Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Diabetic foot ulceration and diabetes-related lower-limb amputation in the Caribbean: burden, outcomes and care pathways – a scoping review

Emmanuel Benjamen

ebenjame@sgu.edu

St. George's University

Tanveer Randhawa

St. George's University

David Shamana

St. George's University

Adan Ahmed

St. George's University

Systematic Review

Keywords: diabetic foot, foot ulcer, amputation, Caribbean, scoping review, care pathways, health services, public health

Posted Date: November 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11641383/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Diabetic foot ulceration and diabetes-related lower-limb amputation in the Caribbean: burden, outcomes and care pathways – a scoping review

Emmanuel Benjamen[1*], Tanveer Randhawa[1], David Shamana[1] and Adan Ahmed[1]

[1]School of Medicine, St. George's University, Saint George's, Grenada

*Corresponding author: Emmanuel Benjamen, ebenjame@sgu.edu, telephone 416--827--3783

Email addresses: EB, ebenjame@sgu.edu; TR, trandhaw@sgu.edu; DS, dshamana@sgu.edu; AA, aahmed48@sgu.edu

Abstract

Background: Diabetic foot ulceration and diabetes-related lower-limb amputation are late complications of diabetes, the frequency of which depends on early detection, referral and treatment. Evidence from the Caribbean is scattered across single countries and institutions and has not been mapped. We aimed to map evidence published from 2016 onward on the burden, outcomes and care pathways of diabetic foot ulceration and amputation in the Caribbean and to identify gaps relevant to surveillance and health services.

Methods: We conducted a scoping review following the PRISMA-ScR guidelines. No protocol was registered. PubMed was searched with 7 query blocks combining diabetic foot, amputation and Caribbean place names, followed by a supplementary search seeded from the included studies. Records from 2016 onward were screened by title and abstract, and only studies with accessible full texts were included. The data were extracted into a 44-field worksheet and synthesized descriptively and thematically.

Results: The search identified 150 records (94 unique). Twenty-one studies passed the abstract screening, 15 had accessible full texts, and the supplementary search added 2 studies, resulting in 17 included studies (7 core, 10 partial). Barbados and Trinidad and Tobago each contributed 5

studies. In a Barbados diabetes programme, 14.7% (33/225) of patients had a foot ulcer in 2019. The amputation incidence in Martinique was 48.9 per 100,000 inhabitants in 2018. At one Trinidad institution, the number of major amputations increased from 66 to 152 per year between 2010 and 2016, the 2-year mortality rate was 34%, and 14.5% of patients acquired a prosthesis. A 25-country survey revealed diabetic foot guidelines in 9 countries and no functional multidisciplinary foot units. The authors most often reported sample size and representativeness (10/14 studies) and selection or self-report bias (9/14) as limitations.

Conclusions: Caribbean evidence on diabetic foot ulceration and amputation is limited, concentrated in 2 countries, and largely single-center or cross-sectional. We found no population-based ulcer incidence studies, national registries, or evaluations of prevention or multidisciplinary programs. Priorities for the region include a shared definition and registry for ulcers and amputations; population-based estimates; and evaluations of screening, education and organized foot care services.

Keywords: diabetic foot; foot ulcer; amputation; Caribbean; scoping review; care pathways; health services; public health

Background

Diabetes mellitus is a chronic condition in which prolonged high blood glucose levels damage nerves and blood vessels. In the foot, this damage has three main effects. Peripheral neuropathy removes protective sensations so that pressure, heat, or a small injury from an ill-fitting shoe or from walking barefoot goes unnoticed; it also dries the skin and deforms the foot, which concentrates pressure at certain points. Peripheral artery disease reduces blood flow and slows healing, and impaired immune responses make infection more likely and harder to clear [1]. A diabetic foot ulcer is a break in the skin of the foot that develops through these combined

47 neurological, vascular, and biomechanical factors. Approximately 50% of people with diabetes
48 and foot ulcers have peripheral artery disease [2], and 50% to 60% of ulcers become infected [1].
49 Ulcers precede approximately 80% of lower extremity amputations in people with diabetes and
50 are associated with an increased risk of death [1].
51 Amputation is generally a last resort [3]. It is considered when infection or ischemia threatens
52 life or the limb and cannot be controlled with debridement, antimicrobial therapy, or
53 revascularization, and guidelines should be set out when surgery and revascularization are
54 considered [2,4]. Such guidelines, for example, those of the International Working Group on the
55 Diabetic Foot (IWGDF), are written by international expert panels that update systematic
56 reviews of the evidence and use the Grading of Recommendations, Assessment, Development,
57 and Evaluation (GRADE) framework to rate the certainty of the evidence and determine the
58 strength of each recommendation [4]. Multidisciplinary care, which usually involves podiatry,
59 infectious disease, vascular surgery, and primary care, is associated with lower major amputation
60 rates [1]. The global prevalence of diabetic foot ulceration has been estimated at 6.3%, and North
61 America has the highest regional estimate (13.0%) [5]. Ulceration and amputation are also more
62 common in Black, Hispanic, and lower-income groups [1], and footwear advice written for
63 temperate, high-income settings may be difficult to follow in warm, low-resource settings, where
64 open footwear is common [6]. These points are relevant to the Caribbean.
65 Diabetes is common in the Caribbean, and its foot complications are a recurrent cause of hospital
66 admission and limb loss. The International Diabetes Federation ranked North America and the
67 Caribbean first in terms of diabetes prevalence (13%) in its 2019 report, and diabetes prevalence
68 in Trinidad and Tobago has been reported to range from 11.7% to 12.5% [7]. The indirect cost of
69 diabetes for the Caribbean was US$826 million in 2015, including US$85 million for Trinidad

and Tobago alone [8]. A diabetes-related lower-extremity amputation incidence of 936 per 100,000 people with diabetes (173 per 100,000 people; 557 per 100,000 for minor amputation and 379 per 100,000 for major amputation) was reported in an earlier Barbados study, which described these rates as among the highest in the world [9], and the figure is quoted in later work [10,11]. A primary care audit reported that only 41% of people with diabetes had a recorded foot examination over 2 years, while foot problems accounted for 89% of diabetes admissions [11]. From a public health perspective, ulceration and amputation are outcomes whose frequency depends on screening, referral, specialist access and the organization of foot care. Describing them at the population level requires surveillance, registries and agreed-upon definitions. Regional policy previously targeted amputation: the 1989 St. Vincent Declaration proposed reducing the major amputation rate by 50% within 5 years [7]. Whether care systems in the region have since closed that gap is unclear. Published studies are scattered across single countries and institutions, define ulcerations and amputations differently, and rarely address care pathways such as screening, referrals, specialist access, and guidelines. A foot ulcer has been defined in the Caribbean as a break in the epidermis and dermis in a person with diabetes [10]. In our PubMed search, we did not find a scoping or systematic review specific to diabetic foot ulceration and amputation in the Caribbean. Four related reviews addressed adjacent questions: footwear worn by people with diabetes in low- and middle-income countries [6], antimicrobial resistance in diabetic foot infection in Latin America and the Caribbean [12], research trends on diabetic foot in Latin America [13], and recovery after nontraumatic lower-limb amputation worldwide [14]. None of them mapped the burden, outcomes, and care pathways of diabetic foot ulceration and amputation in the Caribbean.

