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Review

CHEAP, FAST, OR ACCURATE: COMPARING THE PRACTICALITY OF SCREENING METHODS FOR DIABETIC PERIPHERAL NEUROPATHY

A. Shah[1]†

[1] Tesla STEM High School, Redmond, Washington, USA

† Corresponding author: Aayush Shah, aayush10shah@gmail.com

ABSTRACT

Background: Diabetic peripheral neuropathy (DPN) affects at least half of people with diabetes and is a major risk factor for foot ulceration and amputation. Because nerve damage is least reversible late, a screening method's value depends on whether it can be delivered widely and early, not accuracy.

Methods: This narrative review compared four DPN detection methods, nerve conduction studies, clinical sensory tests, plantar pressure analysis, and wearable gait sensing, across cost, setup, time, scalability, and accuracy.

Results: Accuracy and scalability traded off. Nerve conduction studies are the accepted reference standard for large-fiber function but too specialist-dependent for population screening, while the cheapest test, the 10-gram monofilament, suits advanced disease better than early disease. Sensor-based methods report high accuracy from small, internally validated samples.

Conclusion: No method is simultaneously cheap, fast, accurate, and sensitive to early disease. The unmet need is a scalable test externally validated for early detection.

Keywords: diabetic peripheral neuropathy; screening; diagnostic accuracy; nerve conduction studies; monofilament; wearable sensors; early detection

MAIN MANUSCRIPT

1. Introduction

Diabetic peripheral neuropathy is one of the most common complications of diabetes, and one of the most consequential. Nerve damage gradually erodes sensation in the feet and lower limbs. The danger lies less in the lost sensation itself than in what it permits: patients stop feeling minor injuries, those injuries go unnoticed and untreated, and the sequence advances toward ulceration and amputation. McDermott and colleagues, in a review of the burden of diabetic foot ulcers citing prior epidemiological work, report that the lifetime prevalence of peripheral neuropathy in adults with diabetes is at least 50 percent and that neuropathy confers an approximately sevenfold risk of diabetic foot ulcer, with a lifetime risk of foot ulceration between 19 and 34 percent.[1] The

prognosis they describe once an ulcer occurs is poor: within the populations covered by that review, recurrence rates reach 65 percent within three to five years, lifetime amputation incidence is around 20 percent, and five-year mortality falls between 50 and 70 percent.[1] These figures reflect the specific cohorts summarized in that review rather than fixed rates that hold across all settings.

The scale of the population at risk is large and growing. The International Diabetes Federation's eleventh edition Diabetes Atlas estimates that 589 million adults aged 20 to 79 were living with diabetes in 2024, about one in nine, and projects this figure to reach roughly 853 million by 2050.[2] In the United States alone, one cost-of-illness model estimated approximately 13.2 million people with DPN and an annual cost burden of about 45.9 billion dollars, a figure derived from modeling rather than a direct census.[3] Any method proposed to screen for DPN must therefore work not for dozens of patients but for hundreds of millions.

This is where a tension emerges that the rest of this review examines. The methods that detect DPN most accurately are the hardest to deliver at scale, and the methods easy enough to deliver everywhere tend to detect disease only once it is already advanced. A test that perfectly identifies neuropathy but requires a neurologist and a laboratory cannot screen a population of that size. A test cheap and fast enough to use on everyone is of limited value if it catches the disease only after the window for prevention has narrowed.

For a condition whose entire danger lies in being caught too late, practicality is not a secondary concern behind accuracy. It is the central question. This review therefore compares DPN detection methods primarily on how practical they are for real-world, large-scale screening, treating the accuracy that each method sacrifices as one of the costs of that practicality rather than as the sole criterion. The compounding problem of underdiagnosis sharpens this further: even the screening that guidelines already recommend is delivered inconsistently. A survey of 1,004 patients with diabetes found that while 83 percent reported symptoms consistent with painful neuropathy, only 41 percent of those had been diagnosed.[4] A method's real-world value thus depends on whether clinicians can and will actually use it.

