



Understanding, knowledge and attitudes towards current UK driving advice in insulin treated diabetic patients

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Introduction

Driving is a complex activity that requires a high degree of concentration, visual-spatial awareness and fast reaction times in order to respond to a rapidly altering environment. Hypoglycaemia, an intermittent complication of insulin treated diabetes, may temporarily impair the skills necessary for competent driving.^{1,2}

Deficits in cognitive function are common as a result of hypoglycaemic episodes below 2–2.5mmol/L and noticeable effects can start below 3.5mmol/L.^{3–5} However, drivers may not take corrective action until a blood glucose of 2.8mmol/L is reached.²

Long duration diabetes^{6,7} and tight glycaemic control^{8,9} may predispose to a lack of the usual warning symptoms of hypoglycaemia. This situation is not uncommon; 25% of type 1 diabetic patients are unable to detect the start of hypoglycaemia.¹⁰ Furthermore, the trend towards achieving ever tighter glycaemic control by the use of multiple daily dose injection therapy or continuous subcutaneous insulin infusion therapy may predispose to an increase in the frequency of hypoglycaemia which may lead to a road traffic collision.¹¹ The results from the Diabetes Control and Complications Trial¹¹ highlighted the increased incidence of hypoglycaemia associated with tighter glycaemic control, and alluded to the resulting risk of motor vehicle accidents.

Taking a carbohydrate snack can rapidly re-establish the peripheral blood glucose level after hypogly-

ABSTRACT

UK driving licences are issued and controlled by a government body, the DVLA (Driver and Vehicle Licensing Agency). Diabetic drivers must inform the DVLA and their motor insurer about their condition. Current advice is to test the capillary blood glucose level before driving. If symptomatic hypoglycaemia occurs during driving, the driver should stop, take carbohydrate, and wait 45 minutes after euglycaemia to allow brain function to recover before driving on. Previous studies have shown that diabetic drivers are good at informing both the DVLA and their insurer, but not good at following advice regarding testing and hypoglycaemia treatment. In order to inform our current education process, this study aimed to explore why drivers do not seem to follow this advice by examining the attitudes of patients and their acceptance of current UK advice for diabetic drivers.

Fifty consecutive insulin treated drivers attending a hospital clinic were interviewed over a two-week period. All 50 agreed to interview; there were 34 men and 16 women, the median age was 49 years (range 19–77 years), and the median diabetes duration was 16 years (one month to 46 years). A questionnaire modified from Graveling *et al.* to include attitudes and acceptability of current advice was used.

Median driving duration was 22 years (four months to 56 years) and annual mileage 500–50 000 miles. Thirty-six (72%) drove to work by car and 34% (including a lorry driver and a forklift truck driver) drove as part of their job; nine subjects had no period restriction on their licence. Only 34% always carry a blood glucose testing kit with them when driving. Testing before driving was performed: always (20%), long journeys (20%), sometimes (22%), never (38%); however, only 40% admitted to being previously advised to test before each journey. After the advice about testing before driving was explained, 64% thought it was reasonable, but 52% would not accept it. After hypoglycaemia when driving, the subjects reported that they would wait a mean of 25 minutes (5–60) before driving on. Only 10% knew of waiting 45 minutes after hypoglycaemia. After the current advice was explained, 24% found it unreasonable, while 36% would not accept this stricture.

Current advice for insulin treated drivers is not widely known. Better education is required. However, when given current advice about testing before each journey and waiting 45 minutes after hypoglycaemia, many patients considered this unreasonable and unacceptable. Copyright © 2009 John Wiley & Sons.