This scoping review addresses one research question: what evidence has been published since 2016 on diabetic foot ulceration and diabetes-related lower-limb amputation in the Caribbean? Three objectives guided the search strategy and data extraction. The first aim was to describe the prevalence, incidence, amputation rates, and risk factors reported for diabetic foot ulceration and amputation in the Caribbean. The second objective was to describe the reported healing, mortality, length of stay, and quality-of-life outcomes. The third objective was to describe how prevention, presentation, self-care and traditional treatment, multidisciplinary and specialist access, guidelines, and rehabilitation are organized and to identify key gaps in the literature.

Methods

Study design

A scoping review was chosen to map the available evidence across study designs and to identify gaps. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines [15] (Additional file 1) and used the population-concept-context (PCC) framework. The population included people with diabetes with foot ulceration, diabetic foot infection, or diabetes-related lower-limb amputation. The concept covered burdens, outcomes, and care pathways. The context included Caribbean countries and territories, including members of the Caribbean Community (CARICOM); French, Dutch, and Spanish-speaking territories; and U.S. territories located in the Caribbean (Puerto Rico and the U.S. Virgin Islands).

Protocol and registration

A protocol for this review was not registered, and no protocol was published before the review began.

Information sources and search strategy

We searched PubMed (National Center for Biotechnology Information). No other database was searched. The search used 7 query blocks: diabetic foot with place names; amputation with place names; diabetic foot ulcers with other territories; a Medical Subject Headings (MeSH) query combining the geographic term "West Indies" with the MeSH terms "Diabetic Foot" or "Amputation, Surgical"; review terms; care pathway terms; and ethnicity with outcomes. The full search strings and the number of hits for each block are given in Additional file 2. The 7 blocks returned 150 hits and 94 unique records. A database date filter was not used; records were limited to publications from 2016 onward by publication year at screening. To check whether the 7 query blocks had missed relevant studies, we ran a supplementary PubMed search using the included studies as a starting point (related-article and keyword searches built on their topics and settings) and screened the new records against the same criteria.

Eligibility criteria

The inclusion and exclusion criteria are shown in Table 1. Reviews were set aside and used only to check novelty. Records that touched the topic but lacked the Caribbean setting, the population, or the outcome of interest in the abstract were classified as borderline or context papers.

Table 1 Eligibility criteria for the scoping review

Criterion	Description
Inclusion	People with diabetes with diabetic foot ulceration, diabetic foot infection, or diabetes-related lower-limb amputation, or studies of the foot care and health system context for this population
Inclusion	Caribbean country or territory, including studies covering several countries that include Caribbean settings
Inclusion	Any study design, including quantitative, qualitative, and case reports
Inclusion	Published in 2016 or later
Inclusion	Full text available to the research team
Exclusion	Published before 2016 or without a publication date in PubMed
Exclusion	Reviews (set aside for the novelty check)
Exclusion	Borderline or context papers that lacked the Caribbean setting, population, or outcome of interest
Exclusion	Records excluded on content, for example wrong setting, trauma or nondiabetic amputation, mechanistic or laboratory studies, news items, or errata

Criterion	Description
Exclusion	No accessible full text (n=6)

Criteria were applied at title and abstract screening and at full-text assessment.

Study selection

The titles and abstracts of the 41 records within the date limit were screened by the research team using the criteria in Table 1. All four authors screened the records and extracted the data. In the first round, each author independently screened and extracted the data. In the second round, the authors worked in pairs to review the screening and extraction results. Disagreements were resolved by discussion among all four authors until consensus was reached. Studies retained after abstract screening were sought in full text. The full texts of 15 of the 21 studies were obtained. Six reports could not be retrieved because no full text was accessible to the research team, and they were not extracted from abstracts. The supplementary search added 2 studies (Parey et al. [3] and Camilo Reynoso et al. [16]), whose full texts were read from PubMed Central. The included studies were graded as core when they provided Caribbean data on ulcer or amputation burden, outcomes, or care pathways in a defined country and as partial when the focus was different (for example, a risk factor, knowledge and practice, or treatment only), the data were multiregional, or the paper was a case report. The U.S. territory survey [17] was used as a partial study because it reports data for Puerto Rico, which is in the Caribbean, although it also covers Guam.

Data extraction

The data were extracted into a 44-field Excel worksheet adapted from a standard extraction template (Additional file 3). The fields covered article identification (author, year, title, journal, and digital object identifier); study characteristics (country, design, method, sample size, study period, and setting); participant demographics (age, sex, ethnicity, diabetes type and duration, glycemic control, and comorbidities); ulcer and amputation burden (definitions, data source,

154 severity, prevalence or incidence, amputation rate and level, and delay in presentation); care
155 pathways (access and referral, multidisciplinary and specialist care, prevention and education,
156 treatment, self-directed or traditional treatment, and costs); outcomes (healing, mortality, length
157 of stay, readmission, quality of life, and risk factors); and study limitations, relevance to each
158 objective, key conclusions, and inclusion tier. The research team extracted each value from the
159 full text and checked it against the text or table cited. Items absent from the full text were
160 recorded as "not reported in full text," and no value was estimated or imputed. Inconsistencies
161 within a paper (for example, between the abstract and a table) were flagged and not corrected.
162 Overlapping cohorts were identified and counted once.

163 ***Data analysis and synthesis***

164 We used descriptive methods to summarize the study characteristics, reported as counts and
165 percentages of the included studies. We narratively synthesized findings by objective. Two
166 qualitative variables, the limitations stated by the study authors and the recommendations made
167 by the study authors, were grouped into themes by the research team. We did not appraise the
168 quality of individual studies. Data on burden and outcomes were not pooled because populations,
169 definitions, and denominators differed across studies.

