

# Provider-patient discussions on driving with diabetes

Christine Jarocki and Brian Schmidt

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## Article points

1. Diabetic peripheral neuropathy alters lower extremity biofeedback and may affect how a person drives an automobile.
2. Healthcare providers should engage in a discussion of driving automobiles with patients that have diabetes and lower-extremity complications.
3. Podiatrists should include a driving discussion during the annual diabetic foot exam.
4. Peripheral neuropathy and the presence of a diabetic foot ulcer are often a reason to start a discussion on driver safety with patients.

## Key words

- Automobiles
- Diabetes foot exam
- Driving
- Peripheral neuropathy

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**Diabetes is a significant concern in the United States and approximately 60–70% of people with diabetes will develop mild to severe peripheral neuropathy. A person with diabetes and associated peripheral neuropathy may have delayed biofeedback with their environment due to sensory and motor loss. This has the potential to impede a person's driving capabilities. To understand healthcare providers' role on a patient's own acknowledgement of these deficits, the authors surveyed podiatrists across the United States using an online survey platform. The primary aim was to determine if podiatrists discussed driving automobiles with patients that have lower-extremity complications associated with diabetes. A total of 541 podiatrists responded to the survey, with 497 completed responses. The results indicated 51% reported they did engage in driving discussions with the patient, while 49% did not. Of the podiatrists who engaged in driving discussions, the presence of diabetes with peripheral neuropathy was the primary prompt. While there is a paucity of research regarding diabetic peripheral neuropathy and limitations on driving automobiles, it is important that healthcare providers discuss this with patients to improve the safety of all road users.**

**H**istorically, research regarding diabetes mellitus (DM) and driving automobiles centered around medical emergencies often related to hypoglycaemic events (American Diabetes Association, 2012). Understanding the impediments from DM peripheral neuropathy and relating that to driving automobiles is a recent area of focus. It is important that podiatrists, as well as other healthcare professionals, recognise the potential limitations from DM and discuss these concerns with patients to improve safety of all road users.

Diabetes is a significant concern in the US, impacting approximately 13% of the population older than 18 years (National Diabetes Statistics Report, 2020). Estimates suggest that 60–70% of people with DM will develop mild to severe peripheral neuropathy with affects to the sensory, motor, and autonomic nerves (National Institute of Neurological Disorders, 2020).

Peripheral sensory neuropathy may result in the loss of protective sensation, temperature discrimination, and proprioception. This limits biofeedback for a person interacting with their environment (Pop-Busui et al, 2017). This loss of sensation could be further complicated by motor neuropathy or decreased muscle innervation, as a late finding. The mechanism of motor neuropathy is still not fully understood. However, there is evidence that people with type 2 DM have decreased strength in the lower extremities with an increased quantity of intramuscular noncontractile tissue (Almurudhi et al, 2016).

Using driving simulators, participants with DM and related peripheral neuropathy demonstrated delayed braking response time (Spiess and Meyr, 2017; Spiess et al 2017), altered speed of strength generation and increased ankle reposition error (Perazzolo et al, 2019). These studies suggest

that DM-associated peripheral neuropathy could have an adverse effect on a person's driving ability. To understand healthcare providers' impact on the patient's own acknowledgement of their driving limitations, the authors chose to survey US podiatrists. The aim was to determine if driving automobiles was a topic podiatrists discussed with patients that have DM lower-extremity complications.

**Methods**

The authors created a questionnaire on a popular online survey platform (Qualtrics®XM, Provo, Utah). The aim was to survey podiatrists across the US. Given this undertaking, since nationwide totals between 10,500 jobs (US Bureau of Labor Statistics, 2021) and up to 18,000 licensed podiatrists (American Podiatric Medical Association, 2021), the authors reached out to national and state associations for support in distributing the survey. It was then shared through member-only newsletters and websites. Additional dissemination ensued through internet email mining by the authors. The survey recruitment lasted for approximately 5 months, between November 2018 and March 2019.

