

Driving and insulin-treated diabetes

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Article points

1. Drivers with insulin-treated diabetes face an increased risk of accidents if they develop hypoglycaemia, and therefore are subjected to restrictions when applying for, or renewing, a driving licence.
2. The UK Driver and Vehicle Licensing Agency provides guidance on safe driving requirements; however, knowledge of and adherence to these procedures is poor among both people with diabetes and healthcare professionals.
3. Healthcare professionals need to be up to date with the rules and recommendations and should be proactive in discussing them with people with diabetes as part of the annual review process.

Key words

- Driving
- Hypoglycaemia
- Insulin-treated diabetes

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Drivers with diabetes have restrictions on their driving licences. The main reasons for these restrictions are the risk of hypoglycaemia and hypoglycaemia unawareness. Recent changes in the European Driving Licence Directive have brought significant changes to UK rules and regulations. This article summarises the legal requirements for drivers with diabetes and the recommendations to ensure safe driving. For healthcare professionals responsible for diabetes education, it is vitally important to understand these in order to provide the correct information and to regularly discuss these matters with people with diabetes.

Driving is a complex task, requiring high-level visual skills, good coordination and the ability to mentally and physically multi-task in a split second. It is considered an instrumental activity of daily living (Sherman, 2006), as people rely on driving motor vehicles for their daily routines, including work, leisure and errands. Drivers with diabetes, especially insulin-treated diabetes, are subjected to restrictions on their driving licences in order to promote road safety. As the prevalence of type 2 diabetes and rates of insulin prescription are on the rise (Holden et al, 2014), there will be more drivers using insulin therapy in the future. Diabetes UK estimated that there are up to a million drivers with diabetes (both type 1 and type 2) using insulin (Diabetes UK, 2011).

Effects of diabetes on driving performance

Acute diabetes complications (such as hypoglycaemic episodes and hyperglycaemic emergencies) and long-term complications (retinopathy and peripheral neuropathy) have

significant adverse effects on driving performance. Hypoglycaemia and impaired hypoglycaemia awareness are the most common adverse effects of insulin therapy for all diabetes types. It has been estimated that individuals with type 1 diabetes typically have at least one severe hypoglycaemic episode per year (Cryer, 2014) and up to 20% have hypoglycaemia unawareness (Geddes et al, 2008). Studies have shown that hypoglycaemia has a significant negative impact on cognitive function (Inkster and Frier, 2012), working memory (Sommerfield et al, 2003), spatial awareness (Wright et al, 2009) and emotional wellbeing (McCrimmon et al, 1999). All of these parameters are essential for safe driving performance. In one study, in which a driving simulator was used to examine the driving performance of individuals with type 1 diabetes during an insulin-induced hypoglycaemic episode, moderate hypoglycaemia was found to be associated with disruptive steering, driving off the road, crossing midlines and inappropriate driving speed (Cox et al, 2000). Many of the individuals had no memory of the events and expressed disbelief of their performance

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1. The risks faced by drivers with diabetes are particularly great in those with impaired hypoglycaemia awareness, who are more likely to choose to drive during a hypoglycaemic episode.
2. Recent EU Directive amendments have relaxed the blanket ban on driving goods and public transport vehicles for people with insulin-treated diabetes, but have imposed more stringent rules on those driving ordinary cars and motorcycles.
3. In addition to the minimum vision requirements applicable to the general population, people with diabetes have other requirements in terms of visual acuity and field of vision, as a result of their risk of retinopathy and neuropathy.

when examined later.

Notably, the risk of severe hypoglycaemia is six times higher in people with hypoglycaemia unawareness (Geddes et al, 2008). Furthermore, hypoglycaemia unawareness could impair judgement on whether to drive or not during an episode of hypoglycaemia. For example, Stork et al (2007) enrolled three groups of participants: 23 people with type 1 diabetes and normal hypoglycaemia awareness, 21 with type 1 diabetes and impaired hypoglycaemia awareness and 20 with type 2 diabetes and normal hypoglycaemia awareness. These people were asked whether they felt hypoglycaemic and should continue to drive during experimental states of euglycaemia (5.0 mmol/L) and hypoglycaemia (2.7 mmol/L). Those with type 1 diabetes and impaired awareness frequently decided to drive, while those with normal awareness appeared to make safe decisions.