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KEY WORDS

driving; education; hypoglycaemia; insulin

caemia, but the restoration of cognitive function can lag behind. Reaction times after carbohydrate ingestion continue to be significantly impaired for 40 minutes and may remain so for up to 90 minutes.^{12–14}

Therefore, the UK Driver and Vehicle Licensing Agency (DVLA) currently recommends in patient

leaflets¹⁵ that insulin treated drivers should carry fast acting carbohydrate and their blood glucose meter with them. They should not drive if feeling hypoglycaemic or if the blood glucose is <4mmol/L. In addition, they should test their blood glucose before they drive even on short journeys and not resume driving for

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45 minutes after treating a hypoglycaemic episode. Sulphonylureas may also cause hypoglycaemia and may pose a risk if, for example, taken in the morning without any breakfast.

In our clinic, a diabetes specialist nurse explains these safety measures to new patients as part of their routine education. In addition, this information is reiterated in pamphlet form at each visit for annual retinal screening.

There have been recent cases of diabetic drivers involved in fatal car accidents, following an episode of hypoglycaemia.^{16–19} Therefore, we undertook a survey of how well this advice was known to our patients, as part of an audit cycle of our education methods. We assessed whether patients thought that this advice is reasonable and whether they would comply with it.

Methods

Entry criteria for this study were for insulin treated diabetic drivers attending our outpatient clinic. No distinction between type 1 and type 2 was made as the focus was on insulin use. Fifty people were interviewed over a two-week period and none declined. A questionnaire modified from Graveling *et al.*²⁰ to include attitudes and acceptability of current driving advice was presented to each patient by DMSB (see Appendix 1, available online at www.practicaldiabetesinternational.com). Approval was obtained from the Leeds (West) Research Ethics Committee, as part of a patient educational audit cycle.

Results

There were 34 men and 16 women; the median age was 49 years (19–77), median diabetes duration was 16 years (one month to 46 years) and the median duration of insulin therapy was 13 years (one month to 46 years).

Employment and driving habits

Thirty-four participants were in employment, 15 in a professional capacity (Table 1). All had full driving licences apart from one who had a provisional licence. The median time with a full driving licence was 22 years (four months to 56 years) and the annual mileage was 500–50 000.

Table 1. Participant demographics, employment characteristics and insulin usage

Male/female	34/16 (68%/32%)
Median age (range)	49 years (19–77 years)
Median diabetes duration (range)	16 years (1 month – 46 years)
Median insulin duration (range)	13 years (1 month – 46 years)
Median duration of driving history (range)	22 years (4 months – 56 years)
Profession	
Manual	4 (8%)
Semi-skilled	10 (20%)
Skilled	5 (10%)
Professional	15 (30%)
Retired	11 (22%)
Unemployed	2 (4%)
Student	3 (6%)
Daily insulin regimen	
2 Injections	12 (24%)
3 Injections	7 (14%)
4 Injections	20 (40%)
5 Injections	7 (14%)
6 Injections	2 (4%)
Pump	2 (4%)

Table 2. Sources of information about driving and diabetes

Have received advice about driving and diabetes	31 (62%)
Source of information	
Diabetic clinic doctor	14 (28%)
Family/friends	4 (8%)
Diabetic clinic nurse/dietitian	21 (42%)
Diabetes literature (including driving pamphlet)	21 (42%)
General practitioner	10 (20%)
Newspaper/magazine	3 (6%)
GP practice nurse	1 (2%)
Internet	3 (6%)
DVLA	26 (52%)
Did not receive driving advice	19 (38%)

Twenty-four (48%) drivers with diabetes developed diabetes after they started driving (median 16 years, range 5–50 years). Thirty-six (72%) drove to work by car and 17 (34%) – including a lorry driver and a forklift truck driver – drove as part of their job. Those who drove as part of their work had a median annual mileage of 12 500 compared to 5500 for those that did not. The C1 part of one participant's licence, enabling him to drive vehicles between 3.5 and 7.5 tonnes, had just expired. He had retired as an HGV (heavy goods vehicle) driver, but continued to hold a full UK driving licence. Nine subjects (18%) had no period

restriction on their licence, three (6%) had a two-year restriction and the majority (38 [76%]) had a three-year period restriction. All participants stated that they had informed both the DVLA and their motor insurance company that they have insulin treated diabetes.