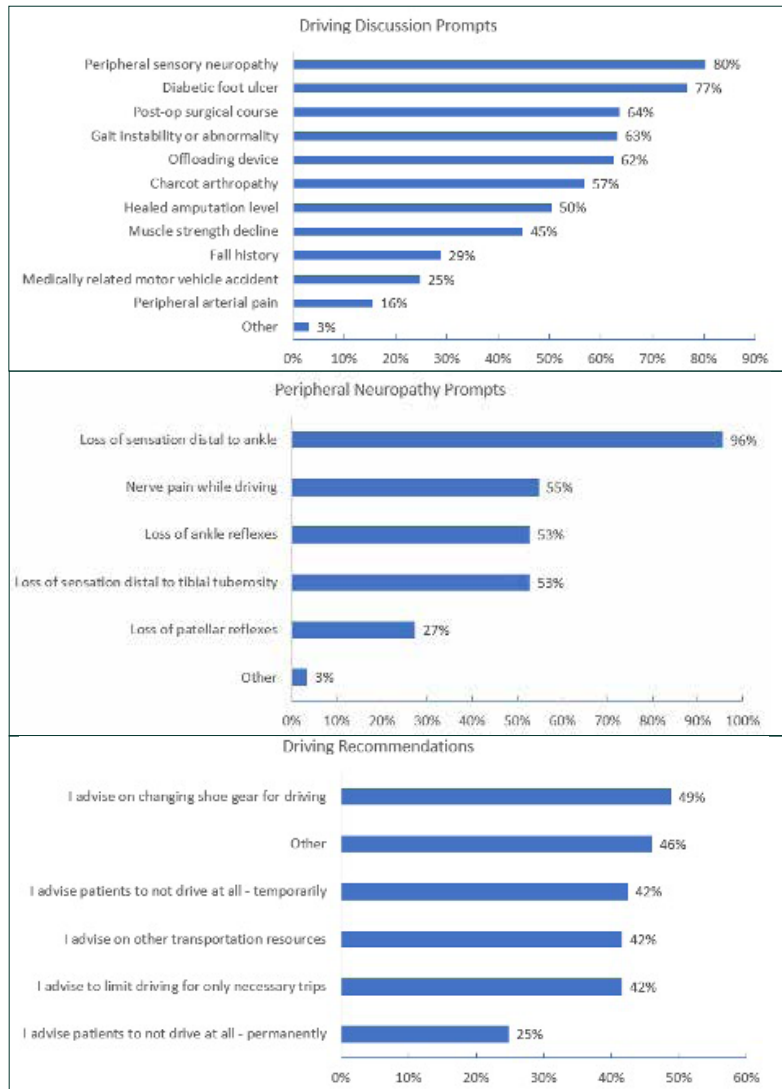
The survey determined if podiatrists discussed driving automobiles with patients that have lower-extremity complications associated with DM. The respondents could proceed if they answered yes.

When a 'yes' was selected, respondents were given a list of examples to select what prompts the discussion and further breakdown the reasoning. Finally, they were asked if they offered recommendations to the patient on changing driving activity.

**Results**

A total of 541 podiatrists volunteered and responded to the survey, with 497 completed responses. Of the 50 states, providers from 41 states responded to the survey. The states with the highest responder rates were Illinois, New Jersey and New York. Missing states were Alaska, Hawaii, Louisiana, Maryland, Mississippi, Nevada, Rhode Island, South Dakota and Wyoming. Podiatrists were from city, urban, and rural locations, in private, multi-specialty, and institutional practice settings.

The initial results were split, as 51% reported that they did engage in driving discussions with the patient and 49% did not. Of the podiatrists



that discussed driving with patients, explanations were offered to understand what prompted the conversation. From this selection, the most common reason a driving discussion occurred was the presence of DM with peripheral neuropathy (Table 1), with the specific physical exam finding of loss of sensation distal to the ankle (Table 2). Following this was the presence of a diabetic foot ulcer (DFU). Other common prompts included post-op surgical course, gait instability or abnormality, and use of an offloading device.

Most podiatrists (90%) reported they advised to change driving activity. Options for the patients include temporary or permanent driving restrictions, limiting driving for necessary trips only, and offering information for alternative modes of transportation (Table 3).

Figure 1 (top). From the sample of podiatrists (n=250), multiple diagnoses prompted the physician to engage in driving discussions with patients.

Figure 2 (middle). A chart of the most common clinical exam prompts when a patient presented with sensory peripheral neuropathy.

Figure 3 (bottom). Recommendations from podiatrists regarding patient's driving behaviour.