There is equivocal evidence on the effect of a hyperglycaemic state on cognitive function and driving performance. Some studies showed that acute hyperglycaemia (≥ 15 mmol/L) was associated with mild impairment in cognitive function (Cox et al, 2005), whereas others showed that cognitive function was well preserved with blood glucose levels of 14–21 mmol/L (Draeos et al, 1995).

Effects of driving on diabetes

The effects of driving on blood glucose levels are less well studied. Driving itself is a complex task with active cognitive–motor demands on the brain. One study has demonstrated that 30 minutes of driving in a virtual simulator was associated with higher glucose utilisation rates and more frequent hypoglycaemic events compared with 30 minutes of watching a video (Gonder-Frederick et al, 1997; Cox et al, 2002). It therefore seems that the very act of driving could lead to more frequent episodes of hypoglycaemia.

Guidance for drivers with insulin-treated diabetes

In the UK, the Driver and Vehicle Licensing Agency (DVLA) is responsible for issuing driving licences and providing guidance on regulations and requirements, including safe driving recommendations (DVLA, 2015a). The

amended Third European Licence Directive (2009/113/EC) came into force in the UK in November 2011 (Butcher, 2013). The new law has brought significant changes for drivers with insulin-treated diabetes, removing the blanket ban on people with insulin-treated diabetes applied to Group 2 licences (passenger-carrying vehicles and large goods vehicles) and imposing more stringent rules on Group 1 licences (cars and motorcycles). Maximum 3-year and 1-year licences are issued for Group 1 drivers and Group 2 drivers, respectively, provided that they meet the strict criteria set out by the DVLA (2015b). The medical standards for Group 1 and Group 2 licence holders with insulin-treated diabetes are summarised in *Table 1*.

Vision requirements

The standard eyesight requirements for Group 1 and Group 2 drivers are as follows. All drivers must be able to read a car number plate from 20 m (65 feet) away in good daylight (with glasses or corrective lenses if necessary). In addition, Group 1 drivers must have the following:

- Visual acuity of at least 6/12 (0.5 decimal) on the Snellen chart (with glasses or corrective lenses if necessary) in both eyes, or in the remaining good eye if they have monocular vision and adequate field of vision. The visual field must cover 120 degrees with no significant defect in the binocular field. This means that an individual who is blind in one eye and has normal vision in the other will usually reach acceptable standards for a Group 1 licence. On the other hand, an individual who has vision in both eyes but has undergone substantial pan-retinal photocoagulation in both eyes, resulting in loss of peripheral vision, may not reach the minimum criteria.

Group 2 drivers must have the following:

- Visual acuity of at least 6/7.5 (0.8 decimal) on the Snellen chart in their best eye and at least 6/60 (0.1 decimal) Snellen in the other eye. Glasses with a corrective power not greater than +8 dioptries or with contact lenses are allowed to reach the above-mentioned standard.
- A horizontal visual field of at least 160 degrees, with left and right extension of at least 70 degrees and up and down extension of at least 30 degrees.

Table 1. Medical standards for Group 1 and Group 2 licence holders with insulin-treated diabetes (DVLA, 2015b).

Group 1 licence holders	Group 2 licence holders
Must have adequate hypoglycaemia awareness*	Must have full hypoglycaemia awareness*
Must not have had more than one episode of severe hypoglycaemia [†] in the last 12 months	Must have had no episode of severe hypoglycaemia [†] in the last 12 months
Must have done appropriate blood glucose monitoring [‡] before driving and while driving	Must check blood glucose levels [‡] at least twice daily, even on non-driving days, and at times relevant to driving
	Three months' worth of continuous blood glucose meter readings must be available for review by an independent consultant diabetologist at the annual examination. These readings must be taken under their usual insulin treatment regimen

*Hypoglycaemia unawareness is defined as "an inability to detect the onset of hypoglycaemia because of a total absence of warning symptoms". [†]A severe hypoglycaemic episode is defined as an episode of hypoglycaemia requiring third-party assistance. [‡]Appropriate blood glucose monitoring is defined as blood glucose testing no more than 2 hours before the start of the first journey and every 2 hours while driving.