DPN is a length-dependent, distal-to-proximal degeneration of peripheral nerves driven by chronic hyperglycemia and related metabolic stress, including oxidative injury, microvascular insufficiency, and impaired nerve repair.[5] The distinction between small and large nerve fibers is central to screening, because the two are damaged at different stages and are detected by different tests. Small, thinly myelinated and unmyelinated fibers carry pain and temperature sensation and mediate autonomic function; they are frequently affected early, and in some patients small-fiber involvement precedes abnormalities on conventional large-fiber tests, though the timing varies with phenotype, diabetes type, and the reference standard used.[5,6] Large, myelinated fibers carry vibration, proprioception, and pressure sensation and are the fibers assessed by nerve conduction studies, the monofilament, and the tuning fork. This division explains a recurring blind spot examined throughout this review: the reference standard and the most widely used bedside tests all assess large-fiber function, so in patients whose damage begins in the small fibers these tests can appear normal while early disease is already present.[6] The clinical stakes of early detection are concrete: improved glycemic control reduces the incidence of neuropathy and delays its onset, an effect that is most firmly established for type 1 diabetes, so identifying disease before protective sensation is lost creates a genuine window for intervention.[7,8]

The objective of this review is to compare four families of DPN detection method on their practicality for large-scale screening, and to identify which unresolved questions most limit progress toward a screening tool that is both deliverable and sensitive to early disease.

2. Methods

2.1 Study design

This is a narrative literature review rather than a systematic review. No protocol was registered, no screening flow was recorded, and PRISMA 2020 reporting does not apply. The aim was to compare screening modalities conceptually across practicality dimensions rather than to pool diagnostic-accuracy estimates quantitatively.

2.2 Search strategy

Searches of PubMed and Google Scholar were conducted between April and June 2026, supplemented by hand-searching the reference lists of retrieved articles and relevant clinical guidelines. Search terms combined the concepts diabetic peripheral neuropathy and screening or diagnosis with modality-specific terms, including nerve conduction, point-of-care, monofilament, tuning fork, Michigan Neuropathy Screening Instrument, plantar pressure, gait, wearable sensor, and inertial measurement unit.

2.3 Inclusion and exclusion criteria

Only English-language sources were included. Sources were selected purposively for relevance and methodological quality rather than through a predefined screening protocol. Priority was given, in descending order, to clinical practice guidelines and consensus statements, including American Diabetes Association standards of care, the Toronto Consensus, and International Diabetes Federation reports; then to systematic reviews and meta-analyses; and then to primary diagnostic-accuracy or validation studies. Individual primary studies were included where review-level evidence was thin, as for the newer plantar-pressure and wearable-sensor methods. Editorials, conference abstracts, and manufacturer materials were excluded as primary evidence, though vendor accuracy claims are noted in the results specifically to explain why they were not relied upon.

2.4 Data extraction

For each source, the screening modality examined, reference standard used, reported sensitivity and specificity or other accuracy metrics, sample size, and validation approach were extracted where available. Because reported accuracy figures vary widely with reference standard, threshold, testing site, and population, values are reported as ranges rather than pooled estimates. Where sources disagreed, the range was retained and the disagreement described rather than resolved in favor of one estimate.

2.5 Evaluation framework

Each modality was scored qualitatively on five practicality dimensions, defined in advance to make the comparison reproducible rather than impressionistic.

Cost: equipment cost plus per-test cost. A method requiring a laboratory instrument differs categorically from one using a filament costing a few dollars.

Setup requirements: what the test needs in order to run, whether a clinic, a trained operator, both, or neither. This dimension largely determines whether a method can leave the clinic at all.

Time per test: how long a single assessment takes, which governs screening throughput.

Scalability: whether the method can realistically run at population scale, in primary care, at home, or in low-resource settings.

Accuracy trade-off: the diagnostic performance, measured as sensitivity and specificity, that a method sacrifices or gains relative to the reference standard, and whether it detects early disease or only advanced disease.

The fifth dimension keeps the comparison honest, because the most practical methods tend to be the least accurate and a comparison that praised convenience while ignoring the accuracy cost would mislead.