Education about driving

Only 62% reported having received any education or information about driving and diabetes, and 52% had remembered receiving some information from the DVLA. Only 42% remembered receiving written advice including the pamphlet distributed at the time of retinal screening. This left

**Table 3.** Performance of self-monitoring of blood glucose

Routine testing	
No, never	0
Only if I think it is too high or too low	1 (2%)
Less than once a week	0
At least once a week	1 (2%)
At least three times a week	6 (12%)
At least once a day	14 (28%)
Three or more times a day	28 (56%)
Always carry their blood glucose testing kit with them while driving	17 (34%)
Testing before driving	
No, never	19 (38%)
Sometimes	11 (22%)
Long journeys only	10 (20%)
Yes, every journey	10 (20%)

Table 4. Driving advice

	Ever been told	Reasonable	Acceptable
Test blood glucose before all journeys, even short ones	20 (40%)	32 (64%)	24 (48%)
Wait 45 minutes after treating hypo and testing for euglycaemia	5 (10%)	38 (76%)	32 (64%)

38% who claimed that they had never received any advice about driving (Table 2).

Hypoglycaemia awareness

All drivers stated that they undertook self-monitoring of blood glucose (SMBG); 56% (28) test several times a day, 28% (14) test once daily and the remaining 16% (eight) test occasionally (Table 3). When asked, most participants (86% [43]) believed that they had hypoglycaemia awareness, but 14% did not and 80% of respondents would do SMBG if they suspected hypoglycaemia.

SMBG when driving

Only 34% (17) always take a blood glucose meter with them when driving. When asked about the lowest safe blood glucose level for driving, the median response was 4.0mmol/L (range 2–7mmol/L). Testing before driving was not performed routinely by 60% (30) of drivers with diabetes (Table 3). Only 40% (20) admitted to being previously advised to test before each journey (Table 4). After

it was explained that the DVLA recommends testing prior to driving, 64% (32) thought this advice reasonable, but 52% (26) would not accept it, mainly citing inconvenience, that they usually test prior to breakfast and that they consider this as a substitute to testing immediately before driving.

All participants who test before they drive, regardless of frequency, stated they tested their blood glucose on a long journey; the mean time before checking was one hour 50 minutes.

Hypoglycaemia whilst driving

All participants stated that they usually carry a carbohydrate snack in the car in case of hypoglycaemia, and 39 (78%) said that they would test their blood glucose after a hypoglycaemic incident, although less than this claim to take a meter with them when driving. Thirteen participants (26%) said they had experienced hypoglycaemia whilst driving, but only one reported an accident following hypoglycaemia. Of these 13 patients, only six reported testing

their blood glucose after these episodes. Following a hypoglycaemic episode when driving and the restoration of euglycaemia, the 50 patients would wait a mean of 25 minutes (range 5–60 minutes) before driving on. Just nine (18%) thought they should wait a minimum of 45 minutes. Only five (10%) had heard of the recommendation to wait for 45 minutes before driving on after the restoration of euglycaemia. The rationale for this recommendation was then discussed with all participants and 38 (76%) found it reasonable, but 12 (24%) found it unreasonable. Furthermore, whilst 32 (64%) found this advice acceptable, 18 (36%) would not accept it. The participant who stated that hypoglycaemia had been a factor in a crash was aware that he should test before every journey; he felt this was reasonable but did not accept this advice. He was unaware of advice regarding waiting after a hypoglycaemic episode whilst driving.

Only one of seven participants who had hypoglycaemia unawareness knew they should test prior to every journey. When the rationale was explained to them, four (57%) found this reasonable and five (71%) acceptable. None knew to wait after a hypoglycaemic episode, but five (71%) found this reasonable and four (57%) acceptable after discussion.