- No visual field defect within the radius of the central 30 degrees.

Safe driving recommendations for drivers treated with insulin

The DVLA has recommended precautionary measures for all drivers with diabetes, especially those treated with insulin. A summary of these recommendations is as follows:

- Always carry blood glucose testing kits in the car while driving.
- Always check blood glucose levels no more than 2 hours before the start of the first journey and every 2 hours while driving. Driving multiple short journeys does not necessarily require checking blood glucose before each journey, provided that testing is done every 2 hours.
- Always keep blood glucose levels above 5 mmol/L while driving. If the level is 5 mmol/L or less, eat a snack. If the level is below 4 mmol/L, or if symptoms of hypoglycaemia develop, do not drive.
- If a hypoglycaemic episode occurs while driving, stop the vehicle as soon as possible when it is safe to do so. Switch the engine off, remove the keys from the ignition and move from the driver's seat. Treat the hypoglycaemia appropriately.
- The driver must wait at least 45 minutes after

correcting hypoglycaemia (confirmed by testing blood glucose levels) before resuming the journey.

- Always carry quick-acting carbohydrates and snacks in the car.

Guidance for temporary insulin users

There are occasions in which diabetes is treated with insulin only for a short period of time (less than 3 months); for example, in cases of gestational diabetes requiring insulin treatment and participants in clinical trials involving oral or inhaled insulin. Group 1 drivers are not obliged to notify the DVLA of this, provided that they are under medical supervision and not at risk of disabling hypoglycaemia. Professional licence holders are obliged to inform the DVLA and they are dealt with in the same way as those with insulin-dependent diabetes.

Guidance for taxi and private hire vehicle drivers

Taxi and private hire vehicle licences are not governed by EU laws. The DVLA has not published any guidance on these types of licences, but it recommends that they should be considered as Group 2 licences. The ultimate responsibility to determine the individual's fitness to drive and to

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1. Insulin-treated drivers are required to meet minimum standards of hypoglycaemia awareness, past-year history of hypoglycaemia and blood glucose testing.
2. Safety recommendations include keeping blood glucose monitors in the car, maintaining blood glucose levels over 5 mmol/L while driving and keeping snacks to raise glucose levels in the car.
3. The regulations are less strict for people who require temporary insulin treatment for fewer than 3 months.
4. While there are no specific laws for taxi and private vehicle licences, it is recommended that these are treated the same way as goods and public transport licences.

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1. While these laws and recommendations are distributed to all people with diabetes at the time of licence application and renewal, studies have shown that awareness of and adherence to the guidelines is poor among drivers with the condition.
2. Healthcare professionals have also been shown to have low awareness of the newer regulations, particularly those concerning goods and public transport vehicles.
3. Healthcare professionals need to be aware of this guidance and regularly review it with their patients.

issue licences lies with the Public Carriage Office in metropolitan areas and the Local Authority in all other areas (Diabetes UK, 2009a).

Guidance for police, ambulance and health service vehicle drivers

The DVLA recommends that drivers who are treated with insulin should not drive emergency vehicles. Driving under blue light condition is demanding and time-critical. Therefore, it would be difficult for drivers with insulin-treated diabetes to comply with the monitoring process required when responding to an emergency situation. The DVLA guidance also mentions a caveat: the individual cases should be assessed in accordance with their specific circumstances. Diabetes UK has successfully campaigned to remove a blanket ban to recruit and retain people with insulin-treated diabetes in the police, fire and ambulance services (Diabetes UK, 2009b). There are, however, variations in local guidelines.