2.6 Quality assessment

As a narrative review, this synthesis did not apply a formal risk-of-bias tool or quantitative quality-assessment instrument, and it may not capture every relevant study. Study quality was considered qualitatively, principally by noting sample size, choice of reference standard, and whether validation was internal or external. The most authoritative or representative source is cited for each claim.

3. Results

3.1 The four modalities

3.1.1 Nerve conduction studies

Nerve conduction studies (NCS) measure how fast and how strongly electrical signals travel along peripheral nerves. NCS anchors the Toronto Consensus diagnostic framework, which grades diagnostic certainty as possible, probable, or confirmed; a confirmed diagnosis requires an abnormality of nerve conduction or a validated measure of small-fiber function in addition to symptoms or signs, and where nerve conduction is not assessed only a possible or probable diagnosis can be assigned.[6] The test is objective and reproducible. Its defining limitation as a screening tool is practical rather than analytic: it requires specialist examiners and laboratory equipment, which makes it inappropriate for screening large numbers of patients.[9] It also measures only large-fiber function, which is affected later in the disease than the small fibers, so a patient may report significant symptoms while nerve conduction remains normal.[6]

A handheld point-of-care device, the NC-stat DPNCheck, measures sural nerve conduction velocity and sensory nerve action potential amplitude using a single-use sensor. It aims to retain much of the accuracy of formal NCS while removing the laboratory and the specialist.

3.1.2 Simple clinical sensory tests

The 10-gram Semmes-Weinstein monofilament tests pressure sensation: the examiner presses a calibrated filament against defined points on the foot until it buckles and records whether the patient feels it. The 128-Hz tuning fork tests vibration perception, a large-fiber function, usually at the apex of the great toe. Both are inexpensive, portable, and easy to use with little training. A distinction that recurs throughout this review should be made explicit here: screening for neuropathy and screening for ulcer risk are related but separate clinical tasks, and the American Diabetes Association (ADA) framework assigns different tools to each. For detecting neuropathy, the ADA recommends that all patients be assessed starting at diagnosis of type 2 diabetes and five years after diagnosis of type 1 diabetes, and at least annually thereafter, using a small-fiber test such as pinprick or temperature combined with the 128-Hz tuning fork for large-fiber function. Separately, and for a different purpose, it recommends that all patients receive annual 10-gram monofilament testing to identify feet that have lost protective sensation and are therefore at risk of ulceration, rather than to detect neuropathy early.[8] That guidance is carried forward in the ADA's current standards of care.[10] Related tools extend the same logic. The Ipswich Touch Test requires no equipment at all and can be performed by caregivers. Composite instruments such as the Michigan Neuropathy Screening Instrument (MNSI) combine a questionnaire with a brief examination to produce a structured score.

3.1.3 Plantar pressure analysis

Plantar pressure systems measure how force is distributed across the sole of the foot during standing or walking. Because insensate feet develop abnormal pressure patterns that drive ulcer formation, pressure distribution carries a signal related to neuropathy and, more directly, to ulceration risk. Recent work pairs pressure platforms with machine-learning classifiers to distinguish neuropathy status from pressure data.[11]

3.1.4 Wearable sensor-based gait analysis

This modality uses motion sensors, principally accelerometers and gyroscopes contained in inertial measurement units, to capture how a person walks, then analyzes gait parameters such as walking speed, step time, and step-to-step variability that are altered in DPN. A scoping review reports that people with diabetic neuropathy walk more slowly and less stably and carry an elevated fall risk, which gives gait a measurable basis for detection.[12] The research to date is largely composed of small case-control and proof-of-principle studies.

3.2 Comparison across practicality dimensions

Table 1. Practicality comparison of four DPN detection modalities. Accuracy figures are reported as ranges because they vary substantially across studies; see text for sources and caveats.