Discussion

Hypoglycaemia whilst driving may have disastrous consequences and may occasionally result in a fatal accident. The diabetic driver may face a charge of causing death by dangerous driving. In some cases, the driver has been acquitted on the basis that he was driving in an automatic manner whilst hypoglycaemic and could not have reasonably prevented the accident. In other cases, where it was shown that a diabetic driver did not test his blood glucose before driving, or did not carry a carbohydrate snack with him or failed to comply with medical advice, then a conviction leading to a custodial sentence has resulted.^{16–18} It is important that SMBG is undertaken before driving as many insulin treated drivers with



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impaired hypoglycaemia awareness make incorrect assessments about their ability to undertake a journey or when to stop.³

This study enquired about impaired hypoglycaemia awareness subjectively, and suggested that objective assessment should be performed using a validated scoring system. Regular blood glucose monitoring should be emphasised to help prevent unrecognised hypoglycaemia, which may precede accidents involving insulin treated drivers.^{9,21} This study incorporated both type 1 and insulin treated type 2 diabetic subjects. It should be emphasised that the risk of hypoglycaemia, and unawareness of it, is greater in the former group with long duration disease.

Repeated hypoglycaemic attacks and autonomic neuronal failure may predispose to hypoglycaemia unawareness. Both these factors may progressively worsen and may explain the correlation between the duration of diabetes and the decrease in awareness of the onset of hypoglycaemia.²² Therefore, it is important for drivers to be aware of the current DVLA recommendations for safe driving in insulin treated patients and for compliance with them. This study and that of Graveling *et al.* conducted in Edinburgh²⁰ have shown that compliance with notification of both the DVLA and insurers is good. However, both studies confirm that SMBG is not commonly practised prior to driving.

The present study has further highlighted the low level of knowledge of current DVLA recommendations for insulin treated drivers despite attempting to provide this information through different routes. This appears to have been relatively unsuccessful in our clinic. Patients may have had their initial education many years ago prior to the institution of the current recommendations, so these recommendations have been reiterated and distributed at the time of annual retinal screening to all diabetic patients in our clinic. Even this route seems to have been largely ignored. Furthermore, half of the patients denied receiving any advice from the DVLA. Despite today's emphasis

Key points

- Diabetes clinics attempt to convey the DVLA advice for drivers with diabetes, including their recommendation that drivers should test their blood glucose level before each journey and also to wait 45 minutes before driving on after an episode of hypoglycaemia
- Drivers' knowledge of this advice is poor
- Whilst some drivers find this advice reasonable, many will not accept it and are therefore unlikely to adhere to it

on the use of information technology, only three subjects reported obtaining relevant advice from the internet. As a low proportion of our subjects habitually carry a meter with them when driving, this proportion would have to be substantially increased to facilitate testing before each journey.

It is then of interest to assess the patient's reaction to the advice to test before each journey. Whilst this would seem logical in order to prevent hypoglycaemia whilst driving, 36% disagreed with this and half of those questioned would not obey this advice. Some patients stated that they would prefer to rely upon their symptoms of hypoglycaemia rather than test, whilst others would not wish to test again having tested earlier that day. Having tested before breakfast, they would not agree to test again before driving to work, feeling confident that additional testing was superfluous. Additionally, some felt that testing was unnecessary for short journeys, and some found the concept simply inconvenient.

It is well established that brain recovery time lags behind the short time needed to correct the ambient blood glucose level with oral carbohydrate following hypoglycaemia. This has led to the idea that an insulin treated driver should wait 45 minutes after the re-establishment of euglycaemia. Only 18% of our subjects complied with this recommendation, whereas only 14% of the Edinburgh subjects would wait 30 minutes or more.²⁰ Few of our subjects even knew of this recommendation. After this recommendation was discussed with each subject, three quarters of them still found this advice unreasonable. Furthermore, only two thirds would comply with it; those who would not, generally cited the inconvenience of the long

waiting period for recovery. On the other hand, several mothers who drive their children to school stated that they would now comply with this advice having heard about it for the first time.

Further work should be done to expand this study, with a focus on younger drivers who may have different attitudes compared with those of our study's participants who were mostly middle aged. However, longer duration diabetes may predispose to hypoglycaemia unawareness and so increase the possibility of an accident. Our study also had a high proportion of people who drive as part of their work, with a higher annual mileage – increasing their risk of accidents.

