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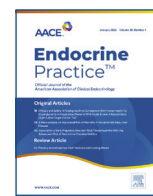
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## Original Article

## Current Practice of Podiatrists in Testing for Diabetic Polyneuropathy and Implementing Foot Care (PROTECT Study Survey 2)



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## ABSTRACT

**Aims:** Podiatrists constitute a key member of a multidisciplinary foot care team, but their services remain underutilized. We sought to gain insights into the daily practice of podiatrists focusing on screening for and monitoring of diabetic sensorimotor polyneuropathy (DSPN) as well as foot management.

**Methods:** This cross-sectional survey included 125 podiatrists from 12 federal states across Germany who responded to an online questionnaire.

**Results:** The majority of patients treated in podiatry practices were referred by general practitioners and diabetologists. Screening for or follow-up of DSPN was performed by 36% of the respondents at least once a year, by 28% only at initial examination, by 21% only at suspicion, and by 10% basically at each treatment visit. Instruments to assess vibration, touch/pressure, and temperature sensation were used by 81% to 94% of the podiatrists. Previously undiagnosed DSPN and foot ulcers were detected frequently/very frequently ( $\geq 6$  cases/mo) by 24.0 and 18.4% of the podiatrists, respectively. Almost all podiatrists advised daily self-monitoring of feet and appropriate foot care and >50% gave advice on medical treatment.

**Conclusions:** Podiatrists play an important role in the detection, monitoring, and management of both DSPN and diabetic foot ulcers, suggesting that the utilization of their services should be fostered.

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## Introduction

Although diabetic sensorimotor polyneuropathy (DSPN) affects around one third of people with diabetes worldwide and exerts a major clinical impact on morbidity, the risk of mortality, and quality of life, primarily due to foot ulcers and neuropathic pain, the condition remains commonly underdiagnosed and

undertreated in clinical practice.<sup>1–5</sup> Diabetic foot ulcers, the incidence of which is approximately 18.6 million people per year, precede 80% of lower extremity amputations among people diagnosed with diabetes and are associated with a poor prognosis.<sup>6</sup> The 5-year mortality rate in people with a diabetic foot ulcer averages around 30%, exceeding 70% for those with a major amputation. The mortality rate in individuals with diabetic foot ulcers amounts to 231 deaths per 1000 person-years in comparison to 182 deaths per 1000 person-years in those with diabetes without foot ulcers. Structured multidisciplinary care, preferentially consisting of podiatrists, infectious disease specialists, and vascular surgeons, in close collaboration with primary care physicians and diabetologists, was shown to be associated with lower

**Abbreviations:** DSPN, diabetic sensorimotor polyneuropathy; NAI, National Education Initiative.

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rates of major amputations (3.2%) compared to standard care (4.4%; odds ratio, 0.40; 95% CI, 0.32–0.51).<sup>6</sup>

Podiatrists have been recognized by professional societies to constitute a key segment of integrated diabetic footcare delivery.<sup>6–8</sup> However, recent studies have shown that in the hospital setting, podiatrists are often impeded to carry out activities due to service demand. Moreover, they were not always supported by allied healthcare professionals in developing the podiatry service.<sup>7</sup> Likewise, a survey among UK healthcare professionals suggested a lack of appreciation of the role of podiatrists and a lack of understanding of the need for a multidisciplinary approach. Furthermore, healthcare professionals reported poor access to diabetic foot education that could only be remedied by continued professional development.<sup>9</sup>

There is paucity of data addressing the podiatrists' specific experiences in managing patients with DSPN and foot ulcers. A survey among podiatrists from Ireland reported that challenges toward integrated diabetic foot care include a perceived lack of awareness of the role of podiatry amongst other healthcare professionals, poor integration between hospital and community podiatry services, especially where new services had been developed, and an insufficient number of podiatrists to meet service demands.<sup>7</sup> Exploring the application, features, and effectiveness of person-centred care with service users, caregivers, and the community within podiatry, a recent scoping review concluded that there is a lack of congruency between the concept of person-centred care and how it is operationalized. A holistic approach considering commissioning, organizational leadership as well as the role of both the practitioners and patients has not been implemented. It has been acknowledged that there is immense scope for the podiatrist to play an important role in the agenda of personalized care, but currently research on the effectiveness of person-centred care in podiatry is not available.<sup>10</sup>

Against this background, we conducted a survey among German podiatrists to obtain insights into their daily practice focusing on the frequency of screening for and follow-up of DSPN and the tools used for this purpose, the rates of previously undiagnosed DSPN and diabetic foot ulcers, the causes for the latter, which advice podiatrists give to their patients, and how they communicate results to the attending physicians.

