variables had consistent associations with the outcome, including 6 ulcer characteristics.

How strong is the model? The model strength close to **strong** (c-statistic = 0.79).

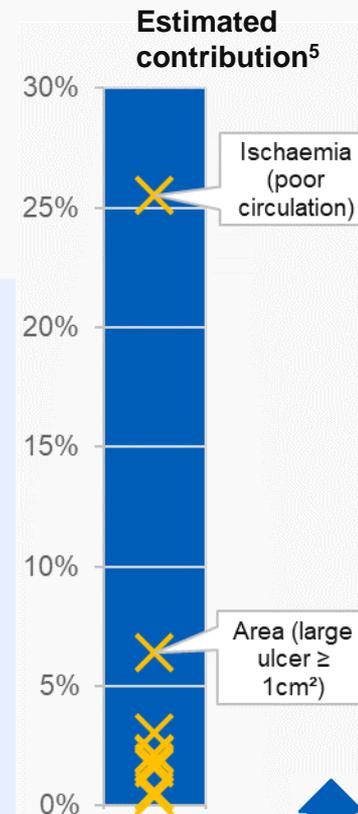
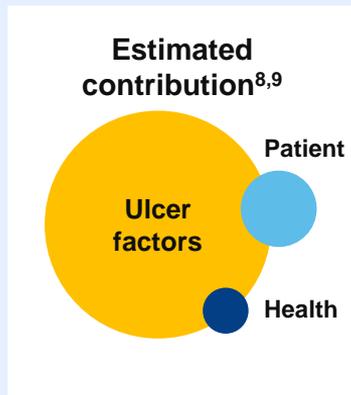
Which variables had the strongest associations? Ulcer factors have much stronger associations than other variable types (see below left).

Higher rates of major amputation (above the ankle) are most strongly associated with:

- **Ischaemia** (poor circulation) has by far the strongest association, followed by having a **large ulcer**.
- Other associated ulcer factors are hindfoot ulceration and Charcot.
- Hospital admissions for renal replacement therapy.
- Being a current smoker.

Lower rates are most-strongly associated with:

- Being aged 80 or above.



3c. Associations: Modelling

6 month mortality: Summary



Developed
using data on
9,355 ulcers¹

Which variables were selected? 9 variables had consistent associations with the outcome, including time to first expert assessment and 4 ulcer characteristics.

How strong is the model? The model strength is strong (c-statistic = 0.81).

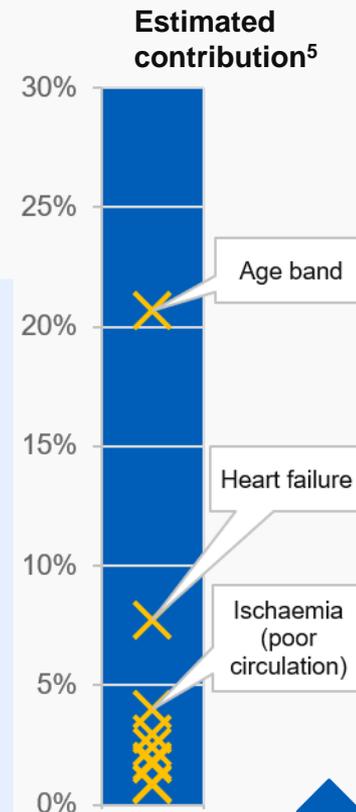
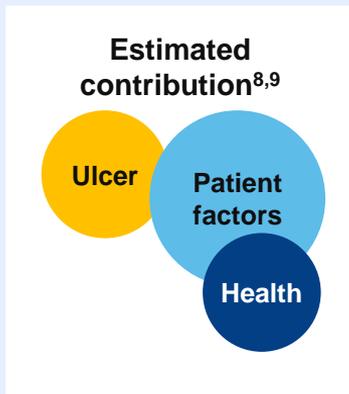
Which variables had the strongest associations? In contrast to the other models where ulcer factors dominate, patient factors have the strongest associations.

Higher mortality rates are most-strongly associated with:

- Being **65 or above**.
- Hospital admissions for **heart failure** or renal replacement therapy.
- Having **ischaemia** (poor circulation), hindfoot ulceration, multiple ulcers or a large ulcer.
- Being an ex-smoker.

Lower mortality rates are most-strongly associated with:

- Being obese or having a single ulcer.



3c. Associations: Modelling

Commentary

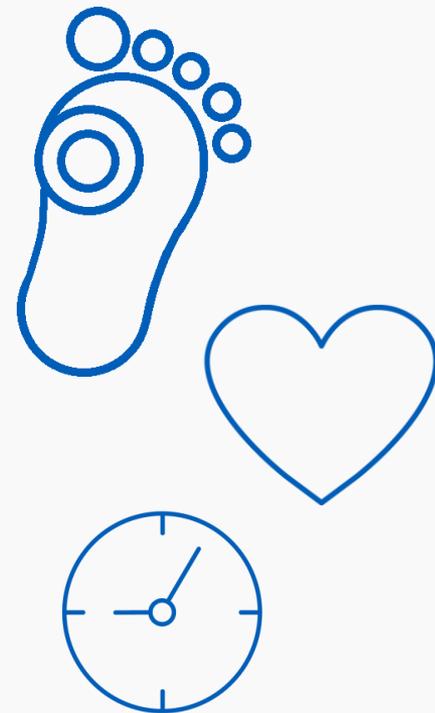


The most consistent theme in this year's modelling work has been the **dominance of ulcer factors** in predicting outcomes, particularly ischaemia (poor circulation). The exception is 6 month mortality, where patient factors such as **age** and other illnesses such as **heart failure** are most important.

The centrality of ulcer factors in predicting most outcomes reinforces the key NDFA message that reducing the proportion of severe ulcers at first expert assessment should lead to better outcomes. Improving life expectancy may require a greater focus on secondary cardiovascular risk management.

Patients that wait two or more weeks for expert assessment are less likely to be alive and ulcer free at 12 weeks. This supports the key NDFA recommendation that care providers should work together to prevent delays in expert assessment, through the creation of simple and rapid referral pathways.

Despite the inclusion of nearly 27,000 ulcer episodes, the underlying weakness of the 'alive and ulcer-free' model shows that a large part of the variation in healing remains unexplained. The NDFA will continue to investigate whether the power of the models can be improved, using additional hospital admission, structural and NDA variables.



National Diabetes Foot Care Audit Fourth Annual Report

4a. Variation: Risk-adjusted variation

Results and findings



4a. Variation: Risk-adjusted variation



Overview

Audit questions Is there variation between care providers, once casemix has been accounted for?

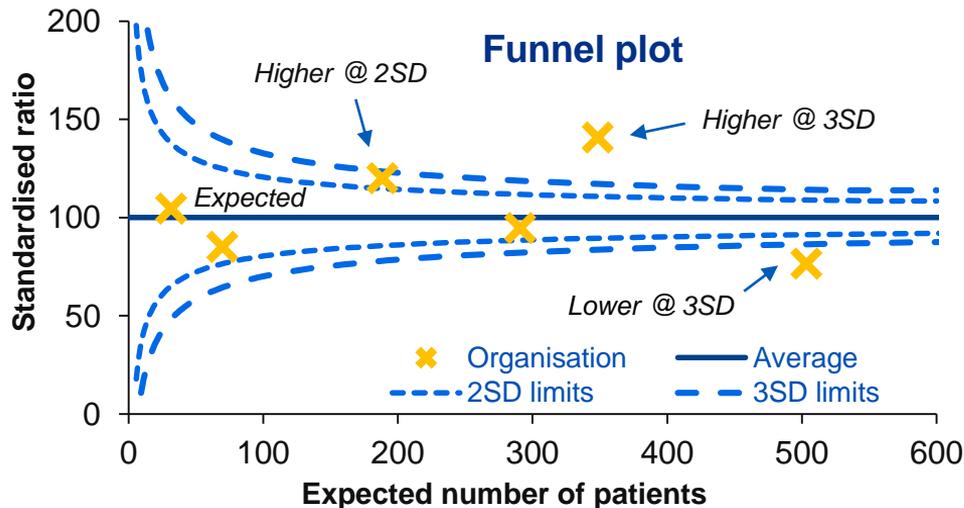
Why is this important? Adjusting for each providers' unique patient casemix allows fairer comparisons between services.

How is this measured? Statistical models for four NDA outcomes were built: 'alive and ulcer free', 'foot disease-related admission', 'major amputation' (above the ankle) and '6 month mortality'. The models were used to estimate the number of patients **expected** to experience the event at each organisation. The expected figures were then compared

with the **observed** number of patients undergoing the event, to produce a standardised ratio (SR).

How are results reported? If more patients had the event than expected the SR is greater than 100 and if there were fewer than expected the SR is less than 100.

Deviation from 100 does not necessarily mean that an organisation is performing better or worse than expected. Instead, **control limits** (2 and 3 standard deviations) are used to assess whether the SR for an organisation is within an expected range or not. Results are displayed on a **funnel plot**.

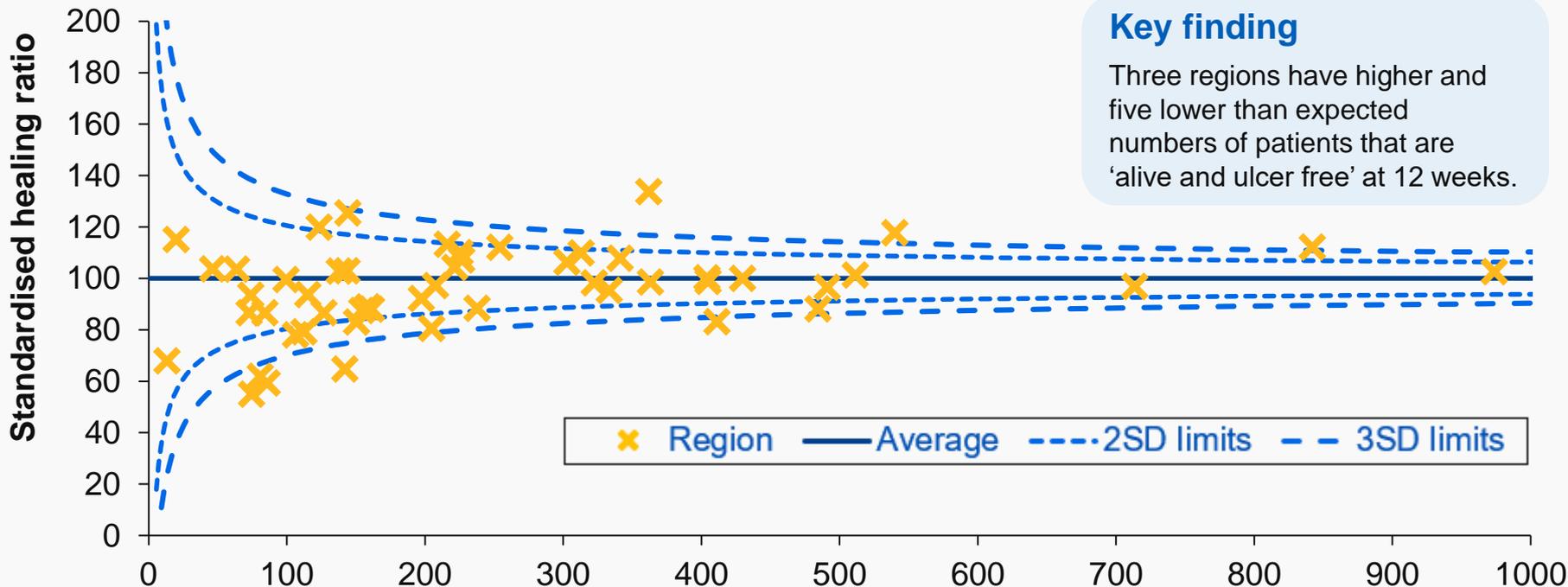


4a. Variation: Risk-adjusted variation

Alive and ulcer free: by region



Figure 4.1: Risk-adjusted outcomes³: alive and ulcer free² at 12 weeks, by region⁴,
England and Wales, 2014-18



Regions = 44 Sustainability and Transformation Partnerships (STPs) in England and 7 Local Health Boards (LHBs) in Wales.

Expected number alive and ulcer free at 12 weeks

Notes: 2, 3, 4. Please refer to list of footnotes in the [Footnote](#) section.