In conclusion, these results mean that more effective ways of disseminating the current DVLA recommendations are required. However, even if all drivers knew about them, a substantial proportion would still find them unreasonable or inconvenient, and a proportion would knowingly not comply with them. Accidents may be caused by those drivers who are unaware of the current DVLA recommendations or who do not wish to comply with them. Despite the best efforts of diabetes educators, drivers with diabetes may choose to ignore this advice because they find it inconvenient. This highlights the necessity for doctors and health care practitioners to enquire about and reiterate this advice at consultations and when completing forms to renew the driver's licence.

Conflict of interest statement

There are no conflicts of interest.

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References are available at www.practicaldiabetesinternational.com.



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<p>16. Is there a period restriction on your licence? <input type="checkbox"/> Yes</p> <p>If yes:</p> <p>A. 1 year <input type="checkbox"/></p> <p>B. 2 years <input type="checkbox"/></p> <p>C. 3 years <input type="checkbox"/></p> <p>D. No <input type="checkbox"/></p> <p>17. About how many miles do you usually drive in a year? <input type="text"/> miles</p> <p>18. Do you drive to work by car? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>19. Do you have to drive as part of your job, other than commuting to and from work? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <hr/> <p>Blood glucose monitoring while driving</p> <hr/> <p>20. Do you ALWAYS carry your blood glucose testing kit with you while driving? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>21. Do you test your blood glucose level before driving? (Please state which most closely applies to your testing habits)</p> <p>A. No, never <input type="checkbox"/></p> <p>B. Sometimes <input type="checkbox"/></p> <p>C. Long journeys only <input type="checkbox"/></p> <p>D. Yes, every journey <input type="checkbox"/></p> <p>The current advice is to test the blood glucose before ALL journeys, even short ones</p> <p>22. Have you ever been told about this? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>23. Do you think that this advice is reasonable? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>24. Would you accept this advice? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>25. When driving, do you test your blood glucose level during a LONG journey? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>26. If yes, when would you stop and test? <input type="text"/> hours</p> <hr/> <p>Driving and hypoglycaemia</p> <hr/> <p>27. Have you ever experienced hypoglycaemia while driving? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>28. Has an episode of hypoglycaemia while driving resulted in an accident? <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>29. Did you measure your blood glucose when you had a hypo WHEN DRIVING? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA</p> <p>Action taken if hypoglycaemia is suspected while driving</p> <p>30. Do you carry some type of carbohydrate/SNACK in the car for the treatment of a hypo? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>31. Would you measure your blood glucose after treating the hypo? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>32. How long after treating the hypo would you wait before DRIVING ON?</p> <p>A. Immediately <input type="checkbox"/></p> <p>B. 5 mins <input type="checkbox"/></p> <p>C. 10 mins <input type="checkbox"/></p> <p>D. 15 mins <input type="checkbox"/></p> <p>E. 20 mins <input type="checkbox"/></p> <p>F. 30 mins <input type="checkbox"/></p> <p>G. 40 mins <input type="checkbox"/></p> <p>H. 50 mins <input type="checkbox"/></p> <p>I. 60 mins <input type="checkbox"/></p> <p>If you have a hypo, THE CURRENT ADVICE IS to wait 45 minutes AFTER treating the hypo and your blood glucose has returned to normal before you start driving again</p> <p>33. Have you ever been told this advice? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>34. Do you think that this advice is reasonable? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>35. Would you accept this advice? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <hr/> <p>Knowledge</p> <hr/> <p>36. Below which blood glucose level would you consider it unsafe to drive? <input type="text"/> mmol/L</p> <p>37. Have you informed the DVLA that you have insulin treated diabetes? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>38. Have you informed your motor insurance company that you have insulin treated diabetes? <input type="checkbox"/> Yes <input type="checkbox"/> No</p>
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