## Methods

This cross-sectional survey among podiatrists was conducted by the National Education Initiative (NAI) "Diabetes! Do you listen to your feet?" (PROTECT Study) in Germany which focuses on sharing experience and to improve patient care with particular emphasis on diabetic neuropathy and its sequels.<sup>2,3,11</sup> The aim of the present study was to obtain detailed insights into the daily practice of podiatrists focusing on screening for and follow-up of DSPN and foot care to identify potential interfaces for an improved collaboration between physicians and podiatrists to ultimately culminate in a holistic management of DSPN. Specific areas of interest included questions about how podiatrists document the status quo, whether they have a role in increasing the diagnosis rate of DSPN, to which extent they provide advice/tips for preventive and treatment measures to patients, and how they communicate with the physician.

In Germany, podiatrists (quasi-synonym: podologists) are neither entitled to prescribe medicine nor to provide wound care or surgery. Their responsibility is confined to surface therapy of the foot including hygiene measures, medical history, and podiatry findings with assessments, biomechanic investigations, nail care, or orthotic technology. Furthermore, they provide general and individual patient consulting and are authorized to design therapy plans albeit no rehabilitation plans.

## Highlights

- 74% of podiatrists reported to screen for diabetic polyneuropathy at least once.
- 46% of podiatrists reported to perform regular follow-up testing.
- Podiatrists primarily assessed vibration, touch/pressure, and temperature sensation.
- 24% of podiatrists reported to frequently detect previously undiagnosed neuropathy.
- 18% of podiatrists reported to frequently detect previously undiagnosed foot ulcers.

## Clinical Relevance

Podiatrists play a significant role in the identification of previously unknown polyneuropathy and diabetic foot. Thus, the utilization of their services should be fostered to close the gap between the medical imperative and the current deficits in real-world clinical practice in the management of diabetes-related foot disease.

The survey was conducted in all federal states of Germany via a self-administered online questionnaire within a 4-week period from February 8 to March 8, 2023 using semi-closed multiple-choice questions (single- and multiselect) with a comment section, respectively. The online survey was written and conducted in German. An expert panel consisting of 5 diabetologists, 1 neurologist, and 1 podiatrist developed the survey. The questionnaire was distributed via the 4 available podiatry networks representing 4800 podiatrists in Germany, with a reminder after 14 days sent to the entire mailing list. A total of 157 podiatrists opened the provided survey link, of whom 156 affirmed their consent to survey participation, while 1 person rejected participation. However, among the 156 podiatrists having initially provided their consent, 125 continued with the subsequent set of content-related questions and completed the survey, equivalent to a response rate of 2.6%.

The questionnaire comprised 11 content-related questions, 4 of which focused on the characterization of the podiatrists' practices and specialties of patient referral. Five questions aimed to capture the screening routine for neuropathy and foot ulcers (frequency/tools) and to identify previously unrecorded cases. One question was designed to gain insight into health-related advice (prevention/treatment) provided during consultations by podiatrists to patients with diabetes and neuropathy. The last question addressed the podiatrist-physician communication.

As expense allowance for the time invested (approximately 6 min), a small lottery with a limited number of neuropathy screening instruments was conducted among participating podiatrists (10 Rydel-Seiffer tuning forks and 10 Tip Therm devices). At the end of the survey, the respondents were requested to indicate whether they would like to take part in the competition. If they agreed, contact details were required, albeit every respondent was also free to complete the survey fully anonymously. Statistical analysis comprised descriptive statistics including categorical data with absolute or relative frequencies.