Dimension	Nerve conduction studies	Monofilament / tuning fork	Plantar pressure analysis	Wearable / sensor gait
Cost	High; laboratory instrument; U.S. per-study prices commonly reach the hundreds of dollars	Very low; instrument costs a few dollars and is reusable	Moderate; dedicated pressure platform required	Low to moderate; inertial sensors are inexpensive

Dimension	Nerve conduction studies	Monofilament / tuning fork	Plantar pressure analysis	Wearable / sensor gait
Setup	Specialist examiner plus laboratory equipment	Minimal training; any clinic; some variants need no equipment	Pressure platform plus software; clinic-based	Sensor plus analysis software; brief walk test
Time per test	Time-consuming	Minutes	Short stance or walk plus processing	Short walk test (e.g., 10 m)
Scalability	Low; confirmatory use, unsuitable for mass screening	High; recommended for routine annual screening	Moderate; clinic-bound, platform-dependent	Potentially high, but unproven at scale
Accuracy trade-off	Reference standard for large-fiber function; objective; misses small-fiber disease	Detects advanced disease, less sensitive early; sensitivity ~41-93%, specificity ~68-100%	High in-sample accuracy reported (88% dynamic, 100% static), but small samples, internal validation only	Good discrimination reported (AUC >0.8, up to 0.975), but small proof-of-principle samples

Table 1 summarizes the comparison, which is presented below by dimension rather than by modality so that the modalities are compared directly rather than described separately.

3.2.1 Cost

Cost separates the four sharply. Nerve conduction studies are the most expensive: they require a laboratory instrument, and in the United States per-study prices commonly run into the hundreds of dollars, with facility fees raising the total further. These per-study figures derive from clinic and payer price lists rather than from peer-reviewed health-economics studies and should be read as illustrative only; the peer-reviewed literature documents that out-of-pocket costs for electrodiagnostic testing have risen substantially over time.[13] The simple clinical tests are the cheapest, costing only a few dollars for an instrument that is used repeatedly across many patients.[9] Plantar pressure systems fall in between, requiring a dedicated platform.[11] Wearable sensors are inexpensive as hardware, with inertial measurement units described as small and low-cost.[12] The point-of-care nerve conduction device occupies an unusual position: it replaces the laboratory with a handheld unit and a single-use sensor, but published per-test prices trace to manufacturer and distributor listings rather than to peer-reviewed sources and are therefore not relied upon here.

3.2.2 Setup requirements

Setup is where nerve conduction studies become impractical for screening. They require a trained specialist and laboratory equipment, which is the main reason they serve to confirm diagnoses rather than to screen.[6,9] The simple clinical tests need minimal training and little or no equipment, which is why they dominate routine screening; the Ipswich Touch Test needs no equipment whatsoever and can be performed by a caregiver. Plantar pressure analysis needs a platform and software and remains clinic-bound. Wearable gait sensing requires only a sensor and analysis software and rests on a brief walking task, giving it the lowest setup burden of the instrumented methods, though the analysis pipeline still has to be built and validated.

3.2.3 Time per test

Nerve conduction studies are time-consuming, involving multiple nerves and trained interpretation.[14] The simple tests take minutes. Plantar pressure and gait sensing both rest on brief tasks, a short stance or a 10-meter walk, with data processing that, once automated, adds little to the patient's time.[11,15] On this dimension the three non-NCS methods are broadly comparable and all are compatible with screening throughput.

3.2.4 Scalability

Scalability tracks setup closely. Nerve conduction studies do not scale to mass screening and are positioned as confirmatory, reserved by guidelines for atypical presentations.[8] The simple clinical tests scale well enough to be recommended for routine annual screening of all patients with diabetes. Plantar pressure analysis is moderately scalable but tied to clinic-based platforms. Wearable gait sensing has the highest theoretical scalability among the instrumented methods, because it depends on inexpensive sensors and a short task, but this potential is so far unrealized: the evidence base consists of small studies and the approach has not been validated at population scale.

3.2.5 Accuracy trade-off

One clarification matters before the figures: the accuracy values below measure how well each test detects neuropathy against a diagnostic reference standard, which is a different question from how well the monofilament identifies feet at risk of ulceration, the task for which guidelines actually recommend it. The two endpoints are related but not interchangeable, and the monofilament's numbers should be read as its performance as a neuropathy-detection test, not as a verdict on its guideline role.