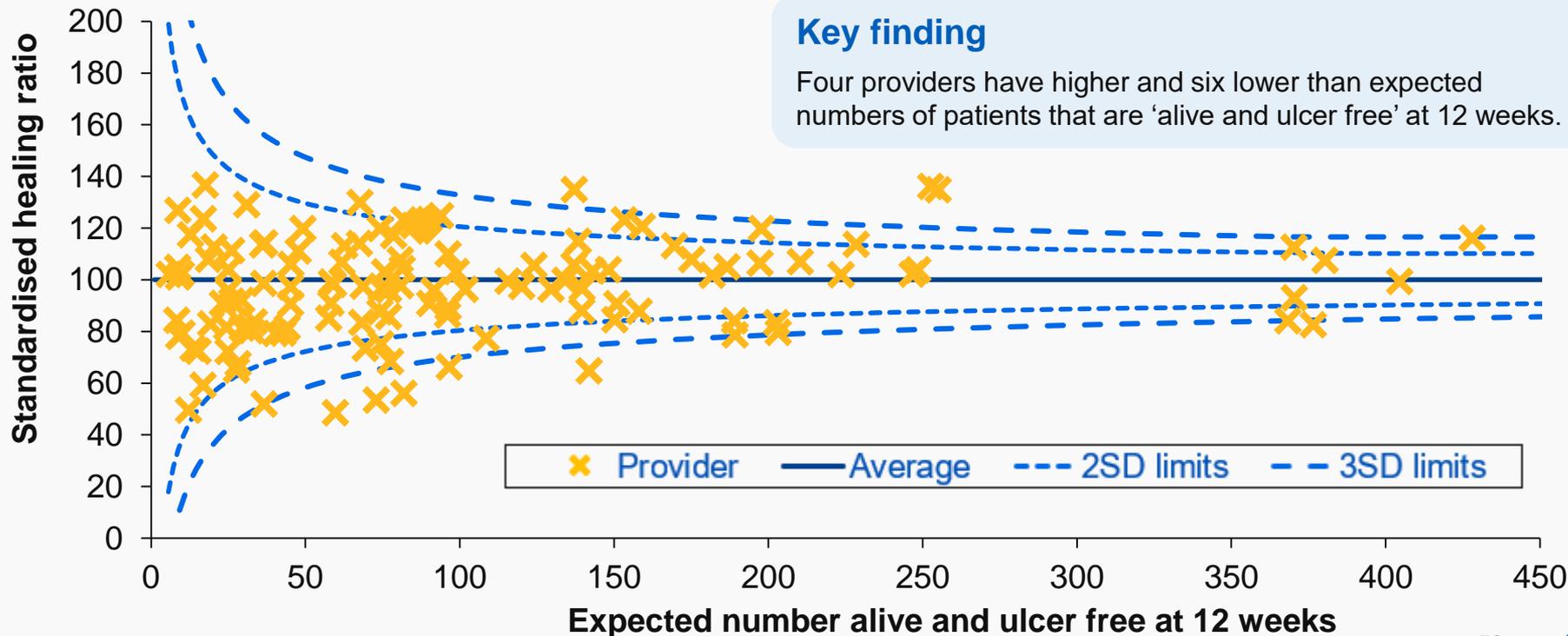


4a. Variation: Risk-adjusted variation

Alive and ulcer free: by provider



Figure 4.2: Risk-adjusted outcomes³: alive and ulcer free² at 12 weeks, by provider⁵, England and Wales, 2014-18

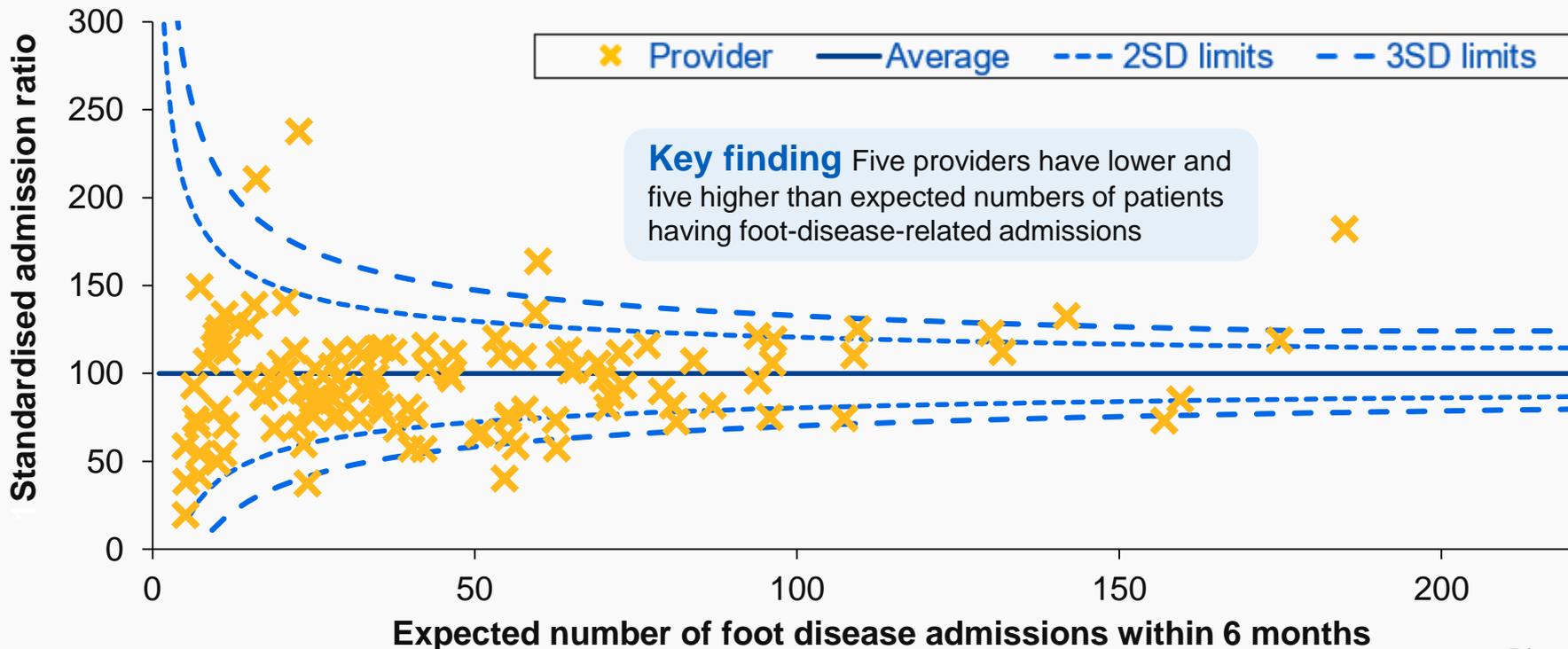


4a. Variation: Risk-adjusted variation

Foot disease-related admissions: by provider



Figure 4.4: Risk-adjusted outcomes³: foot disease-related admissions within 6 months, by provider⁵, England and Wales, 2014-17

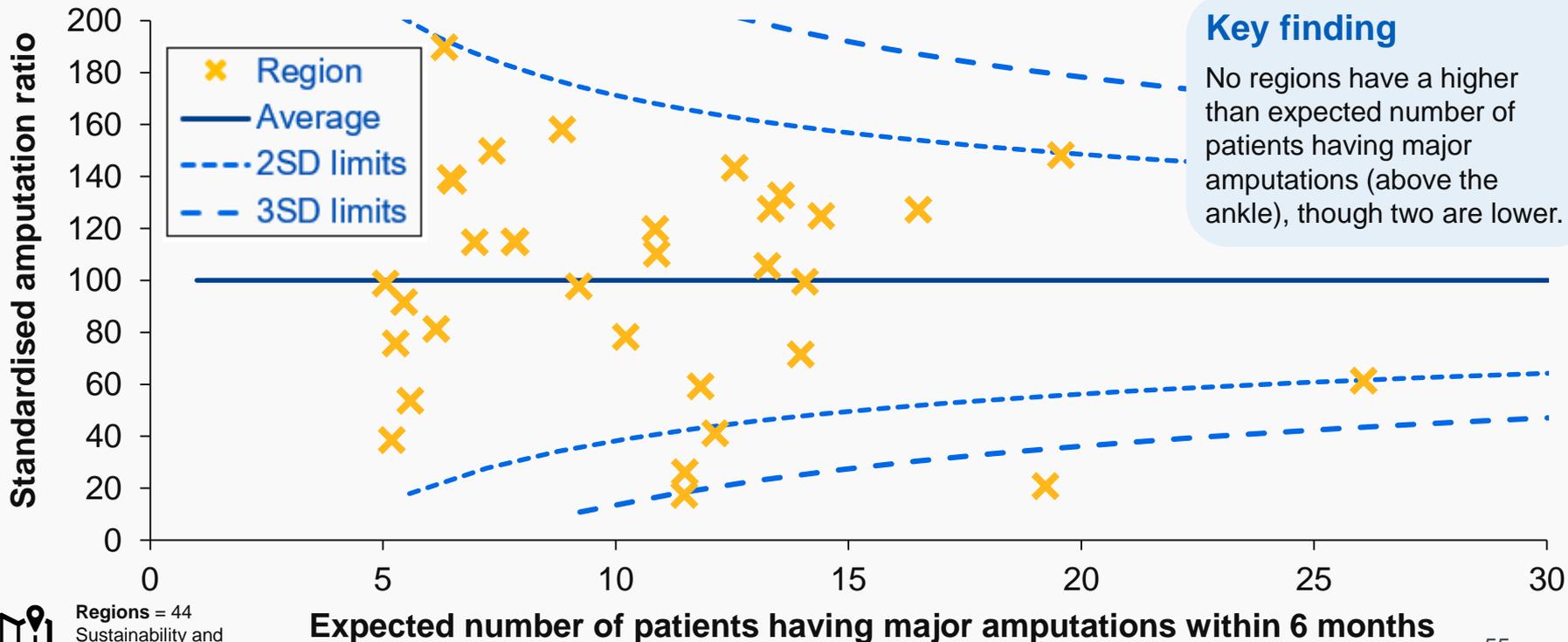


4a. Variation: Risk-adjusted variation

Major amputation: by region



Figure 4.5: Risk-adjusted outcomes³: major amputation within 6 months, by region⁴,
England and Wales, 2014-17



Regions = 44
Sustainability and
Transformation Partnerships (STPs) in England
and 7 Local Health Boards (LHBs) in Wales.

Expected number of patients having major amputations within 6 months

Notes: 3, 4. Please refer to list of footnotes in the [Footnote](#) section.

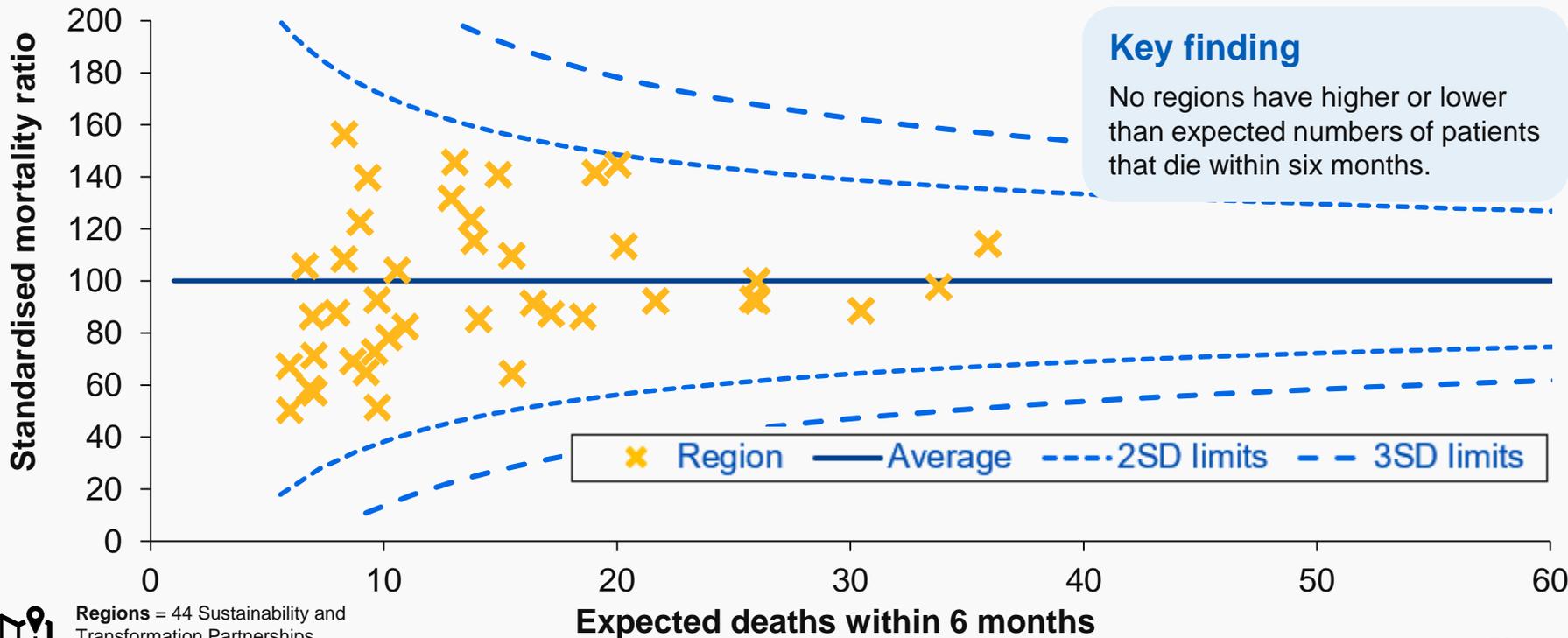


4a. Variation: Risk-adjusted variation

6 month mortality: by region



Figure 4.6: Risk-adjusted outcomes³: 6 month mortality^{9,10}, by region⁴, England and Wales, 2017-18



Regions = 44 Sustainability and Transformation Partnerships (STPs) in England and 7 Local Health Boards (LHBs) in Wales.

Notes: 3, 4, 9, 10. Please refer to list of footnotes in the [Footnote](#) section.



4a. Variation: Risk-adjusted variation

Commentary



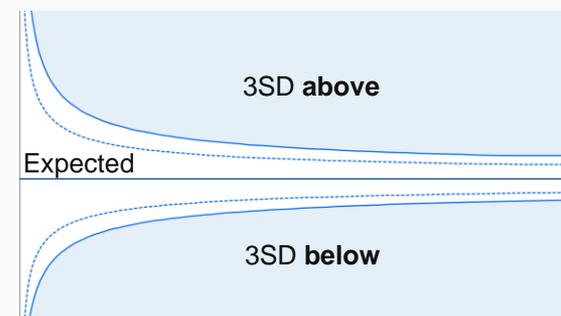
For ulcer healing and foot disease hospital admissions, substantial variation was found even when adjusting for casemix. Whilst the relative strength of these models should be factored-in, providers with worse than expected outcomes at three standard deviations (3SD) should nonetheless consider whether changes to local care structures or processes could improve their outcomes.

It is reassuring that there are no regions with unusually high major amputation (above the ankle) or mortality rates.

NDFA team

Interpreting local results

Risk-adjusted results for providers and STPs are available in the NDFA interactive local reports. Providers should undertake a review of local practice if they are 3SD or more above or below the expected value.



This publication does not define providers as outliers. This is because:

- At 10-20 per cent, NDFA case ascertainment is not high enough to robustly identify outliers.
- Some of the models, particularly 'alive and ulcer free', are not strong enough to robustly identify outliers.
- Risk-adjusted outcomes are new to NDFA and providers need an opportunity to review the initial outcomes and methodology.
- Because this year's work was exploratory in nature, the NDFA modelling cohorts were not split into the test and training cohorts typically used for outlier identification.