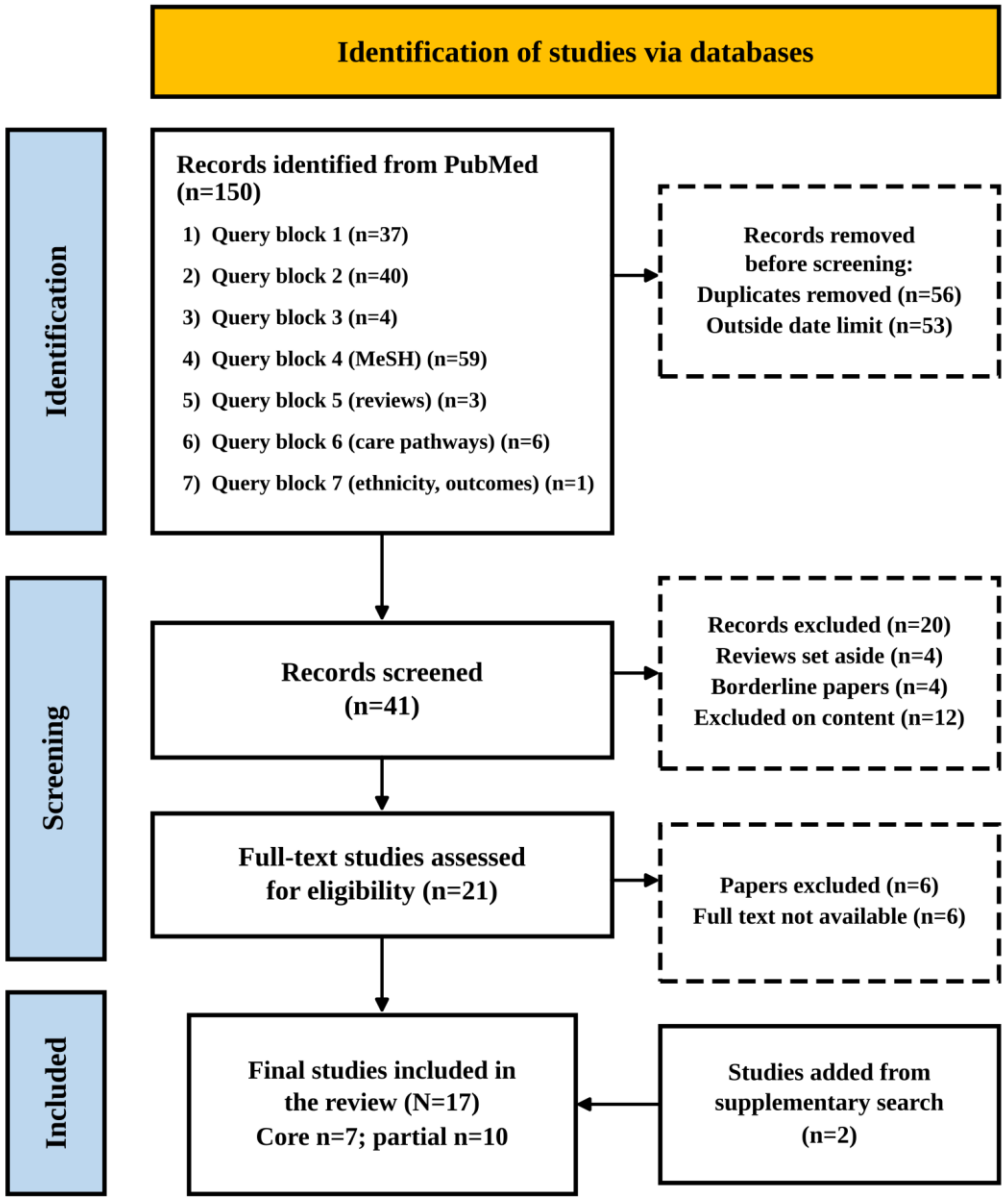
170 **Results**

171 ***Study selection***

172 We selected 17 studies [3,7,8,10,11,16-27] from an initial pool of 150 records retrieved from
173 PubMed (94 unique). Fig. 1 outlines the process based on the PRISMA-ScR flow. After 53
174 records were removed for falling outside the date limit, 41 were screened by title and abstract,
175 and 21 were retained. The full texts of all 21 studies were searched; 6 could not be retrieved,
176 leaving 15 studies. A supplementary search added 2 studies [3,16], resulting in 17 studies (7 core

and 10 partial). Two overlaps exist among the included studies: Adams et al. [11,19] used the same 236 participants from a Barbados population survey, and the 2 Pran et al. papers [7,20] came from one Trinidad institution and shared a 603-patient demographic set. Each overlapping set is counted once in the narrative synthesis.

Fig. 1 Flow chart of records through the scoping review, based on the PRISMA-ScR flow diagram. PRISMA-ScR, Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews; MeSH, Medical Subject Headings.



Characteristics of the studies and literature distribution

Cross-sectional studies and surveys were the most common design (8/17, 47%), followed by cohort studies, record reviews, or observational studies (5/17, 29%), qualitative studies (3/17, 18%), and single case reports (1/17, 6%). Seven studies (41%) were graded as core, and 10 (59%) were partial. Most studies (14/17, 82%) were published from 2021 onward, and none were published in 2023 or 2024 (Fig. 2; Table 2).

Fig. 2 Number of included studies by year of publication (N=17).

