



Multidisciplinary Limb Salvage in a Threatened Diabetic Foot: A Narrative Review of Time to Referral and Amputation-Free Survival

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Abstract

A diabetic foot ulcer is a small wound with a mortality rate. It precedes most lower limb amputations in people with diabetes, and the five-year survival after a major amputation is worse than for many cancers. Whether the limb is saved depends less on any single technique than on how quickly the right several people see the foot.

Objectives: To review the published evidence on multidisciplinary limb salvage in the threatened diabetic foot: the scale of the problem, what coordinated care changes, how much time to referral matters, and what happens after the ulcer heals.

Material and Methods: Narrative review of systematic reviews, meta-analyses, cohort studies, guideline documents and health-economic analyses indexed in PubMed and the major diabetes, vascular and podiatry journals. No new patient data were generated; every estimate quoted is one published by the original investigators.

Results: Diabetic foot ulcers affect approximately 18.6 million people worldwide each year and precede 80 per cent of lower extremity amputations in people with diabetes; between 19 and 34 per cent of people with diabetes develop one in their lifetime. Only 30 to 40 per cent heal at 12 weeks, and recurrence is 42 per cent at one year and 65 per cent at five. Multidisciplinary care was associated with a lower major amputation rate than usual care across 18 studies (3.2 against 4.4 per cent; odds ratio 0.40, 95% CI 0.32 to 0.51). Five-year mortality is approximately 30 per cent after an ulcer and exceeds 70 per cent after major amputation.

Conclusion: The evidence for coordinated care is consistent and the absolute difference is real but modest, and it comes from before-and-after and cohort comparisons rather than randomised allocation. The more striking finding is what follows healing: two in three ulcers return within five years, which means remission rather than cure is the correct frame.

Abbreviations: DFU – Diabetic Foot Ulcer, IWGDF – International Working Group on the Diabetic Foot, LEA – Lower Extremity Amputation, MDT – Multidisciplinary Team, PAD – Peripheral Arterial Disease, OR – Odds Ratio.

Keywords: Diabetic Foot Ulcer; Limb Salvage; Multidisciplinary Care; Amputation; Time to Referral

Introduction

Approximately 18.6 million people worldwide develop a diabetic foot ulcer each year, including 1.6 million in the United States, and between 19 and 34 per cent of people with diabetes will develop one at some point in their lives [1,2]. The pathway to ulceration is well established and unglamorous: loss of protective sensation, often with ischaemia, plus minor trauma the patient did not feel [3,4].

What follows is disproportionate to the size of the wound. These ulcers precede 80 per cent of lower extremity amputations among people with diabetes [1]. Five-year mortality after an ulcer is approximately 30 per cent, and after a major amputation it exceeds 70 per cent, which is worse than for several common malignancies [1,5,6]. The costs to health systems are correspondingly large [7,8].

Against that background, the intervention with the most consistent supporting evidence is not a dressing, a device or a drug. It is the assembly of a team: podiatry, vascular surgery, infectious diseases and diabetes medicine working to a shared protocol, with rapid access from primary care [1,9,10]. This review examines the evidence for that model, the role of time to referral, and what happens after the wound closes.

Material and Methods

Search strategy: PubMed and the archives of the major diabetes, vascular surgery, wound care and podiatry journals were searched for studies of the threatened diabetic foot. Search terms combined diabetic foot ulcer and diabetic foot disease with limb salvage, multidisciplinary team, amputation, revascularisation, offloading, time to referral and remission. Reference lists of the International Working Group on the Diabetic Foot guidelines and the Global Vascular Guidelines [9,10,11] were screened by hand for primary sources.

Eligibility: Studies were included if they reported ulcer incidence, healing, recurrence, amputation or mortality in defined populations, or evaluated a model of care intended to change those outcomes. Studies of individual wound therapies are cited where they establish a component of the pathway and are identified as such.

Data extraction and handling: Design, setting, sample size, comparator and the reported estimate were extracted as published. Whether a comparison was concurrent, historical or before-and-after is reported alongside every figure, because almost nothing in this field is randomised at the level of the care model. No pooling or re-analysis was performed. Figures 1 to 4 and Tables 1 and 2 reproduce published values only. This is a narrative synthesis and was not registered as a systematic review.