The NDFA may identify outliers in future publications.



National Diabetes Foot Care Audit Fourth Annual Report

4b. Variation: Time to first expert assessment

Results and findings



4b. Variation: Time to first expert assessment

Overview

Audit question: Does the time until a patient is first assessed by the specialist foot care service vary across England and Wales?

How is this measured?

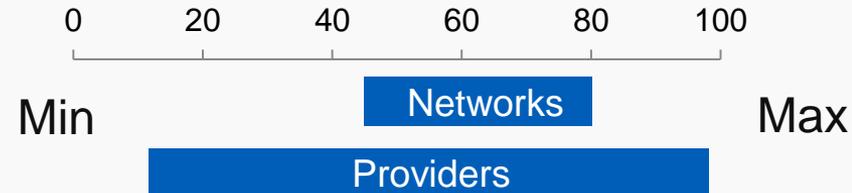
The percentage of ulcers in a provider which have been seen in less than two weeks is calculated for each provider that had at least 50 relevant ulcer cases recorded during the audit period.

Why is this important? The audit has continued to show that shorter times to first assessment are associated with less severe ulcers (SINBAD 0-2) and improved outcomes for patients. Variation in assessment times between providers may be related to differences in outcomes amongst patients from different regions, as suggested by the 'alive and ulcer free²' and 'foot disease-related admission' models (see [Slide 49](#)).

Key findings

Across England and Wales there is substantial variation in the proportions of ulcer episodes where the interval between first healthcare assessment and arrival at the specialist team is less than two weeks:

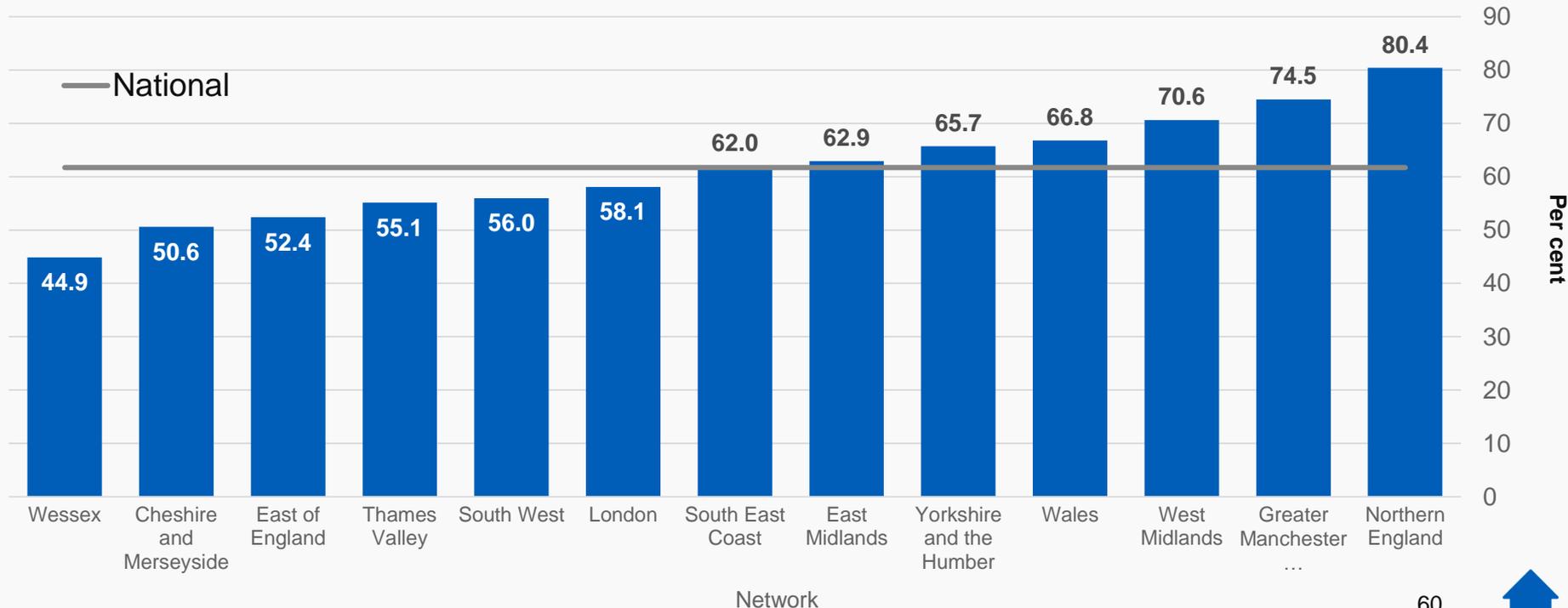
- Amongst networks there is an **35 percentage point** difference.
- Amongst providers there is an **87 percentage point** difference.



4b. Variation: Time to first expert assessment

By network

Figure 4.7: Ulcers having expert assessment within 14 days⁶, by network, England and Wales, 2015-18 (rounded¹)

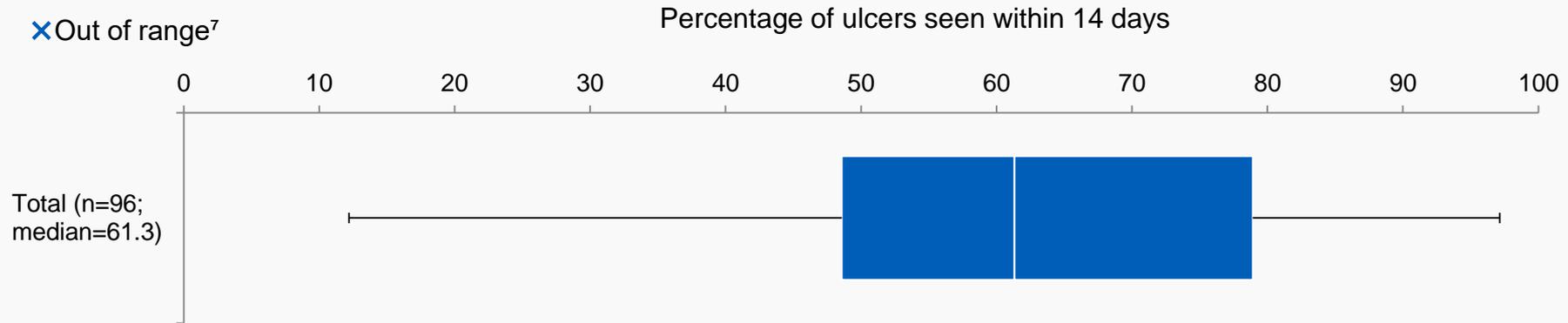


4b. Variation: Time to first expert assessment

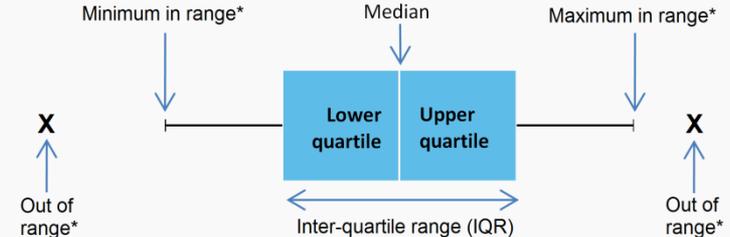
By provider



Figure 4.8: Ulcers having expert assessment within 14 days⁶, by provider⁸,
England and Wales, 2015-18 (rounded¹)



There is an 85 percentage point difference in the proportion of cases where the interval between first healthcare assessment and arrival at the specialist team is less than two weeks



* Range = Between 1.5 x IQR below the lower quartile and 1.5 x IQR above the upper quartile.



4b. Variation: Time to first expert assessment

Commentary

The NDFA has shown that being seen in less than 2 weeks is associated with a marked reduction in ulcer severity (see [Slide 40](#)), which itself is associated with better patient outcomes (see [Slide 24](#)). It is therefore concerning that there is such wide variation between providers, with the proportion seen in less than 2 weeks ranging from 45 to 80 per cent at network level.

Every effort should therefore be made to increase the proportions seen in less than 2 weeks across all organisations, thereby improving equality of access and optimising patient outcomes.

NDFA team

Recommendation

Commissioners should work with services to ensure that referral pathways conforming to NICE guidance for people with diabetic foot ulcers are in place.



National Diabetes Foot Care Audit Fourth Annual Report

Appendix: Modelling

Methodology



Appendix: Modelling

Inclusion criteria

Which patients are included?

NDFA ulcer episodes had to meet the following criteria to be included (**all** models unless stated):

1. Be the patient's first recorded ulcer in NDFA.
2. Be linked to the NDA core dataset.
3. Have both age and sex recorded.
4. Have had first expert assessment within specified parameters:
 - **A&UF**: 14 July 2014 (start of audit) to 31 March 2018 (end of NDFA cohort).
 - **FDA** and **Maj Amp**: 14 July 2014 to 31 December 2017 (to allow full 6 months follow-up using admissions data).
 - **Mortality**: 1 April 2017 (earliest permitted by information governance) to 4 February 2018 (to allow full 6 months post-trace follow-up).
5. Have ulcer status recorded at 12 weeks (**A&UF**).
6. Have mortality data traced by the Office for National Statistics (**Mortality**).

Abbreviations

Alive and ulcer free = **A&UF**

Major amputation = **Maj Amp**

Foot disease-related admission = **FDA**

6 month mortality = **Mortality**

Variable selection A longlist of 27 categorical predictor variables was identified for potential inclusion. To ensure that the final model was as robust as possible, the suitability of each variable was reviewed with respect to the following criteria, with identified data issues classified as of low, medium or high severity:

- **Data quality**: what proportion of the data is missing?
- **Strength**: how strongly is the predictor variable associated with the outcome? Are the associations due to missing data?
- **Stability**: is the predictor variable consistently found to have a significant association with the outcome (e.g. when modelled separately, in groups of similar variables or when the cohort is partitioned).
- **Other**: for example, are there other variables which may have a collinear relationship to the chosen variable (e.g. between 'Age band' and 'Diabetes duration').



Appendix: Modelling

Selection process



Variable type	Variable name	Variable retained? ³			
		Alive and ulcer free ²	Foot disease-related admission	Major amputation	Death
Patient demographics at first expert assessment	Age band	✗	✓	✓	✓
	BMI	✗	✗	✗	✓
	Deprivation quintile	✗	✗	✗	✗
	Diabetes duration	✓	✓	✗	✗
	Diabetes type	✗	✗	✗	✗
	Ethnicity	✗	✗	✗	✗
	Sex	✓	✓	✗	✗
	Smoking status	✓	✗	✓	✓
Patient health in year preceding first expert assessment	HbA1c < 58 mmol/mol	✗	✗	✗	✗
	Blood pressure < 140/80	✗	✗	✗	✗
	Cholesterol < 5mmol/L	✗	✗	✗	✗
	Angina	✗	✗	✗	✗
	Myocardial infarction	✓	✗	✗	✗
	Heart failure	✓	✓	✗	✓
	Stroke	✗	✗	✗	✗
	Renal replacement therapy	✓	✓	✓	✓
	Diabetic ketoacidosis	✗	✗	✗	✗
Care processes prior to first expert assessment	Foot risk surveillance	✗	✗	✗	✗
	Time to first expert assessment	✓	✓	✗	✗
Ulcer characteristics at first expert assessment	Ulcer number (single or multiple)	✓	✓	✗	✓
	Charcot status	✓	✗	✓	✗
	Site (on hindfoot)	✓	✗	✓	✓
	Ischaemia (poor circulation)	✓	✓	✓	✓
	Neuropathy (loss of feeling)	✓	✓	✗	✗
	Bacterial infection	✓	✓	✓	✗
	Area (large ulcer ≥ 1cm ²)	✓	✓	✓	✓
Depth (to tendon or bone)	✓	✓	✓	✗	

Table A.1: Variable selection grid³ for logistic regression models, England and Wales, 2014-18

Key findings

- Half of the chosen variables were ulcer characteristics.
- Time to first expert assessment was retained for 'alive and ulcer free' and 'foot disease-related admissions' only.

Notes: 2, 3. Please refer to list of footnotes in the [Footnote](#) section.



Appendix: Modelling

Model strength

How strong are the models?

The predictive power or **goodness of fit** of a model can be assessed by the c-statistic (See Glossary: [Statistical terms](#)), which ranges from 0.5 (no better than chance) to 1.0 (perfect fit). The c-statistics of the models are shown on Figure A.1 below.

Figure A.1: Predictive strength of logistic regression models⁴, England and Wales, 2014-18



'FD admission' = foot disease-related admission; 'Major amp' = major amputation (above the ankle); 'Mortality' = 6 month mortality.