Road traffic accidents associated with diabetes

There are conflicting reports from studies regarding risk of collision in diabetes driver groups. Several studies agreed that drivers with diabetes pose a greater risk of road collision (Kennedy et al, 2002; Cox et al, 2003), while others showed no increased risk (Sagberg, 2006). The general consensus is, however, that drivers with this condition appear to have a slightly increased risk of road traffic accidents. There have been many fatal accidents in which severe hypoglycaemia has been implicated (BBC News, 2012; Quigley, 2013). Diabetes education on safe driving and identifying high-risk individuals are fundamental steps to promote road and public safety.

Awareness of DVLA guidance

The DVLA sends information on safe driving requirements to people with diabetes at the time of licence application and renewal. However, previous surveys of insulin-treated drivers demonstrated poor understanding, deficits in knowledge and limited compliance with DVLA guidance. In a survey of 202 insulin-treated drivers, 60% of the participants reported never

testing blood glucose levels before driving or only testing if they had symptomatic hypoglycaemia, and 38% never carried a glucose meter when driving (Graveling et al, 2004). Similar findings were noted in a recent survey of 61 participants attending a secondary care diabetes clinic (Min et al, 2015). Approximately half of participants reported always testing blood glucose levels before driving and taking a break to check blood glucose in a long journey, and up to 80% always carried a blood glucose meter and hypoglycaemia remedies in the car. However, 18% did not know the recommended blood glucose levels for safe driving and only 23% would wait the recommended 45 minutes after correcting hypoglycaemia. Overall, 16% of participants stated that they never received advice about driving and diabetes from healthcare professionals, but only 11% would have liked to get more detailed information. Another commercially sponsored survey of 16 172 drivers with insulin-treated diabetes mirrored the above findings: up to one third were not fully aware of current DVLA recommendations and just over half tested blood glucose levels before driving or at appropriate intervals while driving (Inkster et al, 2015).

The results of these surveys raise concerns over the knowledge among those healthcare professionals responsible for delivering diabetes education and completing DVLA forms about drivers' understanding of the recommendations for safe driving. Historically, it has been shown that there were variations in clinical practice and deficiencies in knowledge regarding the DVLA recommendations and requirements among healthcare professionals (Fisher et al, 1985; Flanagan et al, 2000; Watson et al, 2007). Conflicting and confusing opinions from healthcare professionals could lead to poor awareness of and adherence to DVLA guidance among people with diabetes. It is good clinical practice that those delivering diabetes care should be aware of current guidance and provide correct and consistent advice. However, a recent survey of 64 healthcare providers (consultants, registrars, DSNs, GPs and practice nurses) showed significant deficiencies in the understanding and knowledge of Group 2 licence eligibility criteria (including recent changes in EU licensing laws) and safe

driving recommendations (Min and Younis, 2015). Up to 20% of practitioners were unaware of the cut-off blood glucose level for hypoglycaemia or the recommended minimal blood glucose level for safe driving. These findings suggest that there is an urgent need for education of current driving regulations for people with diabetes among healthcare providers.

Conclusion

Severe hypoglycaemia and impaired hypoglycaemia awareness are associated with a greater risk of road traffic accidents. In order to promote road safety, there are well-established principles of safe driving when using insulin. Healthcare professionals should be proactive in discussing these principles, and this should form part of the annual review process. Patient information leaflets such as TREND-UK's (available at: <http://bit.ly/1IW1aF9>) are also a good way of reinforcing what has been discussed during consultation and for delivering consistent advice. They are also a useful way of documenting the advice that has been given for medico-legal purposes. It is vitally important that those responsible for diabetes education are equipped with up-to-date knowledge of DVLA rules and regulations, which can change periodically, in order to provide consistent advice to people with diabetes. Education sessions regarding diabetes-related driving issues, updates on recent developments in DVLA rules and workshops delivered by the DVLA's medical advisory group could be options to improve awareness. ■

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“It is vitally important that those responsible for diabetes education are equipped with up-to-date knowledge of Driver and Vehicle Licensing Agency rules and regulations, which can change periodically, so as to provide consistent advice.”