The 10-gram monofilament's accuracy for detecting neuropathy varies widely across studies. A systematic review found sensitivity ranging from 41 to 93 percent and specificity from 68 to 100 percent; the heterogeneity of the eligible studies prevented a pooled estimate, and the authors concluded that the monofilament should not be used alone to diagnose neuropathy.[16] A later meta-analysis using nerve conduction as the reference standard pooled a sensitivity of only 53 percent (95% CI 32-74) against a specificity of 88 percent (95% CI 78-94), again concluding that the test has limited sensitivity for screening.[17] An umbrella review spanning seven reviews and 19,531 participants reported monofilament sensitivity between 53 and 93 percent and specificity between 64 and 100 percent, and found that the biothesiometer outperformed the tuning fork for vibration perception.[18]

More important than the spread is a consistent qualitative finding: the monofilament is more useful for detecting loss of protective sensation and later-stage neuropathy than for identifying early disease. This is why its guideline role is ulcer-risk stratification rather than neuropathy detection. The ADA characterizes it as a useful clinical tool mainly for detecting more advanced neuropathy and for identifying feet that have already lost protective sensation, not as a test for early disease.[8] Vibration-based testing can reveal neuropathy somewhat earlier. Composite instruments such as the MNSI add structure but inherit the same tension. Validated in the Diabetes Control and Complications Trial and Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) cohort of 1,184 adults with type 1 diabetes, the MNSI examination at its standard threshold of 2.5 achieved about 61 percent sensitivity against 79 percent specificity relative to

confirmed clinical neuropathy, meaning milder cases are commonly missed, and its sensitivity rises only when the threshold is loosened at the expense of specificity.[19]

The point-of-care nerve conduction device performs well against gold-standard testing in controlled validation studies, though its specificity is strongly threshold-dependent. Against formal nerve conduction studies, one validation reported that a sural sensory nerve action potential amplitude at or below 6 microvolts yielded 88 percent sensitivity and 94 percent specificity, with an area under the curve (AUC) of 0.88.[20] A predecessor device achieved 92 percent sensitivity and 82 percent specificity,[21] and a later cohort of 114 patients with type 2 diabetes reported 90.5 percent sensitivity and 86.1 percent specificity against a clinical neuropathy score.[22] Independent validation has been less favorable, however: in one cohort the device showed only moderate overall accuracy, with specificity as low as 44 percent at the amplitude threshold that maximized accuracy, in a setting where even formal electrophysiology performed poorly on specificity.[23] The device also inherits the reference standard's blind spot for small-fiber disease.

The newer modalities report strong accuracy but on weaker evidentiary footing. A plantar pressure study using gradient boosting reported 88 percent accuracy on dynamic data and 100 percent on static data, but on 86 patients with internal validation only; the perfect static-data result should itself be read as a sign of overfitting rather than of clinical readiness.[11] A single-sensor gait study placed one inertial unit on the lower back during a 10-meter walk and found that walking speed discriminated DPN patients from controls with an AUC of 0.975, with step time and a gait-control parameter exceeding 0.8, but the sample was 17 patients with established DPN against a matched control reference and the authors explicitly framed it as a proof of principle.[15] A wearable case-control study found reduced landing and maximum swing angles in diabetic patients both with and without neuropathy relative to controls, while reduced walking speed reached significance only in those with neuropathy.[24]

4. Discussion

Laying the modalities side by side reveals an inverse relationship at the extremes. The most accurate method for large-fiber function, nerve conduction studies, is the least scalable: costly, specialist-dependent, and reserved for confirmation. It is not a perfect standard, since it misses small-fiber disease, but it remains the accepted objective benchmark. The most scalable methods, the simple clinical tests, sacrifice early-stage sensitivity and reliably flag neuropathy only once it is advanced. Scalability and early-detection accuracy pull against each other.