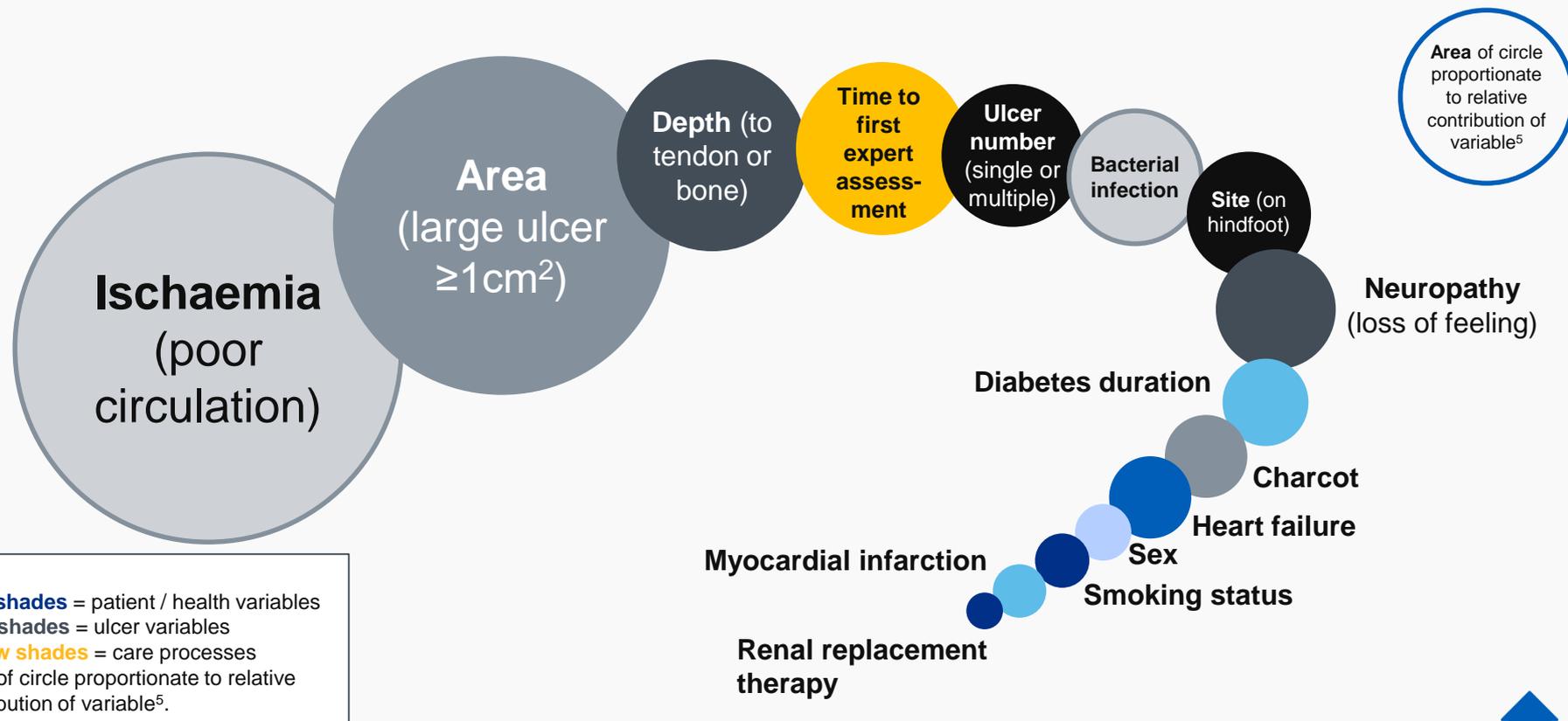
Key findings

- '6 month mortality' and 'major amputation' (above the ankle) were the strongest models.
- 'Alive and ulcer free' was the weakest model, meaning that much of the variation is not explained by the variables included in the model.



Appendix: Modelling

Alive and ulcer free: Variable strength



Notes: 5. Please refer to list of footnotes in the [Footnote](#) section.



Appendix: Modelling

Alive and ulcer free: Category strength

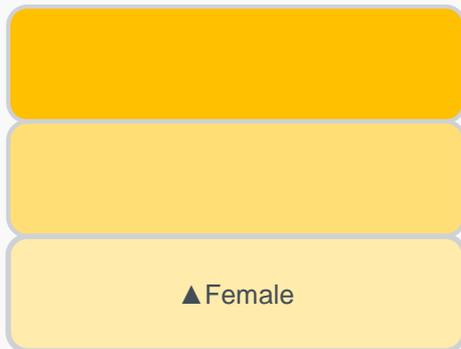


LIMITATIONS

The predictive power of the model is just below **reasonable** (c-statistic = 0.69)



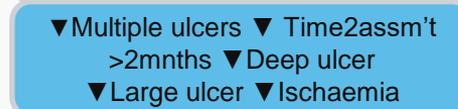
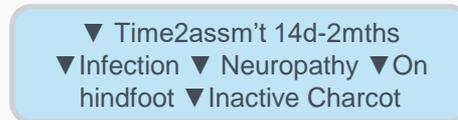
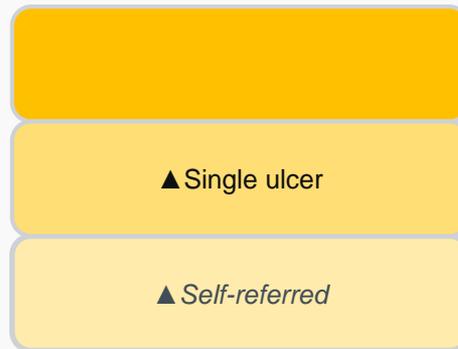
Patient factors



Healed?



Ulcer factors



Notes: *Italics* = confidence interval close to line of no effect (1.0). Underlined = very strong effect. Please see [Glossary](#) for explanation of terms.

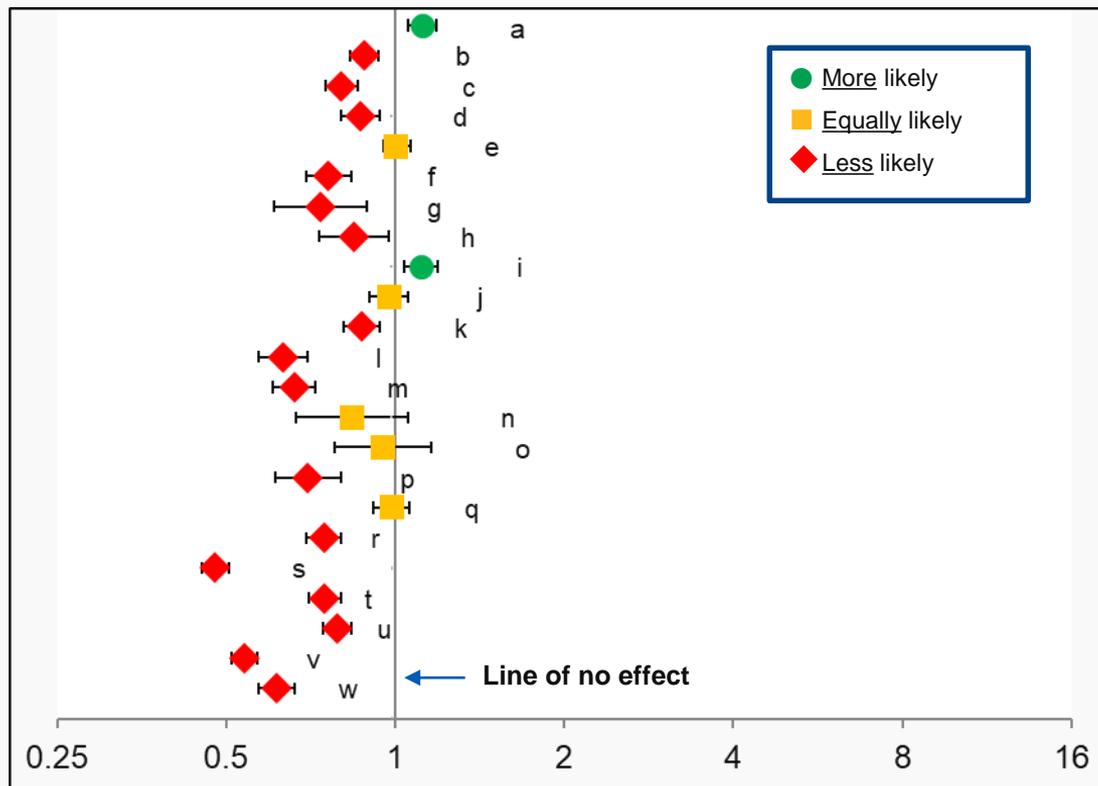


Appendix: Modelling

Alive and ulcer free: Forest plot



Figure A.2: Odds ratios of factors associated with being alive and ulcer free² at 12 weeks, England and Wales, 2014-18



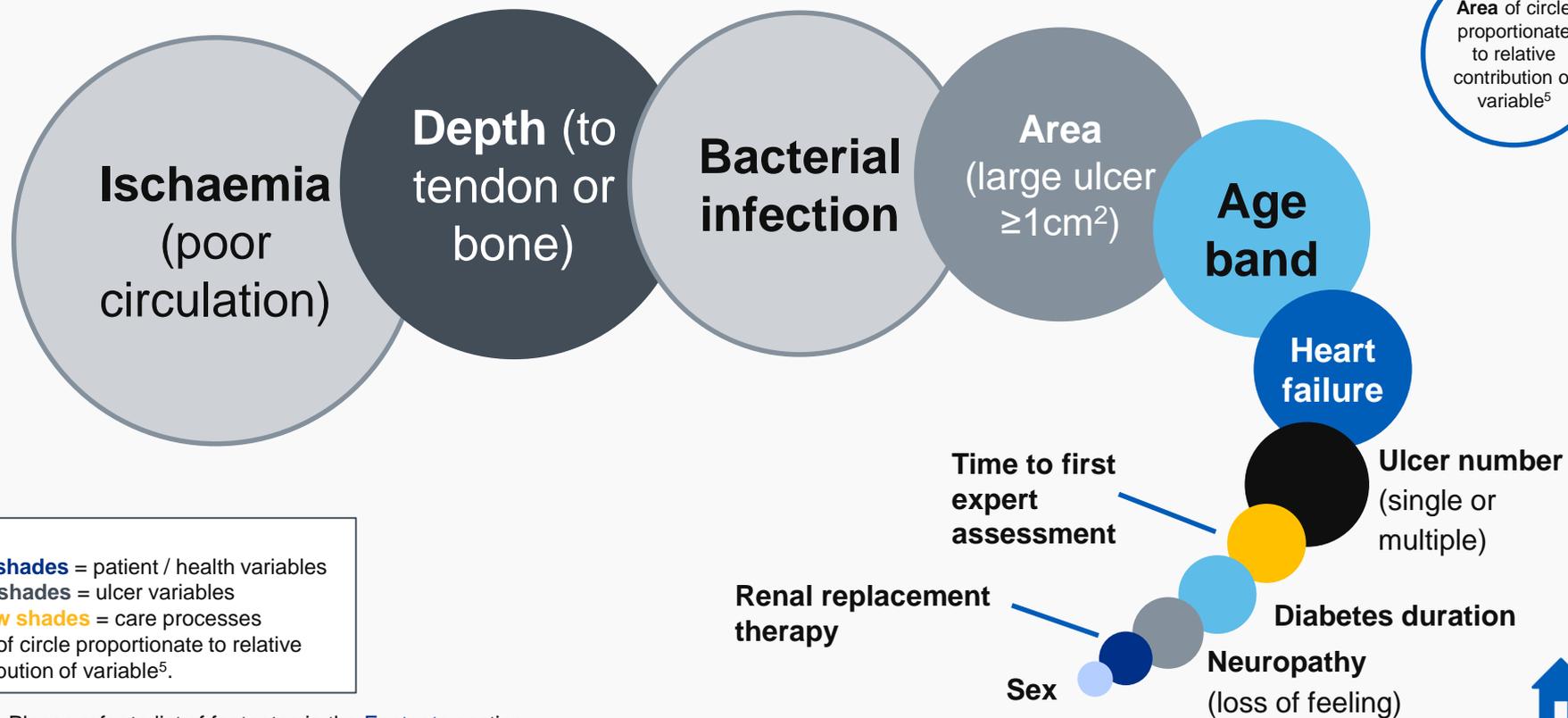
- a. Female vs Male
- b. Diabetes duration 10-19 years vs 0-9 years
- c. Diabetes duration 20+ years vs 0-9 years
- d. Smoking status: Current smoker vs Never smoked
- e. Smoking status: Ex-smoker vs Never smoked
- f. Heart failure: Yes vs No
- g. Myocardial infarction: Yes vs No
- h. RRT: Yes vs No
- i. Time to first expert assessment: Self-referred vs 3-13 days
- j. ...0-2 days vs 3-13 days
- k. ...14 days to 2 months vs 3-13 days
- l. ...>2 months vs 3-13 days
- m. Ulcer number: Multiple vs Single
- n. Charcot: Yes vs No
- o. Charcot: Possible vs No
- p. Charcot: Inactive vs No
- q. Charcot: Unknown vs No
- r. Site (on hindfoot): Yes vs No
- s. Ischaemia: Yes vs No
- t. Neuropathy: Yes vs No
- u. Bacterial infection: Yes vs No
- v. Area (large ulcer $\geq 1\text{cm}^2$): Yes vs No
- w. Depth (to tendon or bone): Yes vs No

Notes: 2. Please refer to list of footnotes in the [Footnote](#) section.



Appendix: Modelling

Foot disease admission: Variable strength



Appendix: Modelling

Foot disease admission: Category strength



LIMITATIONS

The predictive power of the statistical model is **reasonable** (c-statistic = 0.74)



Patient factors

- ▲ Heart failure
- ▲ RRT
- ▲ Diabetic = 20+yrs
- ▲ Male
- ▲ Diabetic = 10-19yrs

- ▼ Female
- ▼ Age 65-79
- ▼ Age = 80+

Admission?



Ulcer factors

- ▲ Deep ulcer
- ▲ Ischaemia
- ▲ Infection
- ▲ Large ulcer
- ▲ Multiple ulcers
- ▲ Neuropathy
- ▲ Time2assm't = 0-2 days

- ▼ Time2assm't = 3-13 days
- ▼ Single ulcer



Notes: *Italics* = confidence interval close to line of no effect (1.0). Underlined = very strong effect. Please see [Glossary](#) for explanation of terms.