## Discussion

Diabetes prevalence continues to rise in the US. The most recent reports suggest approximately 10.5% of the US population have DM, with additional estimates that DM is found within 13% of the US population aged 18 years or older (National Diabetes Statistics Report, 2020). Diabetes continues to be the leading cause for polyneuropathy in the US (National Institute of Neurological Disorders, 2020). Between 60–70% of people with DM will develop mild to severe peripheral neuropathy, leading to deficits in sensory, motor and autonomic nerves (National Institute of Neurological Disorders, 2020).

The literature on how DM peripheral neuropathy affects driving automobiles is limited. Multiple reports have demonstrated the benefits and validity of using driving simulators to measure brake response times, lateral positions, inattention, etc. (Blana, 1996; Hoskins and El-Gindy, 2006; Casutt et al, 2013; Sahami and Sayed, 2013; Meuleners and Fraser, 2015). Driving simulators have suggested participants with DM and related peripheral neuropathy may have altered responses to the vehicle foot pedals. One study demonstrated delayed braking response time (Spiess and Meyr, 2017; Spiess et al, 2017). Another study showed altered lower-extremity speed of strength generation and increased ankle reposition error (Perazzolo et al, 2019). These investigations question the safety for the driver, and all users of the road.

According to the results of our survey, approximately 51% of US podiatrists engage in driving discussions with patients that have DM lower-extremity complications. Diabetic peripheral neuropathy is the primary prompt for this discussion, with specific focus on loss of sensation distal to the ankle. A person with DM and associated peripheral neuropathy may not be aware with how their body is directly interacting with the vehicle. Healthcare providers serve on the frontline of DM care and DM patient education. Multiple organisations focused on DM, such as the American Diabetes Association (ADA) (2021) and International Working Group on the Diabetic Foot (IWGDF) (2019), recommend that people with DM have an annual foot exam.

The ADA Standards of Medical Care in Diabetes (2021) include guidelines for frequency of DM foot exams to assess for lower-extremity complications. It recommends that all people with DM be assessed

for diabetic peripheral neuropathy upon diagnosis of type 2 DM and annually after, and then 5 years after the diagnosis of type 1 DM and annually after. This annual foot exam serves as an opportune time to engage in the driving discussion with the patient and further educate patients on driving safety.

When drivers were surveyed, on a scale of one to ten, people rated their own driving skills as a seven, suggesting people think their own driving is superior to what other people would determine (Roy and Liersch, 2014). The US National Highway Traffic Safety Administration recognizes that diabetes can lead to nerve damage, making sensation difficult, and that pressing the brake pedal fast enough to avoid a crash may be unfeasible. However, the US Federal Highway Administration (2014) acknowledges that a driver's license symbolises independence and freedom. With no national driving recommendations from these organisations, it is difficult for the health care provider to intervene. Future studies should be employed to better understand the implications of DM peripheral neuropathy and driving automobiles and patient perception, to help create evidence-based guidelines.

A driving simulator may not directly parallel real life vehicle ergonomics. Human body posture and foot position is specific to the driver. In a fixed environment, a driver must adjust seat position depending on height or shoe size in relation to the seat, wheel, foot pedals, among others (Sahil and Shashank, 2017; Xi, 2018). Furthermore, vehicle ergonomic studies show that with a taller stature or larger shoe size, a foot transfers from the accelerator or brake pedal through pivoting off the heel, while with a shorter stature or shoe, the driver is more likely to transfer pedals with lifting their leg (Crandall et al, 1996; Xi, 2018). Thus, foot pedal patterns are not necessarily habitual behavior, but rather anthropometrically dependent (Xi, 2018). Future studies should focus on these ergonomic details to improve authenticity.

The survey results have limitations. The study was designed as a pilot to review if podiatrists discussed this topic with patients. The authors present the data to disseminate the activities of other podiatrists and to encourage health care providers to engage in similar conversations with their patients. This survey does not include other nations or specialties, such as primary care, endocrinology, neurology, etc.

Management of DM is a multidisciplinary endeavor, and it may be possible that these other healthcare providers are engaging with patients regarding driving activity. Additionally, there may be other prompts that lead to this discussion.