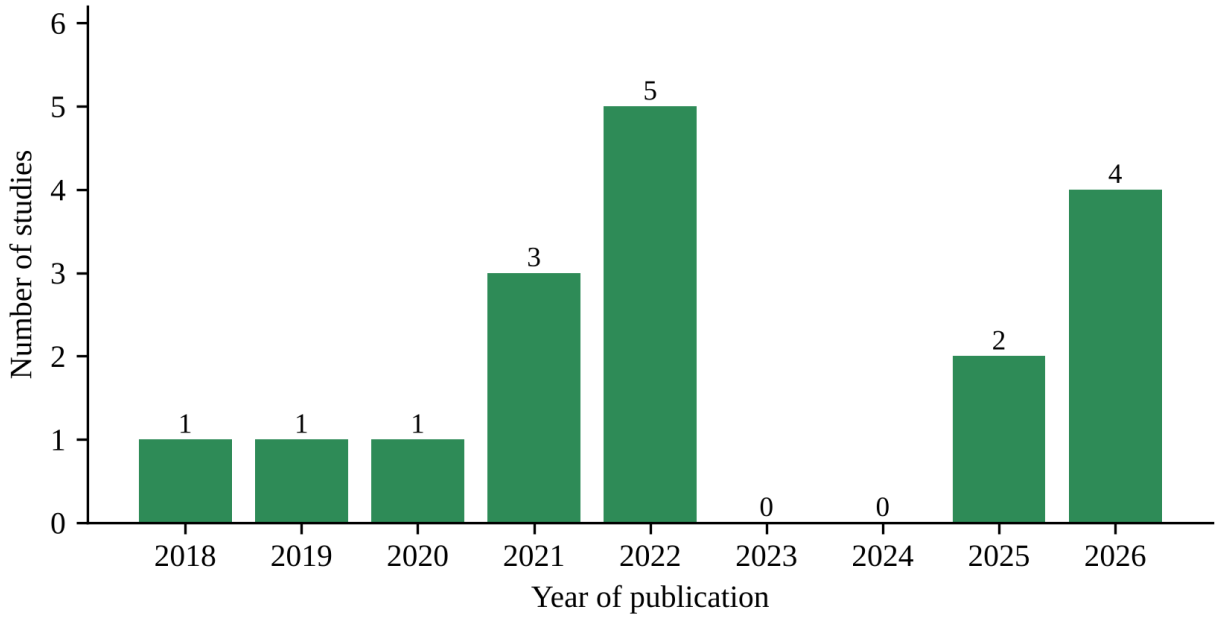


Table 2 Characteristics of the included studies

Characteristic	Studies, n (%)
Study design	
Cross-sectional study or survey	8 (47)
Cohort study, record review, or observational study	5 (29)
Qualitative study	3 (18)
Case report	1 (6)
Inclusion tier	
Core	7 (41)
Partial	10 (59)
Publication year	
2018-2020	3 (18)
2021-2022	8 (47)
2023-2026	6 (35)

N=17 studies. The percentages are rounded to whole numbers.

Barbados and Trinidad and Tobago were the most frequent sources of studies (5/17, 29% each). Single studies were from the Dominican Republic, Guadeloupe, Jamaica, and Martinique, and 3 studies (18%) covered several countries (Table 3). No single-country study has been conducted for Haiti, Cuba, the Bahamas, or the smaller Eastern Caribbean islands, although a 25-country survey [8] covers many of them at the national level. Table 4 lists the design, setting and sample of each included study (Appendix A).

Table 3 Sources of the included studies by country or territory

Country or territory	**Studies, n (%)**
Barbados	5 (29)
Trinidad and Tobago (including Tobago)	5 (29)
Dominican Republic	1 (6)
Guadeloupe	1 (6)
Jamaica	1 (6)
Martinique	1 (6)
Multicountry	3 (18)
25 Caribbean countries and territories [8]	
6 countries including Trinidad and Tobago [27]	
US territories (Puerto Rico, US Virgin Islands, Guam) [17]	

N=17 studies. The percentages are rounded to whole numbers.

Findings from the descriptive analysis

Table 5 shows how many studies reported each burden, outcome, and care pathway item as study data. The time to presentation or pretreatment assessment (5/17, 29%) and the knowledge, beliefs, or experience of patients, relatives, or nurses (5/17, 29%) were the most frequently reported items. The prevalence or incidence of ulcers (3/17, 18%) and the incidence or rate of amputation (2/17, 12%) have been reported by few studies, and mortality after amputation has been reported by only 1 (6%) individual.

Table 5 Burden, outcome, and care pathway items reported in the included studies

Item reported as study data	**Studies, n (%)**	**References**
Ulcer prevalence or incidence	3 (18)	[10,11,21]

Item reported as study data	Studies, n (%)	References
Amputation incidence or rate	2 (12)	[7,18]
Healing outcomes	4 (24)	[16,21,23,26]
Mortality after amputation	1 (6)	[7]
Length of hospital stay	3 (18)	[7,18,26]
Quality of life or wellbeing	3 (18)	[3,20,22]
Time to presentation or pretreatment assessment	5 (29)	[7,18,21,23,26]
Knowledge, beliefs, practice, or experience of patients, relatives, or nurses	5 (29)	[3,22,24,25,27]
Health system capacity, guidelines, or service model data	4 (24)	[7,8,17,23]
Traditional or self-directed treatment	3 (18)	[22,25,26]

N=17 studies. A study can report more than one item.

Burden

Ulcer prevalence and incidence. One study reported ulcer frequency in a defined population. In a publicly funded multidisciplinary diabetes programme in Barbados, 33 of 225 patients (14.7%; 95% confidence interval [CI] 10.5--20.1) had a foot ulcer in 2019 [10]. The reported incidence was 4.4%, and its 95% CI (4.4–4.5) appears narrower than would be expected for a sample of this size. In a population-based Barbados sample of 236 people with diabetes, current or past ulceration or amputation was recorded together, and the combined figure was 4.2% overall (8.3% in those with previously diagnosed diabetes and 0% in those with newly detected diabetes) [11]. In the Barbados inpatient cohort, the hospital-based incidence was 0.23% over 6 months, which the authors state is not a population incidence [21]. Only 2 of the 25 countries included in the regional survey had definitive ulcer or infection incidence data [8].

Amputation. In Martinique, the 2018 amputation incidence was 48.9 per 100,000 inhabitants, or 434 per 100,000 among people with diabetes, and 79 of 170 amputations (46%) were major [18]. In Trinidad, 781 major amputations occurred between 2010 and 2016 at one institution, increasing from 66--152 per year; 473 (60%) were above the knee, and the amputation rate was 28 per 100,000 per year over the 7 years (ranging from 16.5--38 per 100,000 per year) [7]. Among the 344 patients whose full records were available, diabetes was recorded in 312

(90.7%), and diabetes-related foot sepsis was the main cause in 69% (P<0.05) of these patients [7]. According to a regional survey, 3 of 25 countries knew about the incidence of diabetic foot amputation, and 6 knew about the incidence of major amputation [8].