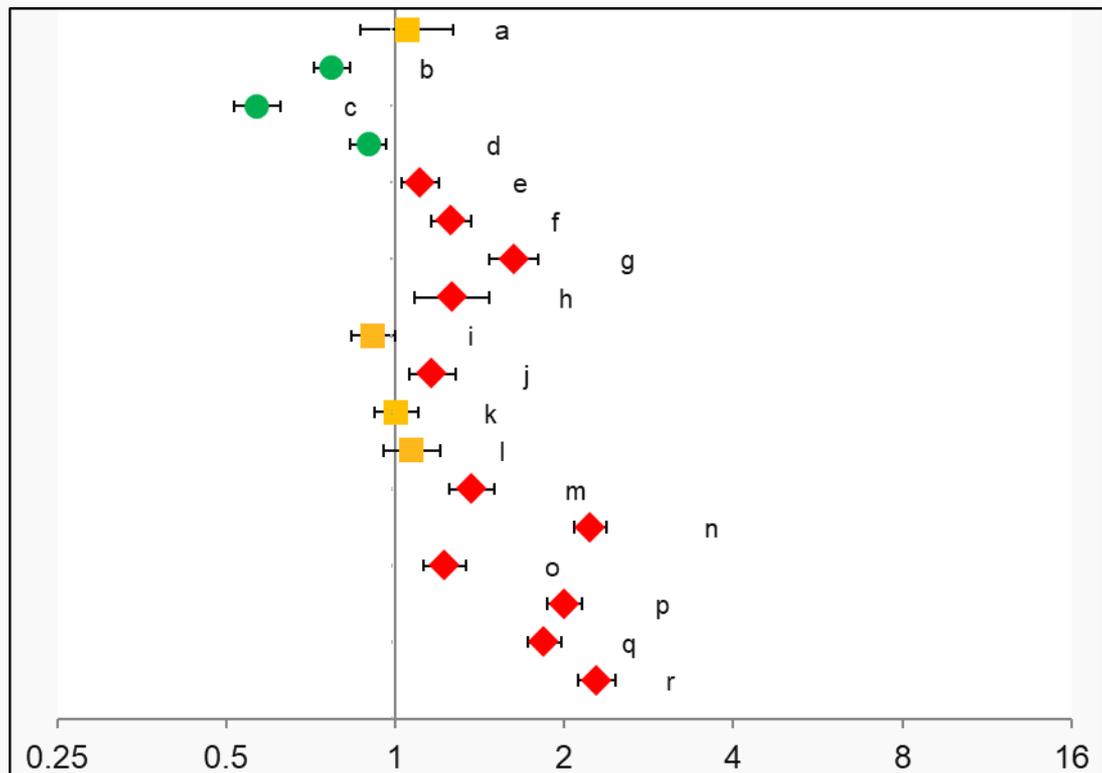


Appendix: Modelling

Foot disease admission: Forest plot



Figure A.3: Odds ratios of factors associated with foot disease admissions within 6 months, England and Wales, 2014-17

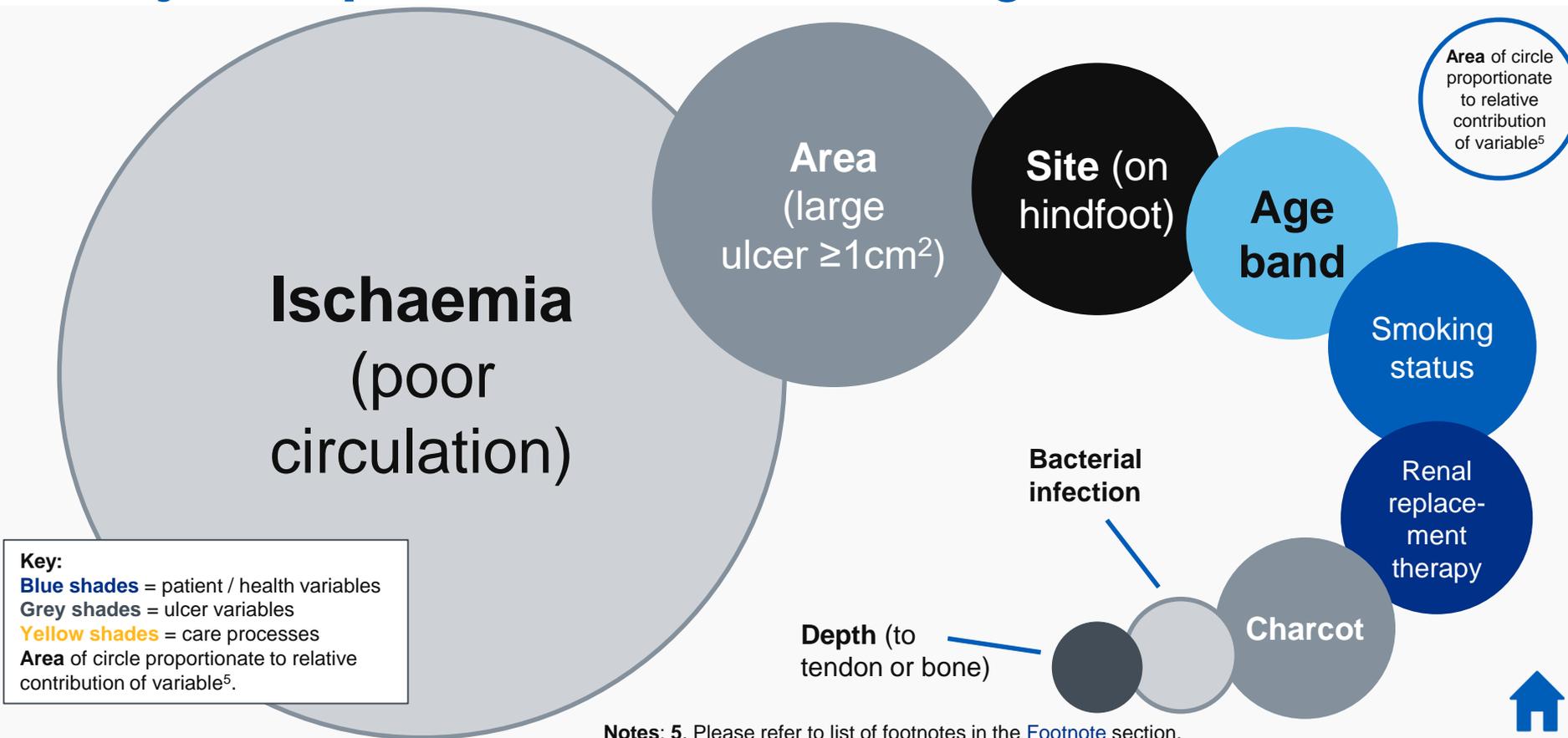


- a. Age band: 0-39 vs 40-64
- b. Age band: 65-79 vs 40-64
- c. Age band: 80+ vs 40-64
- d. Sex: Female vs Male
- e. Diabetes duration 10-19 years vs 0-9 years
- f. Diabetes duration 20+ years vs 0-9 years
- g. Heart failure: Yes vs No
- h. RRT: Yes vs No
- i. Time to first expert assessment: Self-referred vs 3-13 days
- j. ...0-2 days vs 3-13 days
- k. ...14 days to 2 months vs 3-13 days
- l. ...>2 months vs 3-13 days
- m. Ulcer number: Multiple vs Single
- n. Ischaemia: Yes vs No
- o. Neuropathy: Yes vs No
- p. Bacterial infection: Yes vs No
- q. Area (large ulcer $\geq 1\text{cm}^2$): Yes vs No
- r. Depth (to tendon or bone): Yes vs No



Appendix: Modelling

Major amputation: Variable strength



Notes: 5. Please refer to list of footnotes in the [Footnote](#) section.

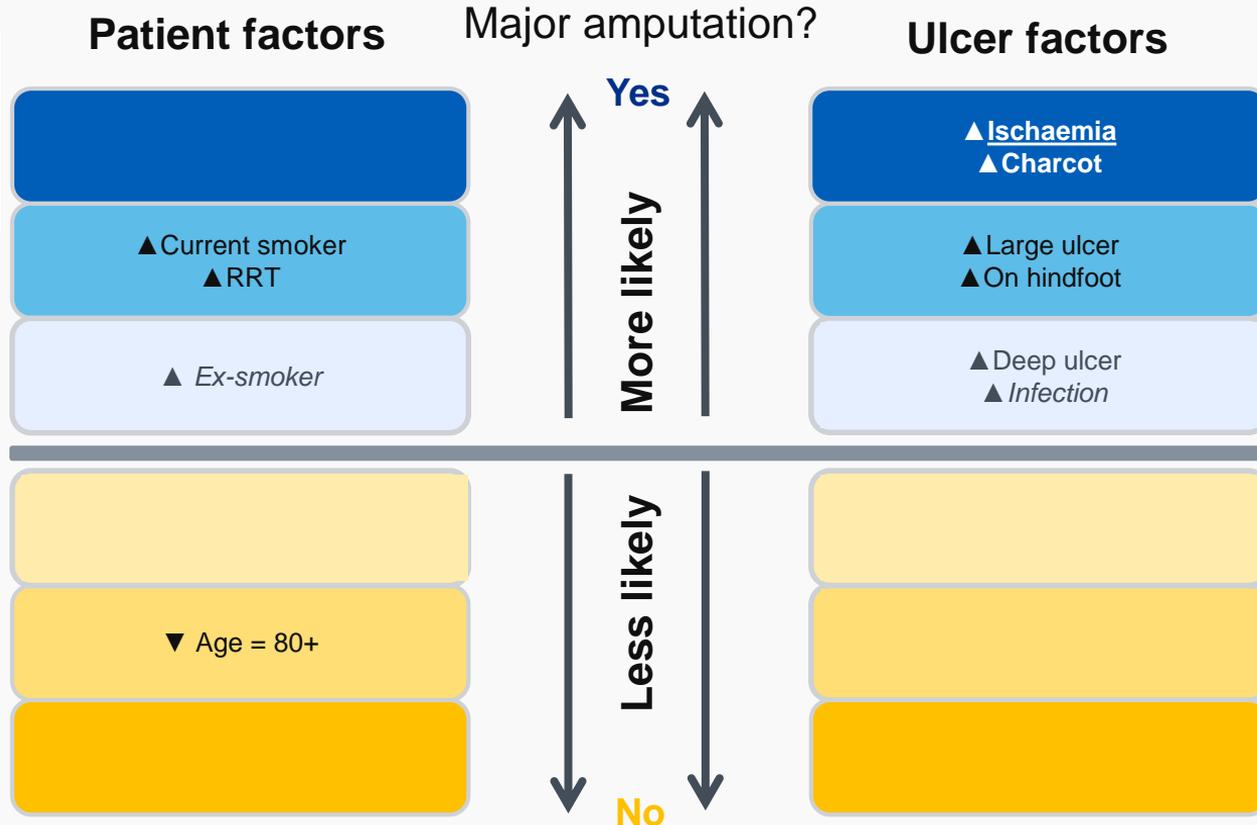


Appendix: Modelling

Major amputation: Category strength



STRENGTH:
The predictive power of the statistical model is just below **strong** (c-statistic = 0.79)



Notes: *Italics* = confidence interval close to line of no effect (1.0). Underlined = very strong effect. Please see [Glossary](#) for explanation of terms.

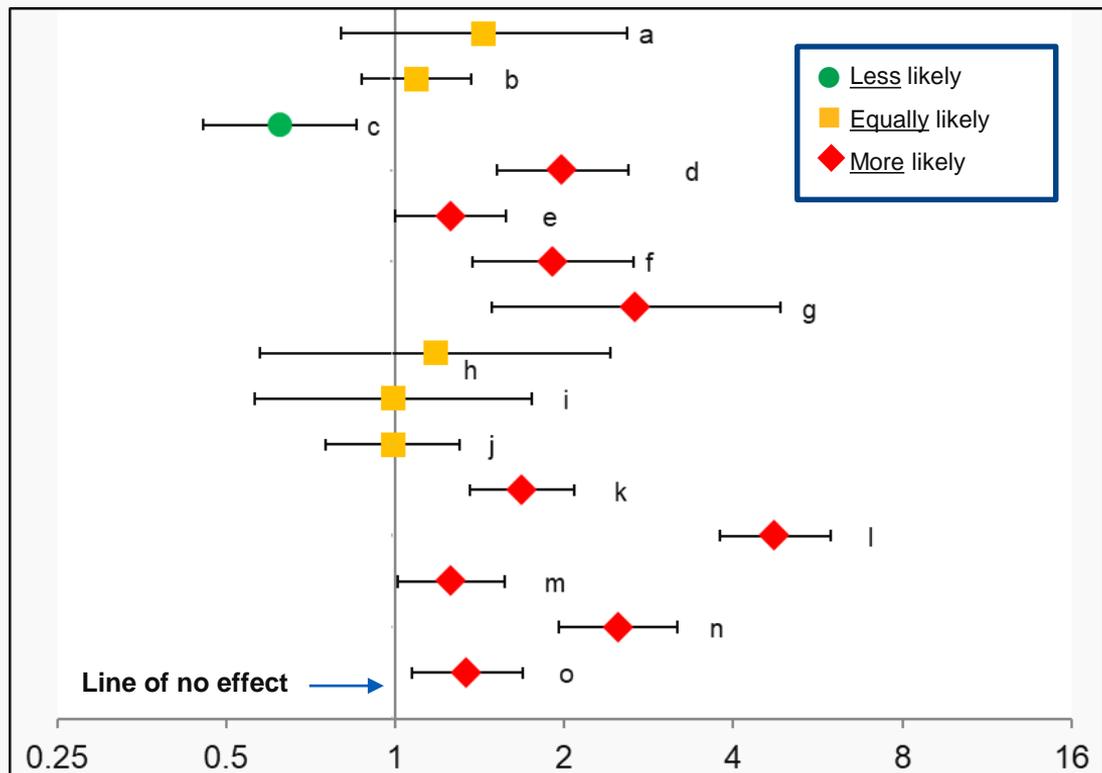


Appendix: Modelling

Major amputation: Forest plot



Figure A.4: Odds ratios of factors associated with major amputation within 6 months, England and Wales, 2014-17