## Results

Participating podiatric practices ( $n = 125$ ) were predominantly located in Middle- and North Germany (12 out of 16 federal states including 35 in Lower Saxony (28.0%), 26 in Hesse (20.8%), 22 in

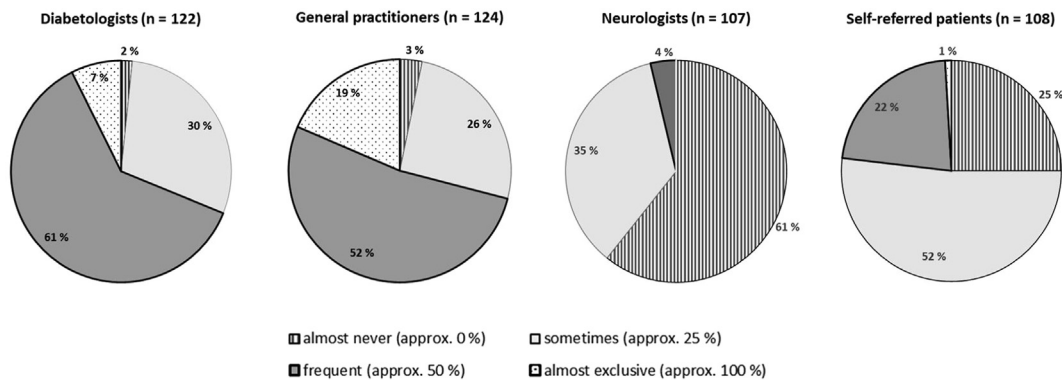


Fig. 1. Frequency of patient referral to podiatrists by medical specialties (N = 125).

Saxony-Anhalt (17.6%), 11 in Thuringia (8.8%), 8 in Brandenburg (6.4%), 7 in Saarland (5.6%), 6 in Berlin (4.8%), 4 in Rhineland-Palatinate (3.2%), 2 each in Saxony (1.6%) and Schleswig-Holstein (1.6%), and 1 each in Mecklenburg-Western Pomerania (0.8%) and Bavaria (0.8%), respectively. The practice setting was a single practice in 66.4% as well as joint practices with 2 podiatrists in 22.4%, with 3 podiatrists in 8.8%, and with 4 podiatrists in 2.4% of the participating practices. The numbers of patients with DSPN treated on average per quarter in 2022 totalled <1000 per quarter in 83.2%, 1000 to 1500 per quarter in 13.6%, and >1500 per quarter in 3.2% of the practices.

Figure 1 shows the distribution of patient referral to podiatrists across the relevant medical specialties. General practitioners and diabetologists were reported to refer 71.0 and 68.9% of the patients almost exclusively or frequently ( $\approx 50$  to 100%), whereas the corresponding rates for neurologists and self-referred were only in 3.7 and 23.1%, respectively. Only a few practices reported referral of patients by other specialists in the comment section (11 dermatologists, 11 orthopedists, 7 rheumatologists, 2 internists, 2 gynecologists after chemotherapy, 2 oncologists, 2 surgeons, 2 nephrologists, 1 phlebologist, 1 cardiologist, and 1 diabetic foot clinic).

Screening for or follow-up of DSPN was performed by 36.0% of the respondents at least once a year, by 28.0% only at initial examination, by 20.8% only at suspicion, by 10.4% basically at each treatment visit, and never by 4.8%. The comment section of this single-select multiple-choice question showed partial overlaps in the replies, eg, initial or annual examinations are sometimes complementing each other. Moreover, suspicion ( $n = 12$ ), complaints ( $n = 2$ ), discomfort ( $n = 2$ ), if needed ( $n = 2$ ), or tendency for/presence of ulcers ( $n = 1$ ), if therapy report is required ( $n = 1$ ) were distinct causes to examine the patient independent of the formulated reply category given. One podiatrist reported to perform annual screenings for patients referred by physicians, but for self-referred patients only in case of suspicion. Additional frequencies of screening reported in the comment section were quarterly ( $n = 3$ ), or semi-annually ( $n = 3$ ). One podiatrist reported to never screen patients for neuropathy due to the fact that his patients are always referred with a diagnosis.