Other limitations include the ongoing COVID-19 pandemic. With the widespread use of telehealth encounters, discussing driving activity may appear irrelevant. However, despite the decrease in number of motor vehicle accidents (MVA) in the US during the pandemic, preliminary studies show that the rate of MVA increased, as well as the fatality rates for both drivers and vulnerable road users for many cities (StreetsBlog USA, 2020). Another study from National Farmers Union Mutual Insurance in the United Kingdom reported that as the pandemic lockdowns ease one of four drivers were “feeling nervous” about driving for long journeys (Motoring Research, 2021). Which suggests that driving may not be as routine for people and they may or may not be cognisant of their inabilities.

## Conclusion

Peripheral neuropathy is a common complication of DM, which may alter how a person perceives their environment. Recent literature has explored how this may negatively impact driving automobiles. In large parts of the world, driving automobiles is still a necessary means of life. Furthermore, outside of extremes, there is no defined logic with how and when to revoke a driver's license, or who is responsible to do so. Future studies could focus on how people with DM and peripheral neuropathy perceive these sensory and motor deficits and if or how these affect their driving, as they are the drivers. Nonetheless, healthcare providers have an opportunity to include driving with DM peripheral neuropathy patient education and during annual DM foot exams. ■

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## Expert commentary: Provider-patient discussions on driving with diabetes

**F**or many of us, including those living with diabetes, driving is a vitally important part of daily life and any condition that threatens our driving license, thus has considerable consequence.

Diabetes has long been recognised to potentially affect driving, due in large part to demonstration of impaired performance during hypoglycaemia in driving-simulator studies (Cox et al, 1993). It has, however, been more challenging to translate these findings into ‘real-world’ evidence of increased road-traffic accidents in those living with diabetes, with some studies supporting an increased accident rate and others not so (Stevens et al, 1989; Cox et al, 2003).

Driving and diabetes has, therefore, largely and correctly focussed on the acute metabolic effects of hypoglycaemia on driving ability. Safe driving, however, is a highly complex activity and requires more than unaffected cognitive performance. Less attention has been given to other aspects of diabetes that may also influence driving, including peripheral neuropathy. The ability to accurately judge pedal position while driving, to respond rapidly and change pedals as needed and to have the muscle strength to depress a brake pedal sufficient for an emergency stop all require a level of appropriate peripheral nerve function. Diabetic neuropathy with its impact on proprioception, sensation and muscle function may potentially negatively affect all of these functions.

Evidence is emerging that attempts to quantify these effects and draw attention to this relatively neglected area (Spiess and Meyr, 2017; Perazzolo et al, 2020). The authors

of the current study rightly take the next logical step in examining whether having identified a problem that may impact driving, the healthcare provider then communicates this to the person living with diabetes. The results of this large and well conducted survey suggest that for many podiatrists (49%), driving discussions are not part of routine clinical practice.

Perhaps this is to some extent understandable. While assessment of loss of protective sensation is routine in diabetes encounters, detailed assessment of neuropathy is more challenging. Furthermore, how any defect discovered then relates to driving performance is much less clear. The relative contribution of impaired proprioception versus tactile sensation versus motor function on the various aspects of driving pedal function is uncertain.

Not only is the assessment and impact of neuropathy on driving a challenge, but what is communicated to the patient is unclear. A ‘Driving with diabetes’ consultation usually has two aspects. Firstly, there is education including glucose monitoring, safe glucose driving levels and action if hypoglycaemic. Given the current absence of any intervention to address impairment due to neuropathy, education may have a more limited role, other than raising the patient’s awareness.

Secondly, there is inevitably a binary conclusion to a consultation (“safe to drive” or “not safe to drive”) based on the UK’s Driver and Vehicle Licensing Authority criteria regarding hypoglycaemia severity, frequency and awareness. It is difficult to envisage how a discussion of driving with neuropathy can avoid

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needing to make a similar conclusion. Available, accurate and reproducible methods to assess neuropathy along with agreed criteria regarding safe driving will be needed for this to happen. Given the strong feelings with which the right to drive is held by some living with diabetes, robust and evidence-based criteria will be necessary.

So while it is good to talk and right to raise awareness of neuropathy and driving, ongoing work in this area is needed perhaps before it can be truly embedded in necessary ‘Driving with diabetes’ conversations. ■

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