Risk factors. In the Barbados programme sample, the odds of having a foot ulcer were greater in patients with older age, hypertension, diabetes duration over 10 years, retinopathy, chronic kidney disease, neuropathy, and antiplatelet use than in patients without these characteristics (univariable odds ratios above 1). However, each factor was tested alone and not adjusted for the others, and the confidence intervals were wide [10]. In a population sample, the loss of protective sensation means that the person can no longer feel pressure, pain, or temperature in the foot and thus may not notice an injury (tested with a 10-g monofilament and vibration test), which affects 28.5% (95% CI 22.7–34.4) of the participants overall and 36.4% of those with previously diagnosed diabetes [11], and peripheral arterial disease affects 18.6% (95% CI 13.8–24.6) [19]. In Trinidad, an open wound on the affected leg preceded 51.8% of major amputations (P=.006), and a prior minor amputation, recorded in 110 of 344 patients, was associated with a greater likelihood of major amputation (P<.05) [7]. In the Dominican Republic cohort, age over 60 years, glycated hemoglobin (HbA1c) above 7%, a baseline wound area above 20 cm^2, infection, higher Wagner grade, and peripheral arterial disease were each linked with lower odds of ulcer closure, although the model was fitted to only 24 patients [16].

Outcomes

Healing and amputation after treatment. Among 176 Barbados inpatients, 12 (7.14% after attrition) had completely healed at 6 weeks [21]. In Guadeloupe, 18 of 53 evaluable patients (34%) had healed at 6 months after hyperbaric oxygen therapy, and no candidate factor reached significance; 11 of 59 patients (19%) had a major amputation during or after therapy [23].

Referral through the diabetic foot care unit was linked to fewer major amputations (1 vs. 7; P=.044), but the authors caution that referral selection may explain this [23]. In a small Dominican Republic study of topical clay used as an adjunct to standard wound care, complete closure by week 20 was reached in 13 of 14 noninfected ulcers (92.9%) and 4 of 10 infected ulcers (40.0%), and no amputations or deaths occurred during follow-up; the study had no control group [16].

Mortality, length of stay, and quality of life. In Trinidad, in-hospital mortality after major amputation was 10%, 30-day mortality was 15%, and 2-year mortality was 34%, which is likely an underestimate because the authors found records of patients who died in hospitals that were more difficult to retrieve [7]. The mean length of stay was 15.2 days in Trinidad [7] and 22.6 days in Martinique [18]. Among 134 Trinidad survivors, EuroQol 5-dimensional 5-level (EQ-5D-5 L) scores were low, with a median index of 0.787 for prosthesis users and 0.195 for nonambulant patients; the abstract's overall mean of 0.598 is not reproduced in the tables [20]. In Trinidad and Tobago, 14.5% of patients acquired a prosthesis after major amputation [7]. A qualitative study of 15 people with diabetic foot ulceration in Barbados described emotional distress, fear of the hospital, and fear of limb loss, including a community perception of a "cut, cut, cut" culture that the authors noted was not verified by any official source [22]. Participants also reported receiving little information from health professionals and preferred videos, one-to-one sessions, and storytelling to printed material, partly because of literacy [22]. In Trinidad and Tobago, 17 people with lower-limb amputations (10 of whom were diabetes-related) and 17 relatives described missed opportunities for prevention, hospital circumstances that compounded their experience, postamputation services that were insufficient for rehabilitation, reliance on informal networks and private funds, and a need for mental health services [3].

Care pathways

Presentation and delay. In Trinidad, 79% of patients presented more than 7 days after symptom onset [7]. In Martinique, 35% of amputees had no preprocedure vascular assessment, and 71% were emergency admissions [18]. In Barbados, 58% of inpatients reached emergency care within 2 days of symptom onset [21]. A Japanese case report described a man who presented to the Accident and Emergency Department of a hospital after approximately one month of self-management and was referred by a private practitioner 2 days earlier [26]. In the Trinidad and Tobago interviews, participants described delayed or missed diagnoses, and one relative reported that a family member avoided clinic visits because of long waiting times for dressing changes [3].

Self-care, beliefs, and traditional treatment. Barbadian participants reported mistrust of the health system, long waits with lost income, and remedies such as saltfish skin and grated papaya [22]. In Tobago, the smaller island of Trinidad and Tobago, 15 of 20 participants had no information about diabetic foot ulcers, although self-reported foot care practices were generally good [25]. In East China Trinidad, 88.5% held strong beliefs about susceptibility to foot injury, and 69% reported good practices [24]. In the Trinidad and Tobago interviews, many people with amputations said that their blood glucose levels had not been monitored before amputation despite a family history of diabetes [3]. In a 6-country nurse survey, Trinidad and Tobago reported low implementation of several foot-care teaching items: checking inside shoes, sock fit, straight cutting of toenails, toenail checks, correctly sized shoes, not applying lotion between the toes, shoe characteristics, bath-water temperature, and checking between the toes [27].

Screening, guidelines, and specialist access. In the 25-country survey, 81% of the respondents could name no initiative monitoring the diabetic foot, and guidelines existed in 9 countries

298 (36%), mostly distributed by diabetes or medical associations. Only 3 countries used the
299 International Working Group on the Diabetic Foot guidelines [8]. The paper's discussion gives
300 slightly different counts (5 countries with guidelines and 2 using the International Working
301 Group guidelines), and we report the figures from its Results. Although podiatrists,
302 endocrinologists, vascular surgeons and infectious disease specialists are scarce or absent.
303 Podiatrists were reported in 6 of 25 countries (24%), and vascular surgery was reported in 10
304 countries (40%), of which only 3 countries had specialist vascular training, and in 4 countries,
305 the vascular surgery available was not focused on the lower limb. Seven countries (28%) had the
306 components of a multidisciplinary clinical team, but none had a functional unit [8]. In a survey of
307 US territories, 45.9% of foot examinations were performed annually in Puerto Rico, whereas
308 66.1% of foot examinations were performed annually in the United States [17]. In Trinidad, the
309 primary amputation rate was comparable before and after a vascular unit opened, and major
310 amputations still occurred [7].

311 ***Findings from the thematic analysis***

312 Fourteen studies [3,7,8,10,11,16-19,21-24,27] had limitations. Table 6 groups these into 5
313 themes. Sample size and representativeness (10/14, 71%) and selection, nonresponse, or self-
314 report bias (9/14, 64%) were the most common, followed by missing or nonsystematic data
315 (5/14, 36%). The 3 studies without limitations were quality-of-life studies [20], qualitative
316 studies [25], and case reports [26].