Results

The pathway to amputation: The sequence is consistent across settings. A neuropathic or neuroischaemic foot ulcerates; infection, ischaemia or both supervene; and amputation follows when tissue loss outruns perfusion or control of infection [3,4,12]. Because ulcers precede 80 per cent of amputations, the ulcer is the point at which the sequence is interruptible (Figure 3) [1]. Lifetime amputation incidence after ulceration is around 20 per cent, and recent data suggest amputation rates have risen in some regions after a long decline, particularly among younger patients and minority populations [5].

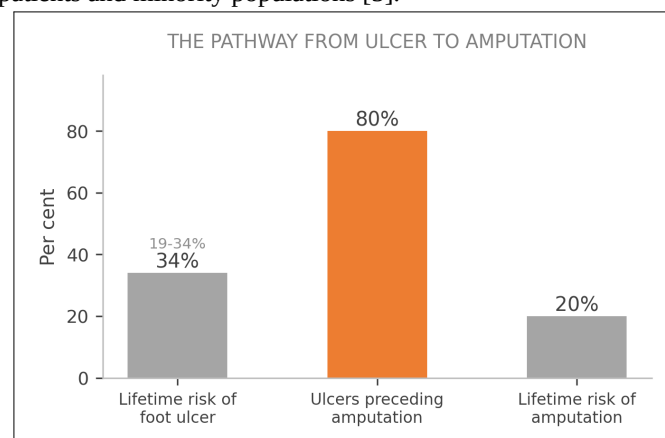


Figure 3: Lifetime risk of ulceration, the proportion of amputations preceded by an ulcer, and lifetime amputation risk [1,5]

What coordinated care changes: The central quantitative finding comes from a review of 18 studies comparing implementation of a multidisciplinary team with usual care. Major amputation occurred in 3.2 per cent against 4.4 per cent, an odds ratio of 0.40 (95% CI 0.32 to 0.51, $p < 0.001$) (Figure 1) [1]. The composition is fairly consistent between services: podiatrists, infectious disease specialists and vascular surgeons working closely with primary care [1,13,14]. Single-service reports describe major amputation rates of a few per cent among patients managed on a pre-set limb salvage protocol [15].

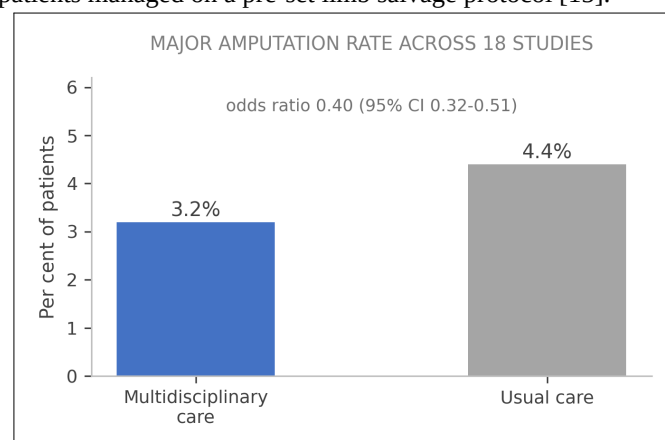


Figure 1: Major amputation rate with multidisciplinary care against usual care, pooled across 18 studies [1]

Time to referral: First-line treatment is not complicated in principle: surgical debridement, offloading, treatment of ischaemia and of infection, and early referral for

multidisciplinary care [1]. The difficulty is that each of these becomes less effective the longer it is delayed, and delay is common because a painless ulcer does not feel urgent to the person who has it. Delays in presentation and in referral are associated with more advanced tissue loss at first specialist assessment [16,17,18], and classification systems exist precisely to trigger escalation at the right threshold [12,19].

Revascularisation and infection: Where perfusion is inadequate, healing will not occur regardless of wound care, and assessment for revascularisation is therefore part of the initial evaluation rather than a later step [10,20]. Randomised comparison of surgical bypass against endovascular treatment in chronic limb-threatening ischaemia has now been undertaken directly [21,22]. Infection is graded and treated according to severity, with guideline documents setting out antibiotic selection and the indications for surgery [23,24].