The stakes follow from the natural history of the disease, which is most treatable early and least treatable late. A screening tool optimized for scale but blind to early disease catches patients at the point where intervention helps least. The tests used most widely are weakest where early detection would do the most good, while the test that detects disease most reliably cannot reach most of the people who need screening.

Two developments may bend this trade-off rather than merely sit on it, and both warrant a skeptical reading. The first is the point-of-care nerve conduction device, which aims to keep much of the reference standard's accuracy while removing the laboratory and the specialist. Its validation figures are encouraging, but the wide swing in specificity across independent studies, from the mid-40s to the mid-90s, and its inherited insensitivity to small-fiber disease mean it improves access more than it solves the early-detection problem.[6,20,23] The second is the family of sensor-

based methods, plantar pressure and gait analysis, which aim for both scale and early sensitivity by detecting subtle movement changes that may precede the sensory loss the simple tests depend on. The reported accuracies are high, but they rest on small, internally validated samples, and a recent meta-analysis complicates the premise. A systematic review with meta-analysis of lower-limb joint moments during gait found reduced ankle and knee moments in people with diabetes relative to healthy controls but no significant difference between diabetes with neuropathy and diabetes without it.[25] That single meta-analysis does not settle the mechanistic question, but it raises a concrete concern: if some gait features do not distinguish neuropathy cleanly from diabetes-related change, a gait-based classifier may be detecting diabetes rather than neuropathy. The same authors note that kinetic changes may appear early in diabetes, before overt neuropathy, which is one reason the biomechanical contrast between the two groups is small. The assumption that altered gait is a clean marker of neuropathy therefore cannot be taken for granted.

Weighing these two directions against the evidence reviewed, the evidence base for the point-of-care nerve conduction device is more mature than that for sensor-based methods, though this does not establish it as the preferred long-term solution. The two approaches are not at the same stage of validation. The point-of-care device has been tested against formal nerve conduction studies in several independent cohorts, and even its least favorable results describe a measured performance envelope rather than an unknown one: sensitivity has been consistently high, and while specificity swings widely with the amplitude threshold and the reference population, that variability is itself a quantified and therefore manageable property.[20,21,22,23] A tool whose weaknesses are known can be deployed with appropriate confirmatory testing; a tool whose real-world accuracy is unknown cannot. The sensor-based methods, by contrast, report higher headline accuracies but from small, single-cohort studies validated only on themselves. A systematic review of machine-learning prediction of DPN found that of fifteen studies, all used internal validation and only three employed external validation.[26] High accuracy in an internally validated sample is a hypothesis about performance rather than a measurement of it, though internal validation alone does not invalidate a result.

The competing view merits a fair hearing. It could be argued that the sensor-based methods are the more promising direction precisely because they target the problem the point-of-care device does not solve, early and preclinical disease, and because inexpensive sensors are the only technology with a plausible path to genuine population and home-based screening. That case is coherent, and on the question of ultimate potential it may prove correct. It rests, however, on performance that has not survived external validation, and the gait-kinetics meta-analysis gives a reason for caution about what the signal represents.[25] Until external validation separates these signals, the strength of the sensor-based case remains provisional.

Several limitations of the present evidence base constrain what can be concluded. Validation is almost entirely internal for the newer methods, as noted above. Reference standards and metrics are inconsistent: reported sensitivity and specificity vary widely partly because studies use different reference standards, whether nerve conduction, vibration perception thresholds, or clinical scores, along with different thresholds and populations.[16,18] This makes head-to-head comparison across modalities unreliable and means the figures reported here should be read as ranges shaped by methodology rather than as fixed properties of each test. The early-detection question is also unresolved, because most accuracy data describe the detection of established neuropathy. This gap is compounded by the shared large-fiber bias of the common tests: because

the monofilament, tuning fork, and nerve conduction studies all assess large fibers, none is well suited to the small-fiber damage that often appears first.[5,6] Whether any scalable method, sensor-based or otherwise, can reliably detect DPN before conventional tests turn positive is largely untested.