317 **Table 6** Themes in the limitations stated by the study authors

Theme	Studies, n (%)	Explanation	References
Sample size and representativeness	10 (71)	Small, single-site, or public-sector samples; convenience sampling; results not generalizable	[3,7,10,11,16,21-24,27]
Selection, nonresponse, and self-report bias	9 (64)	Nonresponders differed from responders; self-reported practice or social desirability; referral and	[3,7,11,17,19,21,23,24,27]

Theme	Studies, n (%)	Explanation	References
		attrition bias; recruitment through personal networks	
Missing or nonsystematic data	5 (36)	Retrospective records, uncaptured variables such as HbA1c, wound grade, or offloading, and missing values	[7,10,18,21,23]
Coverage of settings, countries, or years	3 (21)	Other hospitals, countries, or survey years not covered	[8,17,18]
Design and follow-up	3 (21)	Single-arm or uncontrolled design, no power calculation, and short follow-up	[16,21,23]

n=14 studies that stated limitations. HbA1c, glycated hemoglobin.

The research team also grouped the recommendations made by the study authors (Table 7). Education adapted to literacy, culture, and local beliefs was the most frequent recommendation (6/17, 35%), followed by multidisciplinary teams, specialist services, guidelines (6/17, 35%) and routine foot screening in primary care (4/17, 24%). None of the included studies evaluated any of these interventions, and they could serve as a basis for further exploration.

Table 7 Themes in the recommendations made by the study authors

Theme	Studies, n (%)	References
Education adapted to literacy, culture, and local beliefs	6 (35)	[7,21,22,24,25,27]
Multidisciplinary teams, specialist services, and guidelines	6 (35)	[3,7,8,20,23,25]
Routine foot screening in primary care	4 (24)	[7,10,11,19]
Earlier vascular assessment and timely referral	2 (12)	[7,18]
Rehabilitation and prosthesis access for older patients	2 (12)	[7,20]

N=17 studies. A study can contribute to more than one theme.

Discussion

In response to the burden of diabetic foot disease in the Caribbean, this scoping review aimed to provide an overview of the published evidence on ulceration, amputation, outcomes, and care pathways from 2016 onward. Our discussion is structured to reflect the findings across 3 areas: the characteristics of the literature, the evidence on burden and outcomes, and the evidence on care pathways.

Characteristics of the literature

The amount of evidence from the Caribbean since 2016 has been small and uneven. We included 17 full-text studies, 10 of which were from Barbados or Trinidad and Tobago, which together account for most of the single-country evidence. Most of the studies were cross-sectional studies or surveys (8/17), only 5 followed or described patients over time, and only 3 were qualitative. Most studies are recent (14 of 17 were published from 2021 onward), which suggests growing interest, but none were published in 2023 or 2024, and several are single-center studies whose findings may not apply to other islands. Three studies included several countries, and only 1 of them focused on diabetic foot disease itself [8]. No study was identified from Haiti, Cuba, the Bahamas, or the smaller Eastern Caribbean islands as a single-country study. One Dominican Republic study [16] tested topical treatment in 24 patients and reported little about burden or care pathways. This finding may reflect real gaps in research activity, but it may also reflect our single-database search and our requirement for accessible full text. A recent bibliometric analysis of Latin American diabetic foot research reported that Barbados had among the highest median citations despite low output and that only 1.6% of publications involved collaboration within the region [13].

The study design limits what the literature can show. Retrospective record reviews and cross-sectional surveys can describe how common a problem is at one time, but they cannot reveal how ulcers progress, which interventions work, or how outcomes change after a service is introduced. The 7 core studies provide most of the burden and outcome data, whereas the 10 partial studies add risk factors, patient and nurse perspectives, case-level detail, treatment data, and health system context. Taken together, the evidence is better at describing problems than at testing solutions.

Burden and outcomes

The rates of ulcer incidence, amputation, and healing outcomes are high. In a Barbados diabetes programme, 14.7% (33/225) of patients had a foot ulcer in 2019 [10], the amputation incidence in Martinique was 48.9 per 100,000 inhabitants [18], and major amputations at one Trinidad institution rose from 66 to 152 per year between 2010 and 2016 [7]. The prevalence of ulcers in Barbados (14.7%) is higher than the pooled global prevalence of 6.3% [5], although these are different measures from different populations, and an earlier Barbados study reported that diabetes-related amputation rates are among the highest in the world [9]. The outcomes were poor where they were measured: 7.1% of Barbados inpatients had healed at 6 weeks [21], 34% of a Guadeloupe hyperbaric oxygen cohort had healed at 6 months [23], and prosthesis acquisition after major amputation was 14.5% in Trinidad [7]. The 2-year mortality of 34% after major amputation in Trinidad [7] contrasts with the 5-year mortality of approximately 30% for people with diabetic foot ulcers and over 70% after major amputation reported in a global review [1], but the follow-up periods differ, and the Trinidad figure is probably an underestimate. These figures come from different populations and definitions and cannot be compared directly or pooled. Hospital-based rates are not population incidence rates, and the Martinique rate depends on census and diabetes prevalence estimates [18]. Only 3 of the 17 studies reported ulcer prevalence or incidence, and none provided a population-based ulcer incidence estimate.

Risk factors in Caribbean studies include familial factors such as neuropathy, peripheral arterial disease, older age, hypertension, longer diabetes duration, and kidney disease [7,10,11,19]. Loss of protective sensation affected more than a quarter of a population-based sample in Barbados [11], and an open wound preceded approximately half of major amputations in Trinidad [7]. These findings support early foot screening because the conditions that lead to ulceration can be detected before a wound appears. The healing data revealed a different problem: in the inpatient

and hyperbaric oxygen cohorts, few ulcers had healed within the reported follow-up periods [21,23], and the only study with high closure rates [16] was a small uncontrolled study of noninfected, Wagner grade 1 to 3 ulcers that excluded patients with more severe disease. Because infection and peripheral arterial disease were linked with poorer healing in that study, they remain important targets for early assessment [16]. The experience of living with the condition is also part of the burden: people described fear, mistrust, and the financial and emotional costs of care in Barbados and Trinidad and Tobago [3,22].

Care pathways

The care pathway findings were the most consistent. Late or fragmented presentations have been reported in Trinidad [7], Martinique [18], and Jamaican [26]. A regional survey revealed no functional multidisciplinary units in any of the 25 countries and little national monitoring [8]. Major amputations in Trinidad continued to increase after a vascular unit opened, which the authors attributed to late presentation, referral patterns, and increasing comorbidity [7], so a single new service did not change the trend within the study period. The authors of that study concluded that timely patient referrals and dedicated services for the management of diabetic foot infection, in addition to wound care, are needed [7]. Qualitative work from Barbados, Tobago, and Trinidad and Tobago points to mistrust, waiting times, traditional remedies, limited information, and gaps in rehabilitation as barriers, even where care is free at the point of use [3,22,25]. Several authors recommended foot screening, education adapted to literacy and culture, and multidisciplinary teams (Table 7), but none of the included studies evaluated such a programme. These recommendations therefore remain untested in the Caribbean literature we retrieved.