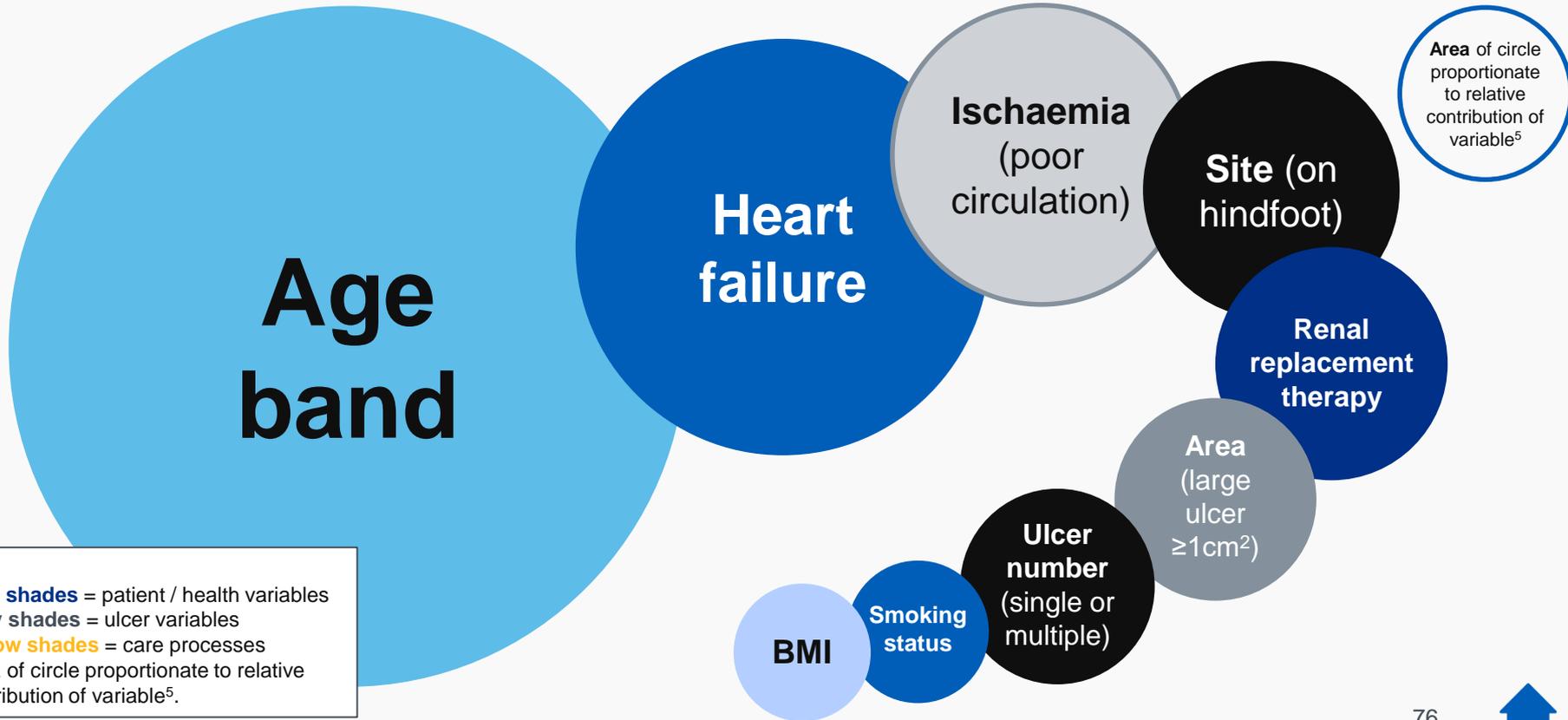


- a. Age band: 0-39 vs 40-64
- b. Age band: 65-79 vs 40-64
- c. Age band: 80+ vs 40-64
- d. Smoking status: Current smoker vs Never smoked
- e. Smoking status: Ex-smoker vs Never smoked
- f. RRT: Yes vs No
- g. Charcot: Yes vs No
- h. Charcot: Possible vs No
- i. Charcot: Inactive vs No
- j. Charcot: Unknown vs No
- k. Site (on hindfoot): Yes vs No
- l. Ischaemia: Yes vs No
- m. Bacterial infection: Yes vs No
- n. Area (large ulcer $\geq 1\text{cm}^2$): Yes vs No
- o. Depth (to tendon or bone): Yes vs No



Appendix: Modelling

6 month^{6,7} mortality: Variable strength



Notes: 5, 6, 7. Please refer to list of footnotes in the [Footnote](#) section.

Appendix: Modelling

6 month mortality: Category strength



STRENGTH

The predictive power of the statistical model is **strong** (c-statistic = 0.81)



Patient factors

▲ Age = 80+
▲ Heart failure
▲ Age = 65-79

▲ RRT

▲ *Current smoker*
▲ Ex-smoker

▼ Obese

Death?

Yes

More likely

Less likely

No

Ulcer factors

▲ Ischaemia ▲ On hindfoot
▲ Multiple ulcers

▲ Large ulcer

▼ Single ulcer



Notes: *Italics* = confidence interval close to line of no effect (1.0). Underlined = very strong effect. Please see [Glossary](#) for explanation of terms.

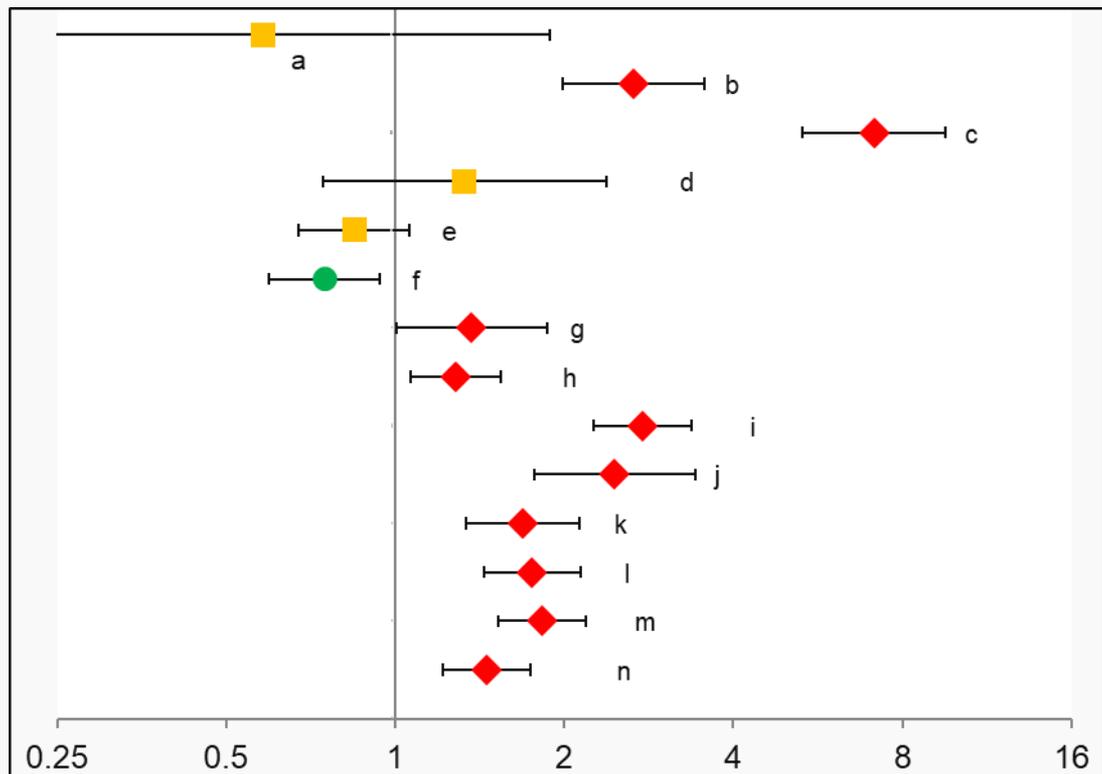


Appendix: Modelling

6 month mortality: Forest plot



Figure A.5: Odds ratios of factors associated with 6 month mortality, England and Wales, 2017-18



- a. Age band: 0-39 vs 40-64
- b. Age band: 65-79 vs 40-64
- c. Age band: 80+ vs 40-64
- d. BMI: Underweight vs Healthy
- e. BMI: Overweight vs Healthy
- f. BMI: Obese vs Healthy
- g. Smoking status: Current smoker vs Never smoked
- h. Smoking status: Ex-smoker vs Never smoked
- i. Heart failure: Yes vs No
- j. Renal replacement therapy: Yes vs No
- k. Ulcer number: Multiple vs Single
- l. Site (on hindfoot): Yes vs No
- m. Ischaemia: Yes vs No
- n. Area (large ulcer $\geq 1\text{cm}^2$): Yes vs No



Appendix: Modelling

Estimated contribution



Which variables contribute most to a logistic regression model?

The complexity of interactions between variables in a model makes it difficult to untangle their relative contributions. Nonetheless an estimate of a variable's contribution can be made using the **model comparison** technique, as shown in the example below.

Model comparison example:

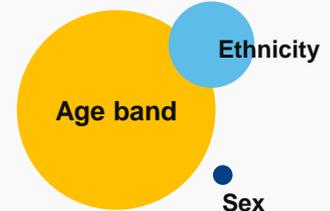
A simple model contains three variables: age band, ethnicity and sex. The dataset has 1,000,000 possible **pairs** where one record has the outcome (1) and the other does not (0). When run, the model assigns a higher probability to (1) than for (0) for 700,000 pairs (**correct guesses**), giving a concordance (or **c-statistic**) of 0.700. Real models are also likely to have **ties**, which are counted as half a correct guess.

To perform a model comparison, the logistic regression is re-run with one (and only one) of the predictor variables removed each time. The resultant c-statistics indicate how much the removed variable contributed to the final model. Example results are shown in the table above right.

When age band is removed, the number of incorrect guesses increases from 300,000 to 450,000, a difference of 150,000. Therefore the inclusion of age band reduces the proportion of incorrect guesses by 33.3 per cent ($150,000 / 450,000$): this is the **estimated contribution**. Using the same methodology, ethnicity and sex have estimated contributions of 6.3 and 0.3 per cent respectively. It can therefore be deduced that age band makes the largest contribution to the model's predictive power. To aid visualisation, variables can be represented as a shape whose area is based on the relative size of their estimated contribution (see above right).

Notes: 1. Estimated contributions cannot be added together. 2. Results for variables in weaker models tend to be smaller because the overall c-statistic limits the maximum size of the estimated contribution.

Model	c-statistic	Pairs	Guesses		Reduction in incorrect guesses when included	
			Correct	Incorrect		
		000s	000s	000s	000s	%
All variables	0.700	1,000	700	300		
Variable excluded						
Age band	0.550	1,000	550	450	150	33.3%
Ethnicity	0.680	1,000	680	320	20	6.3%
Sex	0.699	1,000	699	301	1	0.3%



National Diabetes Foot Care Audit Fourth Annual Report

Footnotes

Details



Footnotes: Results (1)

Footnotes for: 2. Results

1. Counts have been rounded. Counts between 1 and 7 are represented as a 5. All counts greater than 7 have been rounded to the nearest five. Percentages are derived from rounded values.
2. 'Alive and ulcer-free' includes those patients who have had surgery (including major and minor amputation), provided all wounds have healed. Please see [Glossary: Outcomes](#) for further information.
3. Recommendations 1.3.3-7 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
4. Recommendation 1.3.8 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
5. Recommendations 1.4.1-2 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
6. The 2018 NDFA Provider Survey added the requirement that the urgent referral pathway is available 7 days a week.
7. The capacity to record whether a patient was lost to follow up was added to the audit system in August 2016. Patients who have been lost and were recorded in the audit prior to this date may appear as an 'unknown' outcome instead of 'lost to follow up'.
8. Percentage where the ulcer status at 12 weeks is known.
9. To ensure a full six months of hospital data was available for assessment at the point of analysis, patients are included where their first assessment by the specialist foot care service in the NDFA took place prior to 2018.

Continued on following slide.



Footnotes: Results (2)

Footnotes for: 2. Results (continued)

10. Foot disease identified at any point during the admission. Please see [Glossary: Foot disease-related admission](#) for further information.
11. Only includes bed days within the 6 months following first expert assessment. Excludes day cases. Please see [Glossary: Length of stay and bed days](#) for further information.
12. The entire hospital stay is included, including time after the 6 month cut-off and prior to the first assessment, where applicable. Excludes day cases. Please see [Glossary: Which admissions are included?](#) for further information.
13. To comply with information governance requirements, patients were only sent for mortality tracing at the Office for National Statistics (ONS) if they had an ulcer episode first assessed from 1 April 2017 onwards.
14. Patients recorded with less severe (SINBAD 0-2) and severe (SINBAD 3+) ulcers are counted under each ulcer severity. Severity breakdown figures may not match overall totals.
15. Patients traced through ONS had their life status (and date of death) confirmed as of the date the trace was conducted. Not all patients could be successfully traced by this method.
16. Mortality derived from life status at 12 weeks as submitted to the audit, not life status traced from ONS.
17. Mortality derived from life status traced from ONS, not life status life as submitted to the audit.



Footnotes: Associations

Footnotes for: 3. Associations

1. Counts have been rounded. Counts between 1 and 7 are represented as a 5. All counts greater than 7 have been rounded to the nearest five. Percentages are derived from rounded values.
2. 'Alive and ulcer-free' includes those patients who have had surgery (including major and minor amputation), provided all wounds have healed. Please see [Glossary: Outcomes](#) for further information.
3. Recommendations 1.3.3-7 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
4. Recommendation 1.3.8 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
5. Recommendations 1.4.1-2 from the NICE guidelines: <http://www.nice.org.uk/guidance/ng19>.
6. An urgent referral for expert assessment is available if necessary.
7. Denominator excludes self-referrals.
8. Estimated contribution derived from the percentage decrease in incorrect guesses when the stated variable(s) is included the model, compared to when excluded. Please see [Appendix: Modelling – Estimated contribution](#) for further information.
9. The combined estimated contribution of all factors used in the final model, by variable type.
10. Mortality derived from life status traced from ONS, not life status life as submitted to the audit.
11. 'Death within six months' was used for mortality modelling because longer durations (e.g. 'death within one year) reduced the number of eligible patients and thereby reduced the statistical power of the model.