Table 1 depicts the tools used by podiatrists for screening and testing in patients with DSPN. The most frequently applied instruments were the tuning fork to quantify vibration perception, the monofilament to assess touch and pressure sensation, and the Tip Therm device to test temperature sensation (81%–93%). In contrast, instruments for examining pain sensation were employed infrequently (10%), and only a very small portion of the respondents stated that they did not use any instrument (3.2%).

Figure 2 shows how often the podiatrists found evidence of a previously unknown DSPN and diabetic foot ulcers. Undiagnosed

Table 1  
Tools used By Podiatrists to Screen and Test for Diabetic Polyneuropathy (n = 125), Multiple Answers Possible

Instrument	Sensory modality	%
Tuning fork	Vibration perception	94.4
Monofilament	Touch/pressure sensation	90.4
Tip Therm®	Thermal sensation	80.8
Sharp object, needle, toothpick, etc.	Pain sensation	9.6
Other instruments		8.8
No instrument		3.2

DSPN was found very frequently ( $>10$  cases/mo) or frequently (6–10 cases/mo) by 24.0%, while undiagnosed foot ulcers were ascertained very frequently or frequently by 18.4% of the respondents. Only 1.6% of the podiatrists each reported never having detected any undiagnosed DSPN or foot ulcer.

The causes of foot ulcers and their frequencies as reported by the podiatrists are illustrated in Figure 3. The most frequent cause was DSPN reported to be involved almost exclusively or frequently ( $\approx 50$  to 100%) in 52.6% of the cases, followed by ischemic and venous causes (24.1 and 30.8%).

Podiatrists were also asked which advice for stand-alone prevention and treatment measures they give to patients: 95.2% reported to point out the need for daily self-inspection of the feet, 91.2% gave tips on how they can take appropriate care of their feet, 64.8% explained available complementary therapies (medical and non-medical) and referred patients to their attending physician if necessary, 51.2% pointed out the importance of taking their

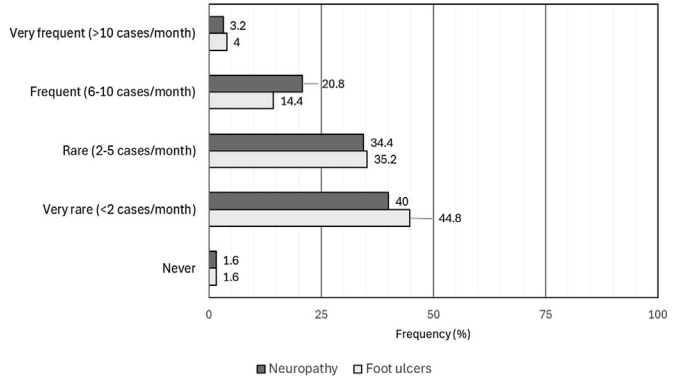


Fig. 2. Percentages of patients with previously undiagnosed neuropathy and foot ulcers (n = 125).

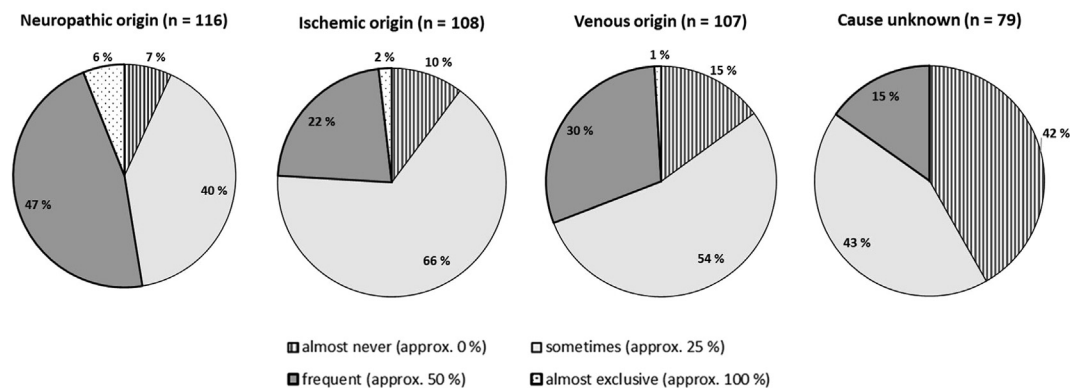


Fig. 3. Causes of foot ulcers in patients with diabetic polyneuropathy treated by podiatrists (N = 124).