Implications for public health

Taken together, these studies describe a health-system problem as much as a clinical one. The measures that could be used to determine whether foot outcomes are improving in the region, such as population-based ulcer incidence, national amputation registries and routine foot examination coverage, are largely absent from the literature we retrieved. Where they exist, they come from single institutions, a single census year or a single programme. Surveillance built on shared definitions of ulceration and amputation would allow countries to be compared and would provide a baseline against which screening, education and multidisciplinary programmes could be evaluated.

Limitations

Several limitations should be acknowledged. First, only PubMed was searched, so Caribbean literature indexed elsewhere, for example, in LILACS, SciELO, and regional journals, was likely missed, and the place-name terms covered some territories only partly. The supplementary search relied on PubMed-related article and keyword searches and did not include formal citation tracking in other databases, and gray literature was not searched. Second, 6 studies that passed abstract screening were excluded because their full text was not accessible; thus, inclusion depended on access and not on quality, and those studies might have changed the picture or added meaningful inclusions to the data and interpretation. Third, the full texts were mostly read from PubMed Central versions, which may differ from the journal versions. Fourth, the 2016 limit was applied by publication year after retrieval and not as a database filter. Fifth, no protocol was registered, and we did not appraise the quality of individual studies. Finally, this review maps the evidence and does not provide pooled estimates.

Conclusions

This review aimed to outline the current evidence on diabetic foot ulceration and diabetes-related lower-limb amputation in the Caribbean. Using a scoping review with descriptive and thematic methods, we evaluated 17 studies with accessible full texts. Our primary finding is that the burden is high where it has been measured, outcomes are poor, and care systems show late presentation and few multidisciplinary services, but the evidence is limited, concentrated in Barbados and Trinidad and Tobago, and mostly descriptive. No population-based ulcer incidence, national registry, or evaluation of a prevention or multidisciplinary programme was found. These insights are valuable for clinicians, policy makers, and researchers, as they point to priority areas: a shared definition and registry for ulcers and amputations; population-based estimates; and evaluation of screening, education, and multidisciplinary foot-care programmes in the region.

List of abbreviations

CARICOM: Caribbean Community

CI: Confidence interval

EQ-5D-5 L: EuroQol 5-dimensional 5-level

GRADE: Grading of recommendations, assessment, development, and evaluation

HbA1c: Glycated hemoglobin

IWGDF: International Working Group on the Diabetic Foot

MeSH: Medical subject headings

PCC: Population-Concept-Context

PRISMA-ScR: Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

All the data gathered during this study are included in this published article and its additional files.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable.

Authors' contributions

EB, TR, DS and AA contributed equally to this work. All four authors took part in conceptualizing the review, designing the search strategy, screening studies, extracting and checking data, analyzing and interpreting the findings, and drafting and revising the manuscript. All the authors read and approved the final manuscript.

Acknowledgments

Not applicable.

References

1. Armstrong DG, Tan TW, Boulton AJM, Bus SA. Diabetic foot ulcers: a review. JAMA. 2023;330:62-75. https://doi.org/10.1001/jama.2023.10578

2. Fitridge R, Chuter V, Mills J, Hinchliffe R, Azuma N, Behrendt CA, et al. The intersocietal IWGDF, ESVS, SVS guidelines on peripheral artery disease in people with diabetes and a foot ulcer. Diabetes Metab Res Rev. 2024;40:e3686. https://doi.org/10.1002/dmrr.3686

3. Parey B, Varachhia S, Enightoola H, Kutscher E. Pre- and postamputation healthcare experiences among persons with lower-limb amputations and their relatives: the case of Trinidad and Tobago. PLOS Glob Public Health. 2025;5:e0004739. https://doi.org/10.1371/journal.pgph.0004739

4. Senneville E, Albalawi Z, van Asten SA, Abbas ZG, Allison G, Aragon-Sanchez J, et al. IWGDF/IDSA guidelines on the diagnosis and treatment of diabetes-related foot infections (IWGDF/IDSA 2023). Diabetes Metab Res Rev. 2024;40:e3687. https://doi.org/10.1002/dmrr.3687

5. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. Ann Med. 2017;49:106-16. https://doi.org/10.1080/07853890.2016.1231932

6. Reddie M, Shallal C, Frey D. A scoping review of footwear worn by people with diabetes in low- and middle-income countries: implications for ulcer prevention programs. Glob Health Sci Pract. 2023;11:e2200392. https://doi.org/10.9745/GHSP-D-22-00392

7. Pran L, Harnanan D, Baijoo S, Short A, Cave C, Maharaj R, et al. Major lower limb amputations: recognizing pitfalls. Cureus. 2021;13:e16972. https://doi.org/10.7759/cureus.16972

8. Sumpio BE, McConnie S, Maharaj D. Heterogeneity in the guidelines for the management of diabetic foot disease in the Caribbean. PLOS Glob Public Health. 2022;2:e0000446. https://doi.org/10.1371/journal.pgph.0000446

9. Hennis AJM, Fraser HS, Jonnalagadda R, Fuller J, Chaturvedi N. Explanations for the high risk of diabetes-related amputation in a Caribbean population of black African descent and potential for prevention. Diabetes Care. 2004;27:2636-41. https://doi.org/10.2337/diacare.27.11.2636

10. Lovell L, Dunkley A, Webb D, Jarvis J, Gillies C. Incidence, prevalence, and potential risk factors for diabetic foot ulceration: a retrospective review at a multidisciplinary center in Barbados. Int Wound J. 2022;20:935-41. https://doi.org/10.1111/iwj.13940

11. Adams OP, Herbert JR, Howitt C, Unwin N. The prevalence of peripheral neuropathy severe enough to cause a loss of protective sensation in a population-based sample of people with known and newly detected diabetes in Barbados: a cross-sectional study. Diabet Med. 2019;36:1629-36. https://doi.org/10.1111/dme.13989

12. Husaini DC, Chiroma JH, Sani GM, Ihebie CE, Nwachukwu I, Nwokocha C, et al. Antimicrobial resistance in diabetic foot infections in Latin America and the Caribbean: a systematic review and meta-analysis (1980-2025). Int J Microbiol. 2026;2026:5244269. https://doi.org/10.1155/ijm/5244269