Footnotes: Variation

Footnotes for: 4. Variation

1. Counts have been rounded. Counts between 1 and 7 are represented as a 5. All counts greater than 7 have been rounded to the nearest five. Percentages are derived from rounded values.
2. 'Alive and ulcer-free' includes those patients who have had surgery (including major and minor amputation), provided all wounds have healed. Please see [Glossary: Outcomes](#) for further information.
3. So as not to adjust for clinical practice, care processes such as time to first expert assessment have been excluded from the model.
4. 44 Sustainability and Transformation Partnerships (STPs) in England and 7 Local Health Boards (LHBs) in Wales.
5. 119 NHS Trusts and Independent Healthcare Providers (IHPs) in England and 7 Local Health Boards (LHBs) in Wales.
6. Excluding ulcers seen after the patient self-referred.
7. Providers with outcome rates outside the interquartile range (IQR) by more than 1.5 times the IQR are shown as 'out of range'.
8. Only includes providers that submitted 50+ ulcers in the audit year (excluding self-referred).
9. Mortality derived from life status traced from ONS, not life status life as submitted to the audit.
10. 'Death within six months' was used for mortality modelling because longer durations (e.g. 'death within one year) reduced the number of eligible patients and thereby reduced the statistical power of the model.



Footnotes: Appendix

Footnotes for: Appendix

1. Counts have been rounded. Counts between 1 and 7 are represented as a 5. All counts greater than 7 have been rounded to the nearest five. Percentages are derived from rounded values.
2. 'Alive and ulcer-free' includes those patients who have had surgery (including major and minor amputation), provided all wounds have healed. Please see [Glossary: Outcomes](#) for further information.
3. The process for selecting predictor variables is summarised in [Appendix: Modelling - Inclusion criteria](#).
4. Categories derived from Hosmer and Lemeshow (2000).
5. Estimated contribution derived from the percentage decrease in incorrect guesses when the stated variable(s) is included in the model, compared to when excluded. Please see [Appendix: Modelling – Estimated contribution](#) for further information.
6. Mortality derived from life status traced from ONS, not life status as submitted to the audit.
7. 'Death within six months' was used for mortality modelling because longer durations (e.g. 'death within one year') reduced the number of eligible patients and thereby reduced the statistical power of the model.



Glossary

Information and definitions



Glossary: Data sources

Data collected in the **NDFA** for each ulcer episode:

- Patient characteristics (NHS number, date of birth)
- Time interval to first expert assessment from first presentation to a healthcare professional
- Ulcer characteristics (SINBAD elements, Charcot foot disease, Single / multiple ulcer status)
- Clinical outcomes (Patient status at 12 weeks after assessment: Alive / Dead / Lost to follow up, Ulcer free / Persistent ulceration).



Data linked from core **National Diabetes Audit (NDA)**:

- Patient characteristics (Diabetes duration, smoking status, sex, ethnicity, etc.)
- Treatment targets (HbA1c, cholesterol, blood pressure)

Data linked from **Hospital Episode Statistics (HES)** and **Patient Episode Database for Wales (PEDW)**:

- Data related to foot disease admissions and length of stay after the first expert assessment.
- Data related to major amputations and length of stay after the first expert assessment.
- Data related to diabetes related complications (DKA, RRT, cardiovascular incidents etc.) preceding first expert assessment.

Data linked from **Office for National Statistics (ONS)**

Life status: Date of death

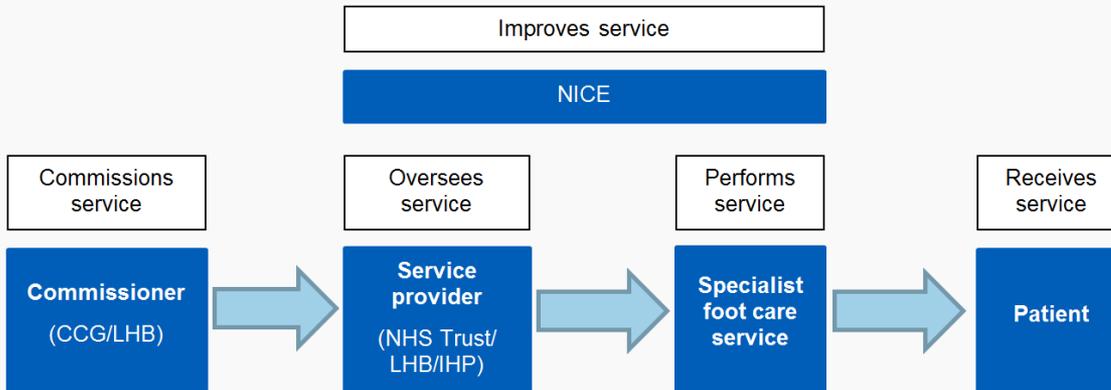


Glossary: Healthcare providers

NDA data is submitted by **specialist foot care services** that treat people with diabetic foot ulcers. This includes community and hospital based organisations.

Service providers are the specialist foot care service's parent organisation. This is typically an **NHS Trust** in England or a **Local Health Board (LHB)** in Wales. It may also be an independent healthcare provider (IHP).

Commissioners decide what health services are needed and ensure that they are provided. Clinical Commissioning Groups (CCG) in England and LHBs in Wales are responsible for commissioning healthcare services.



The National Institute for Health and Care Excellence (**NICE**) produces guidelines for the treatment of diabetic foot problems. All diabetes foot care services should follow these guidelines, so that people with diabetes receive the best possible foot care.

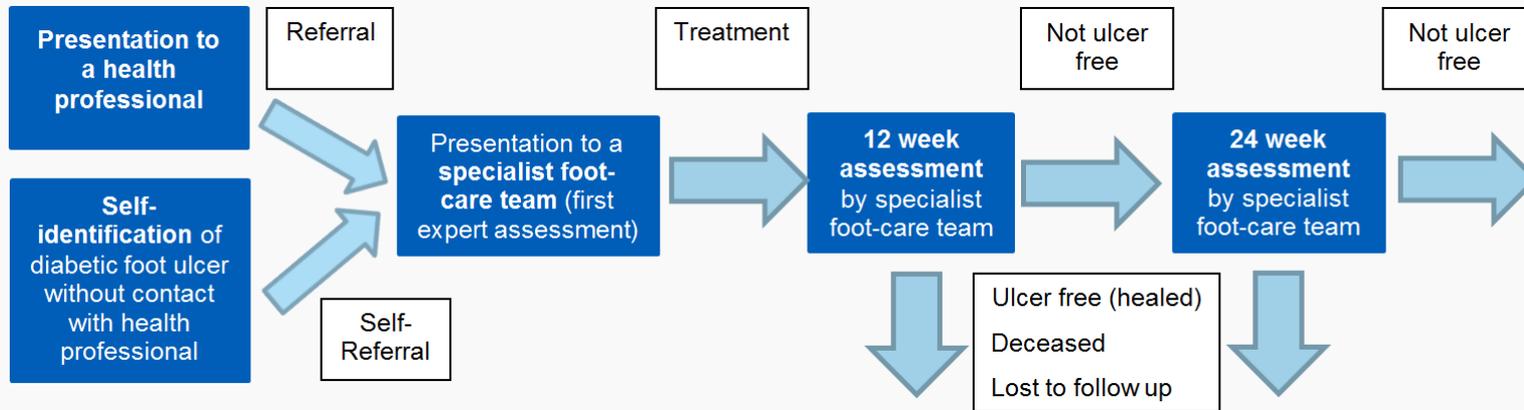


Glossary: Patient pathway

The **first expert assessment** of the foot ulcer is undertaken by the specialist foot care service. Patients may self-refer to the specialist foot care service (**self-referral**) or they may be referred following **presentation to a health professional** (e.g. GP community team, Accident and Emergency or another specialist foot care service).

At 12 and 24 weeks following the first expert assessment, the specialist foot care service will record whether the patient is **alive and ulcer-free** (i.e. all ulcers present at the start of this episode have fully healed and no other ulcers remain unhealed). Being ulcer-free also includes those patients who have had surgery (including major and minor amputation), provided all wounds have healed. **Persistent ulcers** are ulcers that have not healed.

Healed at 12 weeks includes all ulcer episodes reported as healed at 12 weeks. **Healed at 24 weeks** includes all ulcer episodes reported as healed at 24 weeks plus those reported as healed at 12 weeks, unless a new ulcer episode occurred within 12 weeks of their 12 week assessment.



Glossary: Referrals to the foot care service

People seen by the specialist foot care service are generally referred to the foot care team by a health professional.

This will often be by a general practitioner (GP) who has identified a foot ulcer. Less often it will be by a hospital consultant – where a patient is referred after attending an A&E department, or after they have been seen by a specialist in another department (such as orthopaedics, renal services or dermatology). People may also be referred by community nurses, or another part of the specialist diabetes service.



Some people are seen by the specialist service after they have ‘self-referred’. These people have usually had an earlier foot ulcer and know the foot care team, or may have been identified as high-risk and attend a foot protection service. They will have been encouraged to contact the specialist foot care service at the first sign of trouble.

Most people with diabetes that develop a new foot ulcer **do not** and **cannot** refer themselves directly to a specialist foot care service and **must be referred by a health professional** – usually their GP.



Glossary: 2018 NDFA Provider Survey

The 2018 NDFA Provider Survey asked NHS Trusts in England and Local Health Boards in Wales the following questions:

1. Is there a training programme designed to ensure that all responsible health care professionals have the necessary competence to undertake foot risk examinations as part of routine annual diabetes review? **Yes / No / Don't know**
2. Is there an established pathway for referral of all people with diabetes who are defined as being at increased risk during annual foot examination to a designated Foot Protection Service (FPS)? **Yes / No / Don't know**
3. For a person with new, deteriorating or recurrent diabetic foot disease is there an established pathway which can allow referral to an expert assessment within 24 hours, 7 days a week, if needed? **Yes / No / Don't know**
- 3b. Are some or all of the following personnel available to undertake the expert assessment – even though they may not necessarily be available at the same time: **Yes / No / Don't know**
 - Podiatrist(s)
 - Diabetologist(s)
 - Orthotist(s)
 - Microbiologist(s)
 - Vascular surgeon(s)
 - Designated administrative support?
 - Appropriate facilities available?
4. Is there a protocol of care for foot ulcers which includes the option for step-down or shared care between the Specialist Foot Care Services (MDFT) and the FPS? **Yes / No / Don't know**
5. Is there dedicated time to discuss the management of your patients with vascular services? **Yes / No / Don't know**
6. Is it easy to discuss the management of your patients with vascular services? **Yes / No / Don't know**
7. How many patients with diabetic foot ulcers do you estimate your service(s) deal with every year?



Glossary: Ulcer characteristics

Ulcer characteristics are measured at the first expert assessment by the specialist foot care service. Overall **ulcer severity** is recorded using the **SINBAD** scoring system, which scores an ulcer between 0 (least severe) and 6 (most severe) depending on how many of the 6 SINBAD elements are present. The 6 **SINBAD elements** are:

- **Site (on hindfoot)** – Ulcer penetrates the hindfoot (rear of the foot).
- **Ischaemia** – Impaired circulation in the foot.
- **Neuropathy** – Loss of protective sensation in the foot.
- **Bacterial infection** – Signs of bacterial infection of the foot (e.g. redness, swelling, heat, discharge).
- **Area (large ulcer $\geq 1\text{cm}^2$)** – Ulcer covers a large surface area (1cm^2 or more).
- **Depth (to tendon or bone)** – Ulcer penetrates to tendon or bone.

An ulcer with a SINBAD score of 3 or above is classed as a **severe ulcer**.
An ulcer with a SINBAD score of less than 3 is classed as a **less severe ulcer**.

Charcot foot disease is a type of serious bone deformity associated with neuropathy.



Glossary: Outcomes

What are the outcomes for patients?

Alive and ulcer free: A patient is considered to be 'alive and ulcer free' if they have no instances of foot ulceration 12 weeks after their first expert assessment. They may have had a major or minor amputation, but all wounds must have healed for the patient to be considered alive and ulcer free.

Major amputation: Lower limb amputation is the surgical excision of bone and soft tissue of the foot or leg. Major amputation (above the ankle) is carried out when all other treatments have failed.

Foot disease-related admission: A hospital admission predominantly associated with inpatient management of diabetes related foot disease including one or more foot disease related clinical diagnosis or procedure.

Mortality: A patient that has died a short time after developing a diabetic foot ulcer, from causes that may or may not be directly related to their foot disease.

How are outcomes measured?

Alive and ulcer free: The foot service is asked to record the patient's status approximately 12 weeks after their first expert assessment, noting whether they are alive or dead, and whether their foot ulceration is still active.

Major amputation/Foot disease-related admission: Hospital episode data from England and Wales is checked to find any instances of major amputation / foot disease related admission taking place within six months of the patient's first expert assessment.

Mortality: Patients are traced using ONS data and the time interval between any dates of death and their first expert assessment are measured. A patient is only included in mortality measures if sufficient time – 6 months – has elapsed since their assessment and the date of the mortality trace.



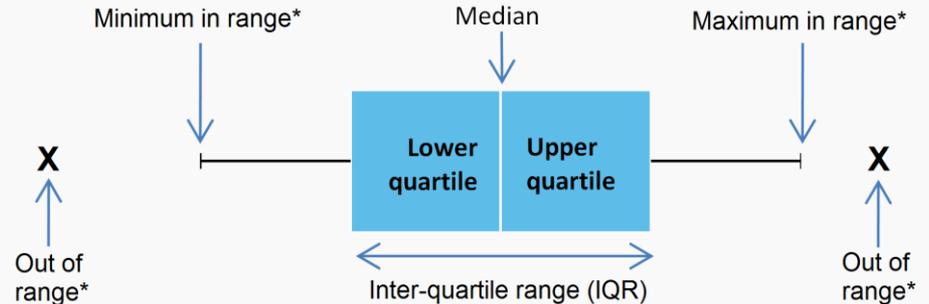
Glossary: Statistical terms (1)

Quartiles: Lists of values can be ranked numerically from lowest to highest.