Study	Design and cohort	Principal reported finding
Armstrong et al. 2023 [1]	Systematic review, 18 studies of MDT care	Major amputation 3.2% vs 4.4%; OR 0.40 (95% CI 0.32-0.51)
Armstrong et al. 2023 [1]	Same review, natural history	18.6m ulcers/year; 80% of amputations preceded by ulcer
Armstrong et al. 2017 [2]	Review of ulceration and recurrence	Recurrence 40% at 1 year, 65% at 5 years; remission framing
Hicks et al. 2023 [5]	Epidemiology and disparities review	Lifetime amputation ~20%; 5-year mortality 50-70%
Prompers et al. 2008 [16]	Eurodiale, European multicentre cohort	Delayed referral associated with more severe presentation
Farber et al. 2022 [21]	BEST-CLI randomised trial	Compared surgical bypass with endovascular revascularisation
Bus et al. 2020 [25]	IWGDF guidance on prevention	Structured prevention reduces recurrence in remission

Table 1: Principal studies reviewed, with the finding as reported by the original investigators

Healing is slower than expected: Only about 30 to 40 per cent of diabetic foot ulcers have healed at 12 weeks [1]. That figure is worth stating to patients, because the mismatch between expectation and reality drives disengagement from offloading, which is the intervention most dependent on adherence and least popular with the people asked to use it [26,27]. The effect on daily life is substantial and under-recorded [31], and the field has repeatedly named prevention as the under-addressed opportunity [32].

What happens after healing: The most consequential number in this literature is the recurrence rate. After an ulcer heals, 42 per cent recur within one year and 65 per cent within five (Figure 2) [1,2]. A healed diabetic foot is therefore not a cured foot, and the field has increasingly adopted the language of remission rather than cure [2,25]. Structured prevention in remission, including appropriate footwear, regular examination, patient education and prompt treatment of pre-ulcerative signs, is what the guidelines recommend for that phase [9,25,28]. Structured prevention programmes have been associated with fewer amputations and admissions [33], and sustained

multidisciplinary work with continuous audit reduced amputations over a decade in defined populations [34,35].

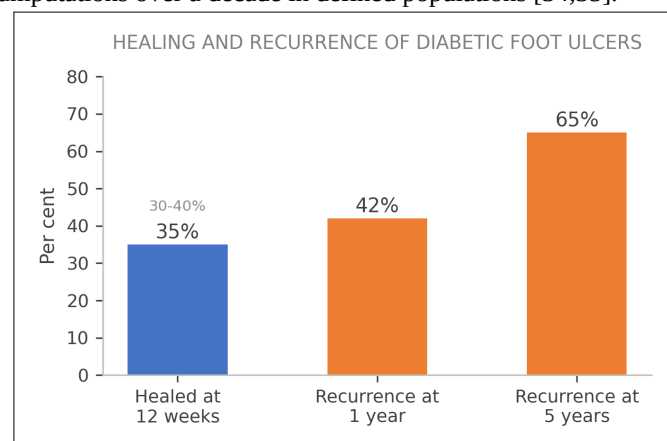


Figure 2: Healing at 12 weeks and recurrence after healing at one and five years [1,2]

Mortality: Five-year mortality is approximately 30 per cent after a diabetic foot ulcer and exceeds 70 per cent after major amputation (Figure 4) [1,5,6]. The association is not straightforwardly causal, since ulceration marks advanced microvascular and macrovascular disease, but the practical implication holds either way: a foot ulcer identifies a patient whose cardiovascular risk warrants attention independent of the wound [6,29]. Ulcer type itself carries prognostic weight [30].