medication regularly, 2.4% gave other tips along the way, and 2.4% deemed advice being usually unnecessary, as their patients claimed to be always well informed about their neuropathy and associated risks (Table 2).

As to the question about how podiatrists communicate their examination and treatment results to the patients' attending physician, 51.2% stated to report and transmit via email, fax, etc., 43.2% reported to discuss the findings with their patients and request that they be passed on to the attending physician, 36% gave a report to their patients, 18.4% reported telephone discussion of the findings with the attending physician, 12% used other ways of transmitting information, and 8% did not deploy any standardized procedure and generally did not send a report to the attending physician.

Discussion

The results of this survey indicate that 3 quarters of podiatry practices screen every patient for DSPN at least once and further 21% at least in case of suspicion, while 46% perform regular follow-up testing primarily using tools to assess vibration, touch/pressure, and temperature sensation. Moreover, 24 and 18% of the podiatrists detected previously undiagnosed DSPN and foot ulcers frequently or very frequently ( $\geq 6$  cases/mo), respectively. Podiatrists also contribute to health education by frequently advising patients about improved health care. These data point to a key role of podiatrists not only in managing cases diagnosed with these conditions within the multidisciplinary foot care team, but also in identifying those with previously unknown foot disease.

We and others recently found that both painful and painless DSPN remain underdiagnosed and undertreated in clinical practice.<sup>2,3,5</sup> Moreover, we reported that the willingness of physicians to implement both standardized testing procedures and assessment and to follow guidelines is low when they screen for and clinically

diagnose DSPN.<sup>11</sup> Others found that disparities exist between physician and patient perceptions around the diagnosis and treatment of painful DSPN.<sup>12</sup> Thus, both the relatively high rates of screening and the likelihood of detecting previously unrecognized DSPN and foot ulcers reported herein suggest that podiatrists could achieve a significant role in bridging the gap between clinical guidelines and real-world practice and thereby help to improve the awareness of DSPN by patients and physicians alike. There are no studies with which to directly compare our results, but a survey including 50 private podiatry practices in Flanders, Belgium, recently reported that 98% of the podiatrists used the monofilament test to assess touch/pressure similar to our corresponding rate (90%). In contrast, only 14% assessed thermal sensation (Tip Therm), and 56% deployed the tuning fork to measure vibration sensation,<sup>13</sup> whereas the corresponding figures in our survey were 81 and 94%, respectively, suggesting that differences exist across countries in the frequency of using simple screening tools for DSPN. The Belgian survey also reported that vascular assessment of the diabetic foot consisted only of a medical history and pulse palpation and that 66% of the respondents oriented themselves yet to a variety of guidelines and risk stratification systems for diabetic foot assessment.<sup>13</sup> Guidelines for the best clinical practice and management strategies in patients with DSPN specifically developed by podiatrists could be helpful in their daily practice. Such consensus-based recommendations have recently been developed by Australian podiatrists eg, for patients with chemotherapy-induced peripheral neuropathy.<sup>14</sup>

A recent systematic review identified a number of barriers to accessing foot care services for people with diabetes. The predominant themes emerging from the patient perspective included lack of understanding, socioeconomic factors, and lack of service availability, while the themes emerging from the practitioner perspective were poor interprofessional communication, lack of resources, lack of practitioner knowledge, and perceived patient factors.<sup>15</sup> There is a fundamental misunderstanding of the role of podiatry in foot care services in some patients who perceive it as a "pedicure" service.<sup>16</sup> Others did not know specialist foot care services were available to them, until they had been referred after developing more serious foot complications.<sup>17</sup> Patients also sought alternative care through chiropractors, homeopaths, or acupuncturists for their foot problems rather than looking for care from podiatrists.<sup>18</sup> Practitioners reported delayed referrals to specialized diabetes foot clinics or podiatrists as an important access barrier for patients. Further barriers included inadequate staff numbers including podiatrists with specific knowledge and skills in diabetic foot care related to an inability to recruit and retain staff.<sup>15</sup> A survey of specialist inpatient diabetes teams in the UK for current staffing and the perception of optimal staffing was recently conducted by The Joint British Diabetes