Screening in low-resource settings remains underserved. Much of the diagnostic-accuracy literature comes from well-resourced clinics, yet the largest and fastest-growing diabetic populations are in low- and middle-income countries.[2] Equipment-free tests such as the Ipswich Touch Test are promising here, with reported sensitivity around 0.77 and specificity around 0.96 in the umbrella-review evidence,[18] but their performance for early rather than advanced disease is largely untested.

Screening in children and adolescents is a further underdeveloped area. Almost all of the diagnostic-accuracy evidence reviewed here comes from adults, yet neuropathy begins in youth: in the SEARCH for Diabetes in Youth study, the prevalence of DPN was 7 percent among young people with type 1 diabetes and 22 percent among those with type 2 diabetes who had at least five years of diabetes duration.[27] The screening tools carried over from adult practice have been far less validated in this age group, and pediatric screening is delivered inconsistently: a nationwide survey of Italian pediatric diabetes centers found that only 18.6 percent reported annual neuropathy screening, more than 40 percent screened only once symptoms appeared, and the MNSI was used in just 14.6 percent of centers.[28] Because pediatric neuropathy is usually subclinical, and because the rationale for screening rests on early detection, the shortage of validated, age-appropriate screening tools for young people is a clinically meaningful gap distinct from those above, which concern the adult evidence base.

A specific, answerable question follows from the evidence reviewed. In children and adolescents with type 1 diabetes of at least five years' duration, can an externally validated wearable inertial-sensor gait screen detect diabetic peripheral neuropathy as accurately as the MNSI, using nerve conduction studies as the reference standard? The question is testable with a prospective multi-center cohort that applies all three measures to the same participants and validates the sensor model on a separate site, and it is motivated directly by the two limitations this review identifies: the near-total absence of external validation for sensor-based methods and the shortage of screening evidence in pediatric populations.

5. Conclusion

Across cost, setup, time, scalability, and accuracy, no current method for detecting diabetic peripheral neuropathy is both practical at scale and reliable for early detection. Nerve conduction studies are accurate and objective but not scalable. The simple clinical tests are cheap, fast, and scalable but are less sensitive for early disease, flagging neuropathy mainly after much of the opportunity for prevention has passed. Plantar pressure and gait-sensing methods show early promise on both fronts but rest on small, internally validated studies that have not been tested at screening scale, and recent meta-analytic evidence raises a question about whether gait changes mark neuropathy specifically rather than diabetes broadly.[25] The umbrella-review consensus is that no single test can be universally recommended and that clinicians should select tools suited to their population, setting, and resources.[18] For now, the practical standard remains a combination: a vibration-sensitive test for large-fiber neuropathy paired with the monofilament for ulceration-risk stratification. This reflects current practicality rather than adequacy, since its central limitation,

insensitivity to early small-fiber disease, is precisely the gap that motivates the search for a better scalable method. The most important next step is an externally validated trial of a scalable method, most plausibly a sensor-based one, in large and diverse populations, tested specifically for its ability to detect early disease.

DECLARATIONS

Abbreviations

ADA, American Diabetes Association; AUC, area under the curve; CI, confidence interval; DCCT/EDIC, Diabetes Control and Complications Trial and Epidemiology of Diabetes Interventions and Complications; DPN, diabetic peripheral neuropathy; IDF, International Diabetes Federation; MNSI, Michigan Neuropathy Screening Instrument; NCS, nerve conduction studies.

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Ethics Statement

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Data Availability Statement

No new data were generated. All evidence discussed in this review is contained in the published sources listed in the references, each of which is identified by a digital object identifier or public URL.

AI Use Statement

The author used Perplexity to identify gaps where literature reviews would be necessary. The author used ChatGPT to give feedback and grade the article. The author used Claude to enhance the paper after a draft was written. All AI-assisted output was reviewed and edited by the author, who verified the substantive claims and numerical values against the cited primary sources and takes full responsibility for the accuracy, originality, and integrity of the final manuscript.

Author Contributions

A.S. was solely responsible for conceptualization, literature searching and source selection, data extraction, analysis and interpretation, writing of the original draft, and revision of the manuscript.

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