- The **median** is the middle value in the ranked list.
- The **lower quartile** is the middle value of the lower half of the ranked list.
- The **upper quartile** is the middle value of the upper half of the ranked list.
- The **interquartile range** represents values between the lower and upper quartiles – the middle 50 per cent of the values in the ranked list.

- The interquartile range, along with minimum and maximum range values, can be plotted on a **box and whisker plot** – see example right.
- Values outside 1.5xIQR below the lower quartile and 1.5xIQR above the upper quartile are shown as points outside the plot.

Box and whisker plot



- The **mean** is the average of the values in the list. The mean may be higher or lower than the median, depending on the extent to which the data is skewed (e.g. by very large values).



Glossary: Statistical terms (2)

Where a result is flagged as **significant at 0.05 level**, there is only a 5 per cent probability that the result is due to chance.

Logistic regression is used to examine the relationship between an outcome (e.g. alive and healed at 12 weeks) and related variables (e.g. ulcer characteristics). Backwards elimination is used to remove variables found not to be significant at 0.05 level, producing a final model that includes variables with significant associations only

Two outputs are particularly useful when interpreting the results of a logistic regression model:

- The **c-statistic** can be used to assess the goodness of fit, with values ranging from 0.5 to 1.0. A value of 0.5 indicates that the model is no better than chance at making a prediction of membership in a group and a value of 1.0 indicates that the model perfectly identifies those within a group and those not. Models are typically considered reasonable when the c-statistic is higher than 0.7 and strong when the c-statistic exceeds 0.8 (Hosmer and Lemeshow, 2000).
- **Odds ratios** (OR) illustrate how strongly a particular value of a variable is associated with the outcome. The further from one the ratio is (either above or below), the stronger the association between it and the outcome. For example, an odds ratio of 0.764 would suggest a stronger association than an odds ratio of 0.830. An odds ratio of one would show that the variable value has no bearing on how likely the outcome is.

There is always a degree of uncertainty in the calculated odds ratio. This is described by the **confidence interval**. The wider the confidence interval, the less certainty there is in the odds ratio. If the confidence intervals are either side of 1 this indicates that the value taken by the variable has no bearing on how likely the outcome is. Where the confidence interval approaches 1 this indicates that the association with the outcome may be weak.



Glossary: Modelling infographic

Model **strength** is derived from the c-statistic and adapted from Hosmer and Lemeshow (2000).

Patient factors include:

- **Patient** demographics at first expert assessment.
- Patient **health** in year preceding first expert assessment.

Details

- The infographic shows categories (e.g. age 80+) from variables (e.g. age) used in the final model where a significant association with the outcome (e.g. death) has been found ($p = 0.05$).
- The position of the category on the infographic is defined by its **odds ratio** (OR), using **effect sizes** adapted from Rosenthal (1996). The OR ranges are shown on the right.
- Categories in *italics* have confidence intervals close to the line of no effect (0.95 - 1.05).
- See Glossary for further description of [Statistical terms](#).

Outcome

Yes

More likely

Less likely

No

Effect size

▲ **Very large effect** OR ≥ 4.00
▲ **Large effect** OR 2.50 – 3.99

▲ **Medium effect**
OR 1.50 - 2.49

▲ **Small effect**
OR 1.00 - 1.49

OR 0.67 - 1.00
▼ **Small effect**

OR 0.40 - 0.66
▼ **Medium effect**

OR 0.25 - 0.39 ▼ **Large effect**
OR < 0.25 ▼ **Very large effect**

Colours:
Blue = less desirable.
Orange = more desirable.

Ulcer factors include:

- **Ulcer** characteristics at first expert assessment terms.
- **Care processes** prior to first expert assessment.

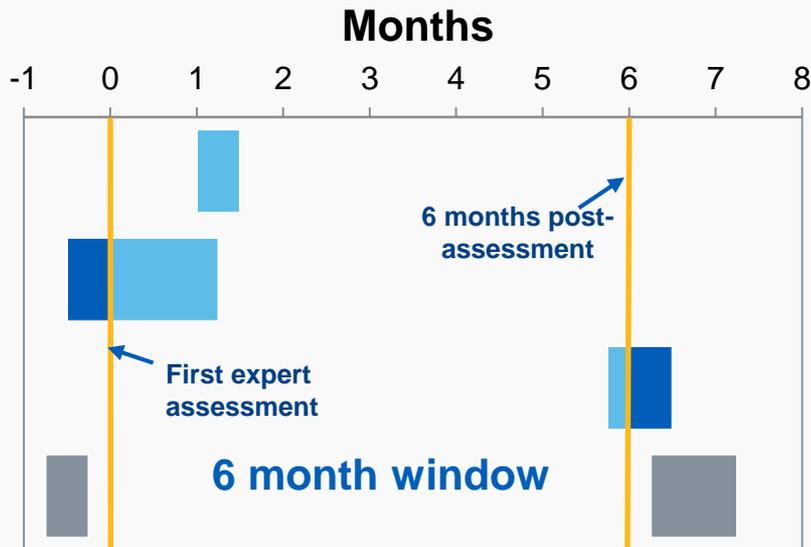


Glossary: Length of stay and bed days

The full duration of the hospital admission contributes towards the **length of stay**, including days outside the 6 month window. This ensures that hospital stays that overlap with the beginning or end of the 6 month window are not artificially shortened. Length of stay is reported using the median (middle) value, which prevents skewing of results by very long stays.

Bed days are only counted if they occur within 6 months of first assessment by the specialist foot care service. This ensures that the currency (bed days within 6 months of first expert assessment) is easy to understand and also prevents patients with very long stays (e.g. long-term mental health admissions) from inflating the total.

Story	Admission included?
Admitted and discharged within 6 month window	Yes
Admission overlaps with assessment, concluded within 6 months	Yes
Admission overlaps with end of 6 month window	Yes
Admitted and discharged outside 6 month window	No



Key	Length of stay counted?	Bed days counted?
Light Blue	Yes	Yes
Dark Blue	Yes	No
Grey	No	No



Glossary: Foot disease-related admissions

Diabetic foot disease is defined as a foot affected by ulceration that is associated with neuropathy and/or peripheral arterial disease of the lower limb in a patient with diabetes¹.

People with diabetic foot ulcers sometimes require admission to hospital to treat their foot disease. This occurs when the condition of the foot threatens survival of either the foot or the patient. Such deterioration is often a result of infection (requiring intravenous antibiotics, with or without local surgery) or poor arterial blood flow. Resultant hospital stays and rehabilitation may be lengthy. In extreme cases amputation is required.

To identify foot disease-related admissions, all episodes of hospital care have been searched for the following **clinical procedures** or **diagnoses** predominantly associated with inpatient management of diabetes related foot disease²:

Foot disease clinical diagnoses

- Diabetes mellitus with peripheral circulatory complications
- Ulcer of the lower limb
- Decubitus ulcer
- Cellulitis
- Osteomyelitis
- Gangrene
- Atherosclerosis

Foot disease clinical procedures

- Debridement of a foot/leg wound
- Minor and major amputation of lower limb

For reporting purposes, the foot disease may be identified at any point during the hospital admission. Single patients may have more than one admission and/or foot disease type.



Notes: 1. [Alexiadou, K and Doupis, J \(2012\).](#)

2. [Public Health England \(2017\).](#) Patients may have other conditions which are contributing factors towards their hospital stay.



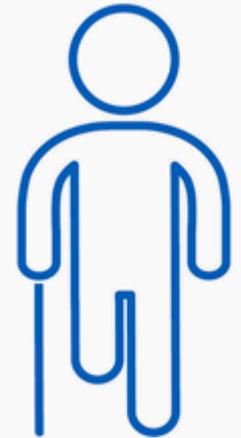
Glossary: Amputation procedures

Amputation, or surgical removal, of part of the foot or leg may be required when a diabetic foot ulcer cannot otherwise be successfully treated. When this is the case then an operation is needed to surgically excise bone and soft tissue in order to allow healing.

This may be a **minor amputation (below the ankle)** in which toes or part of the foot are removed in an attempt to save the leg. When this is not possible, **major amputation (above the ankle)** may be required.

Amputation is a life-changing event, with significant physical and psychological effects. Long hospital stays and periods of rehabilitation can result.

For reporting purposes, amputation must occur within 6 months of first expert assessment by the specialist foot care service. Any one patient may have more than one amputation-related admission and/or amputation procedure.



Further information

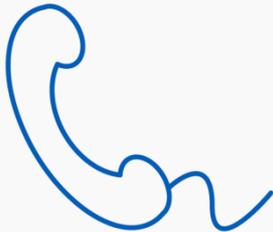
Audit references



Further information: Summary



For more information on the National Diabetes Foot Care Audit or access to the Service Level Analysis, please visit the NDFA webpage at <https://digital.nhs.uk/footcare>.



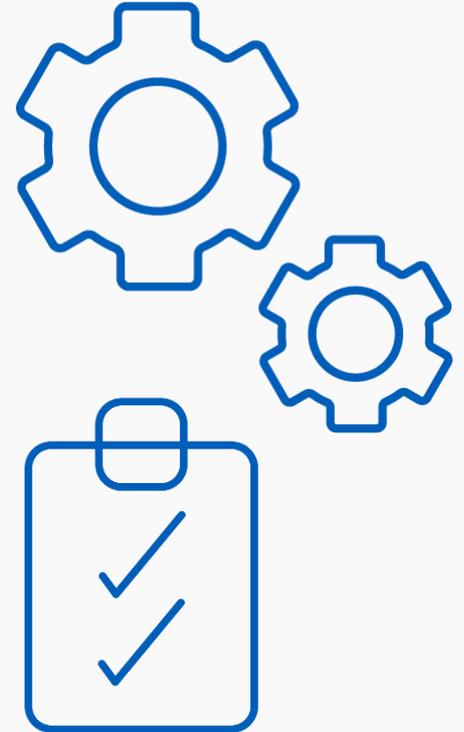
For further information about this report, please contact NHS Digital's Contact Centre on 0300 303 5678 or email enquiries@nhsdigital.nhs.uk.



Further information: Future plans

Over the next 12 months, the NDFA team will:

- Work with submitters to **encourage participation**. Improve case ascertainment by surveying service providers for estimated number of cases seen.
- Promote the mini-project done on **success factors** to improve outcomes at 12 weeks – alive and ulcer free.
- Promote the **key messages** to all service providers and relevant professional and patient groups.
- Undertake the **Quality Improvement Collaborative**. Key topics chosen include improving the time to first expert assessment.



Further information: References

- **Abbott CA, Carrington AL, Ashe H, et al.** (2002) The North-West Diabetes Foot Care Study: incidence of, and risk factors for, new diabetic foot ulceration in a community-based cohort. *Diabetes Med* 2002; 19: 377–84. DOI: [10.1046/j.1464-5491.2002.00698.x](https://doi.org/10.1046/j.1464-5491.2002.00698.x)
- **Alexiadou, K and Doupis, J** (2012) Management of Diabetic Foot Ulcers: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3508111>
- **Hosmer DW, Lemeshow S** (2000) *Applied Logistic Regression* (2nd Edition) New York, NY: John Wiley & Sons.
- **Ince P, Abbas ZG, Lutale JK, et al.** (2008) Use of the SINBAD classification system and score in comparing outcome of foot ulcer management on three continents. *Diabetes Care* 2008; 31: 964-7. <http://care.diabetesjournals.org/content/31/5/964.long>
- **Kerr M** (2017) Diabetic foot care in England: An economic study: <https://www.evidence.nhs.uk/document?id=1915227>
- **NICE-recommended care processes** <http://pathways.nice.org.uk/pathways/foot-care-for-people-with-diabetes>
- **NICE Guidelines:** Diabetic foot problems: prevention and management; January 2016; <http://www.nice.org.uk/guidance/ng19>
- **NHS Digital** (2018) National Diabetes Foot Care Audit - 2014-2017 <https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-footcare-audit/national-diabetes-foot-care-audit-2014-2017>
- **Public Health England** (2018): Diabetes footcare profiles <https://fingertips.phe.org.uk/profile/diabetes-ft>
- **Rosenthal JA** (1996) Qualitative Descriptors of Strength of Association and Effect Size, *Journal of Social Service Research*, 21:4, 37-59, DOI: [10.1300/J079v21n04_02](https://doi.org/10.1300/J079v21n04_02)



Further information: Acknowledgements

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Development and delivery of the N DFA is guided by a multi-professional advisory group of clinicians and patient representatives, chaired by Professor William Jeffcoate. The N DFA Advisory Group members include:

William Jeffcoate	Consultant Diabetologist, Nottingham University Hospitals NHS Trust (Chair)	Naomi Holman	Methodology Advisor, University of Glasgow
Bob Young	NDA Specialist Clinical Lead	Roy Johnson	Patient representative
Emma Barron	Head of Health Intelligence (Diabetes), NCVIN, Public Health England	Jane Lewis	Specialist Podiatrist & Research Lead, Cardiff Metropolitan University
Alex Berry	Engagement Lead, Diabetes UK	Claire Meace	Higher Information Analyst, NHS Digital
Jonathan Boyle	Consultant Vascular Surgeon, Addenbrooke's Hospital, Cambridge/Chair National Vascular Registry	Julie Michalowski	Audit Manager, NHS Digital
Sue Brown	Patient representative	Angela Pinnock	Audit Coordinator, NHS Digital
Sheila Burston	Patient representative	Gerry Rayman	Consultant Diabetologist, Ipswich Hospital NHS Trust
Scott Cawley	National Diabetic Foot Co-ordinator for Wales	Michael Sykes	Quality Improvement Lead, Diabetes UK
Mike Churchill	Patient representative	Andrew Whitehead	Audit Coordinator, NHS Digital
Sophie Colling	NDA Project Support Officer, Diabetes UK	Dean Williams	Professor of Surgery, Betsi Cadwaladr University Health Board
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Alexandra Harrington	Head of Community Podiatry at Great Western Hospitals		



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