Table 2  
Advice by Podiatrists for Stand-alone Prevention and Treatment Measures (n = 125), Multiple Answers Possible

Advice by podiatrists	%
I point out the need for daily self-inspection of the feet.	95.2
I give tips on how they can take care of their feet.	91.2
I will explain available complementary therapies (medical and nonmedical) and refer them to their treating physician if necessary.	64.8
I point out the importance of taking their medication regularly.	51.2
I give other tips along the way.	22.4
Usually not necessary, as my patients are always well informed about their neuropathy and associated risks.	2.4



Societies for Inpatient Care Group. Current diabetes specialist staffing level for podiatrists per 100 people with diabetes in hospital was 0.19 (0.00–0.62) (Median, IQR), whereas for optimal care level of 0.93 (0.65–1.24) would be necessary, suggesting that the current inpatient diabetes staffing is much lower than needed.<sup>19</sup>

The current International Working Group on the Diabetic Foot guideline<sup>8</sup> addresses healthcare professionals providing services to people with diabetes-related foot disease. Since these professionals treat patients within a healthcare system or organization, the latter itself may have an effect on outcomes, albeit direct evidence for this is not available. However, indirect evidence can be derived from the effect of increasing podiatry and multidisciplinary teams in the Netherlands which resulted in a reduction of lower-extremity amputations.<sup>16</sup> Studies over 2 years in the US showed that the inclusion of podiatrists in a multidisciplinary approach to diabetic foot disease has reduced amputations by 64%,<sup>20</sup> and treatment by a podiatric physician reduced medical care costs compared to no such a treatment.<sup>21</sup> On the other hand, the discontinuation of podiatry care from Medicare in the US resulted in an increase in hospitalizations for diabetes-related foot disease.<sup>22</sup> Likewise, in the South-West of England, the introduction of an effective service provision including a foot care pathway to multidisciplinary care resulted in a significant reduction in major amputation incidence within 2 years.<sup>17</sup> Consequently, it has been suggested that rapid access to a multidisciplinary diabetes foot team should be available to all people with diabetes,<sup>9</sup> and early referral for multidisciplinary care is a first-line therapy for diabetic foot ulcers.<sup>6</sup>

The strength of this work is the detailed survey on the screening procedures, previously undiagnosed foot disease, health related advice, and podiatrist-physician communication. One limitation is the potential for selection bias of the participating podiatrists. The surprisingly low response rate to the survey may have introduced another source of bias, as only the most motivated podiatrists and those with special interest in DSPN may have participated. However, low response rates from surveys focusing on DSPN that included health care providers have previously been reported across countries.<sup>12</sup> Furthermore, it has been suggested that in general there is no simple answer to what is an appropriate rate, and no rate is automatically indicative of greater or lesser accuracy and utility.<sup>23</sup> Other potential sources of bias include the lack of information on possible variations in podiatrist practice across the regions and the length of their practice experience.

In conclusion, our data indicate that podiatrists play a significant role not only in the management of diabetic foot ulcers but also in the identification of previously unknown DSPN and the monitoring thereof. Hereby podiatrists could help to increase the awareness of the impact DSPN on foot health by patients and physicians alike. Thus, the utilization of their services should be fostered to close the gap between the medical imperative and the current deficits in real-world clinical practice in the management of diabetes-related foot disease.

## Disclosure

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D.Z. wrote the manuscript. D.Z., S.B., R.L., Kh.R., K.R., and O.S. researched data, contributed to discussion, and reviewed and edited the manuscript. D.Z. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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