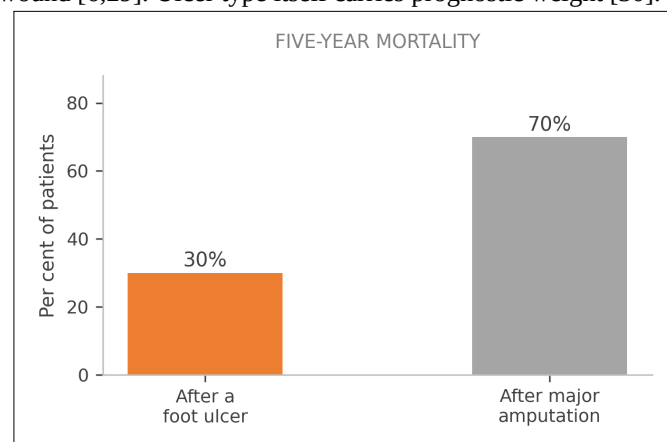


Figure 4: Five-year mortality after a diabetic foot ulcer and after major amputation [1,5,6]

Element	What it addresses	Evidence
Multidisciplinary team	Fragmented responsibility across specialties	OR 0.40 for major amputation across 18 studies [1]
Early referral	Advanced tissue loss at first assessment	Delay associated with worse presentation [16,17]
Perfusion assessment	Wounds that cannot heal without blood flow	Guideline-mandated first step [10,20]
Offloading	Continued pressure on the wound	Effective but adherence-dependent [26,27]
Infection grading	Under- and over-treatment of infection	Severity-based guidance [23,24]
Structured remission care	65% recurrence at five years	Prevention guidance for the healed foot [2,25,28]

Table 2: Components of limb salvage and the failure each is intended to correct

Discussion

The case for multidisciplinary care is strong in direction and modest in magnitude. An odds ratio of 0.40 sounds dramatic; the absolute difference behind it is 3.2 per cent against 4.4 per cent [1]. Both framings are accurate, and the second is the one a service planner needs. Roughly one major amputation is avoided for every eighty-odd patients managed by a team rather than by whoever happens to see them, which is worthwhile given the consequences of amputation, and is not the transformation the relative figure suggests.

The evidence also has a familiar structural weakness. Almost none of it randomises the care model. Services that establish a diabetic foot team are services that were already attending to the problem, comparisons are frequently against historical controls, and amputation rates have been falling for other reasons across the same period [1,5]. Some of the apparent benefit is likely to be secular improvement wearing a team's badge. Since withholding coordinated care to test it is not a plausible trial, this will probably not be resolved.

What is not confounded is the biology of the sequence. Perfusion, infection control and pressure relief each have independent evidence, each is time-sensitive, and each sits with a different specialty [10,20,23,26]. A model of care whose only function is to make all three happen quickly in the same week does not need its own trial to be credible.

The finding that should reshape how this is discussed with patients is recurrence. Sixty-five per cent within five years means that healing an ulcer is the beginning of a surveillance relationship, not the end of an episode [2]. Services organised around closing wounds and then discharging will, on these numbers, see most of those patients again. The language of remission is not a rhetorical flourish; it describes the observed natural history and implies a follow-up structure that most services do not currently provide.

Study limitations

The limitations belong to the underlying literature. The pooled amputation comparison combines studies with heterogeneous definitions of both the team and the outcome, and major and minor amputation are not consistently separated [1]. Before-and-after designs cannot exclude secular trend [5]. Ulcer classification systems differ, so healing and recurrence rates are not directly comparable across cohorts [12,19]. Recurrence figures derive from populations already in specialist follow-up, and may understate recurrence among those lost to it [2]. Mortality after ulceration is confounded by the cardiovascular disease that produced the ulcer, so the association should not be read as an effect of the wound [6,29]. Offloading trials measure adherence poorly [26,27]. And most of this evidence comes from high-income settings, while the burden is growing fastest elsewhere [7,8].

Conclusion

A threatened diabetic foot is a time-limited opportunity in a patient who cannot feel the clock running. Coordinated care by podiatry, vascular surgery, infection and diabetes services is associated with fewer major amputations, and the intervention responsible is organisational rather than technical: making perfusion assessment, infection control and offloading happen together and early. The absolute benefit is smaller than the odds ratio implies and the evidence is not randomised, but the mechanism is sound and the alternative is a sequence that ends in an operating theatre. The number that should change practice most is the one that applies after the wound closes: two in three ulcers return within five years, and a service that discharges at healing has not finished the job.

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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