13. Martin AM, Verastegui A, De la Torre OA, Sanchez CG, Fabiani MA, Gonzalez-Urquijo M. Research trends on diabetic foot in Latin America: a bibliometric analysis (2000-2025). Int J Low Extrem Wounds. 2025;25:1138-48. https://doi.org/10.1177/15347346251380036

14. Lee SP, Eskandarighargheh F, Magsi F, Akiona-Bannan C, Contreras J, Francisco KC, et al. Recovery after nontraumatic lower limb amputation: a scoping review of longitudinal research studies. Arch Rehabil Res Clin Transl. 2026;8:100671. https://doi.org/10.1016/j.arrct.2026.100671

15. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169:467-73. https://doi.org/10.7326/M18-0850

16. Camilo Reynoso A, Diaz Beltre A, Figueras A. Dermomina clay achieves high closure rates in noninfected diabetic foot ulcers. Front Endocrinol (Lausanne). 2026;17:1742928. https://doi.org/10.3389/fendo.2026.1742928

17. Ogilvie RP, Patel SA, Narayan KMV, Mehta NK. Are the U.S. territories lagging behind in diabetes care practices?. Prim Care Diabetes. 2018;12:432-7. https://doi.org/10.1016/j.pcd.2018.04.005

18. Fournet B, Falchetti A, Roques F, Gaillard G, Inamo J, Blanchet-Deverly A. Epidemiology of the vascular assessment and correlation of the WIfI classification in lower limb amputee patients at Martinique university hospital in 2018. J Med Vasc. 2020;45:114-24. https://doi.org/10.1016/j.jdmv.2020.03.008

19. Adams OP, Herbert JR, Unwin N, Howitt C. Peripheral arterial disease prevalence in a population-based sample of people with diabetes on the Caribbean island of Barbados. Vasc Health Risk Manag. 2022;18:387-95. https://doi.org/10.2147/VHRM.S364993

20. Pran L, Baijoo S, Harnanan D, Slim H, Maharaj R, Naraynsingh V. Quality of life experienced by major lower extremity amputees. Cureus. 2021;13:e17440. https://doi.org/10.7759/cureus.17440

21. Lovell LN, Chockalingam N, Davies N, Chami P, Greaves NS. Educational attainment and diabetic foot ulceration: outcomes from the Barbados Diabetic Foot Study. Int Wound J. 2026;23:e70969. https://doi.org/10.1111/iwj.70969

534 22. Lovell L, Campbell MH, Greaves N. Multiple lenses to unearth hidden voices: living with
535 diabetic foot ulceration in an Afro-Caribbean community. Int J Environ Res Public Health.
536 2025;22:304. https://doi.org/10.3390/ijerph22020304
537 23. Chingan Martino V, Pusel M, Bouamama D, Gibert D, Cheret A. Hyperbaric oxygen therapy
538 for diabetic lower-limb wounds in the Caribbean: a retrospective cohort study. Int Wound J.
539 2026;23:e71040. https://doi.org/10.1111/iwj.71040
540 24. Vincent-Edinboro RL, Onuoha P. Beliefs and self-reported practice of footcare among
541 persons with type II diabetes mellitus attending selected health centers in east Trinidad. Egypt J
542 Intern Med. 2022;34:92. https://doi.org/10.1186/s43162-022-00180-2
543 25. Adeyemi TM, Olatunji TL, Adetunji AE, Rehal S. Knowledge, practice and attitude toward
544 foot ulcers and foot care among adults living with diabetes in Tobago: a qualitative study. Int J
545 Environ Res Public Health. 2021;18:8021. https://doi.org/10.3390/ijerph18158021
546 26. Lawrence R, Kirby RX, Ikeokwu AE. Ray amputation in a traumatic diabetic foot. Cureus.
547 2022;14:e24444. https://doi.org/10.7759/cureus.24444
548 27. Liu Y, Riklikiene O, Ezenwaka C, Nwankwo CU, Zhu S, Makhanbetkulova D, et al. Key
549 challenges in nurse-led foot care education for persons with diabetes: an international survey
550 across six countries. BMC Nurs. 2026;25. https://doi.org/10.1186/s12912-026-04457-7

551 **Appendix A**

552 **Table 4** Design, setting and sample of the included studies

Study	Country	Design	Sample	Tier
Pran et al. [7]	Trinidad and Tobago	Retrospective single-institution review, 2010-2016	781 major amputations	Core
Sumpio et al. [8]	25 Caribbean countries	Survey of national representatives	25 of 25 countries	Core
Lovell et al. [10]	Barbados	Retrospective cross-sectional study, electronic records, 2019	225 patients (33 with foot ulcer)	Core

Study	Country	Design	Sample	Tier
Pran et al. [20]	Trinidad and Tobago	Retrospective review and interviews	603 reviewed; 134 interviewed	Core
Lovell et al. [21]	Barbados	Prospective inpatient cohort, January-June 2024	176 inpatients	Core
Lovell et al. [22]	Barbados	Qualitative focus groups	15 participants	Core
Chingan Martino et al. [23]	Guadeloupe	Retrospective single-center cohort (hyperbaric oxygen therapy)	71 adults with diabetes	Core
Adams et al. [11]	Barbados	Cross-sectional, population sample (neuropathy)	236 participants	Partial
Adams et al. [19]	Barbados	Cross-sectional, same sample (peripheral arterial disease)	236 (235 with ankle-brachial index)	Partial
Fournet et al. [18]	Martinique	Retrospective monocentric amputation cohort, 2018	170 patients	Partial
Vincent-Edinboro and Onuoha [24]	Trinidad and Tobago	Telephone survey of foot-care beliefs	87 participants	Partial
Adeyemi et al. [25]	Tobago	Qualitative interviews	20 participants	Partial
Lawrence et al. [26]	Jamaica	Case report	1 patient	Partial
Liu et al. [27]	6 countries including Trinidad and Tobago	Nurse survey	412 nurses (57 from Trinidad and Tobago)	Partial
Ogilvie et al. [17]	US territories	Repeated cross-sectional survey, 2001-2015	390268 adults with diabetes	Partial
Parey et al. [3]	Trinidad and Tobago	Qualitative interview study, February 2024	17 people with lower-limb amputations (10 diabetes-related) and 17 relatives	Partial
Camilo Reynoso et al. [16]	Dominican Republic	Preexperimental observational study of topical clay therapy, 2022-2024	24 patients with Wagner grade 1-3 ulcers	Partial

N=17 studies. Overlapping samples: Adams et al. [11,19] used the same 236 participants, and Pran et al. [7,20] used data from one Trinidad institution.