PACTS

Parliamentary Advisory Council for Transport Safety

(an All-Party Parliamentary Group)

PACTS

Parliamentary Advisory Council for Transport Safety

(an All-Party Parliamentary Group)

The Parliamentary Advisory Council for Transport Safety (PACTS) is an All-Party Parliamentary Group and a registered charity. Its charitable objective is "To protect human life through the promotion of transport safety for the public benefit". Its aim is to advise and inform members of the House of Commons and of the House of Lords on air, rail and road safety issues. It brings together safety professionals and legislators to identify research-based solutions to transport safety problems having regard to cost, effectiveness, achievability and acceptability. In recent years it has paid increasing attention to the links between transport safety, sustainability and public health.

PACTS
Clutha House
10 Storey's Gate
Westminster
London
SW1P 3AY
Telephone: 020 7222 7732
www.pacts.org.uk
Email: admin@pacts.org.uk
Twitter: @pacts

Fit to Drive?

Oliver Carsten, Dan Campsall, Nicola Christie and Rob Tunbridge

on behalf of the PACTS Road User Behaviour Working Party

March 2016

PACTS statement:

PACTS is very grateful to the authors of this report , members of the Road User Behaviour Working Party, chaired by Professor Oliver Carsten, for the work they have undertaken in producing this report. The Working Parties provide important technical advice to PACTS and are a vibrant and vital part of PACTS activity. PACTS is pleased to publish this report. Responsibility for the contents lies with the authors and does not necessarily represent the views of the Parliamentary Officers or the PACTS Board of Directors.

Summary

It is fundamental expectation of the Safe System approach to road safety management that those operating motor vehicles should be fit to do so. This report examines the research evidence and current practice in Great Britain on fitness to drive. It covers a wide range of impairments, including ones that are relatively long-term for the individual (such as physical and cognitive impairments) and the short-term ones that can be sometimes be related to individual behaviour and choice (for example alcohol consumption and fatigue). For each type of impairment, there is a discussion of how that impairment affects risk in driving. Where appropriate, this is followed by a review of interventions to manage and control those risks. Finally, there is a discussion of implications for policy.

The report concludes with a set of recommendations (see page 20) both on road safety policy in order to improve the management of fitness to drive, and on identified research needs, where the required evidence on effective countermeasures is lacking. The policy recommendations cover the regulatory framework, enforcement, road design, health practice and the management of occupational road risk. New research initiatives in the areas of health practice and of vehicle and road design are advocated.

PACTS
www.pacts.org.uk

Contents

Introduction

It is reasonable to expect that every road vehicle operator, whether driver or rider, should be fit to drive. "Fitness" can be defined as being physically and mentally fit to hold a licence and being unimpaired whenever driving or riding. This report summarises the research evidence on how the various sources of lack of fitness are related to the risk of being involved in a crash. It identifies where there are evidence gaps, and it further identifies gaps in how the various deficits are currently managed in the UK. Its particular aim is thus to focus the attention of policy-makers and the managers of the road transport system on how we can improve the handling of fitness to drive, so as to deliver safer use of the roads.

What is Fitness to Drive?

As regards *prima facie* fitness to drive, the major piece of law affecting the right to drive is the Third European Directive on Driving Licences (Directive 2006/126/EC). This declares:

> On road safety grounds, the minimum requirements for the issue of a driving licence should be laid down. Standards for driving tests and licensing need to be harmonised. To this end the knowledge, skills and behaviour connected with driving motor vehicles should be defined, the driving test should be based on these concepts and the minimum standards of physical and mental fitness for driving such vehicles should be redefined.

It also states: *"*Specific provisions should be adopted to make it easier for physically disabled persons to drive vehicles.*"*

In fact, the directive does not define minimum standards of physical and mental fitness, except in certain particulars such as eyesight. Rather, it defines factors affecting fitness. For non-professional licences to drive cars or ride powered two-wheeled vehicles, these are:

- **Eyesight**, which is regulated in terms of visual acuity and, to some extent, horizontal field of view.
- **Locomotor disability**: *"*Driving licences subject to certain restrictions, if necessary, may be issued to physically disabled applicants or drivers following the issuing of an opinion by a competent medical authority. This opinion…must also indicate what type of modification to the vehicle is required and whether the driver needs to be fitted with an orthopaedic device…*"*
- **Cardiovascular diseases:** Conditions preventing licensing are serious arrhythmia and angina during rest or emotion. Abnormal arterial blood pressure is to *"*be assessed with reference to the other results of the examination, any associated complications and the danger they might constitute for road safety. For myocardial infarction, issue or renewal is subject to authorised medical opinion and, if necessary, regular medical check-up".
- **Diabetes:** Licensing is permitted "subject to authorised medical opinion and regular medical check-ups appropriate to each case*"*.
- **Neurological diseases:** "Driving licences shall not be issued to, or renewed for, applicants or drivers suffering from a serious neurological disease, unless the application is supported by authorised medical opinion. Neurological disturbances associated with diseases or surgical intervention affecting the central or peripheral nervous system, which lead to sensory or motor

deficiencies and affect balance and coordination, must accordingly be taken into account in relation to their functional effects and the risks of progression." The only *specific neurological disease* that is addressed is **epilepsy**: "A licence may be issued or renewed subject to an examination by a competent medical authority and to regular medical check-ups. The authority shall decide on the state of the epilepsy or other disturbances of consciousness, its clinical form and progress (no seizure in the last two years, for example), the treatment received and the results thereof."

- **Mental disorders:** Excluded from being licensed are persons suffering from:
    - **severe mental disturbance**, whether congenital or due to disease, trauma or neurosurgical operations,
    - **severe mental retardation**,
    - **severe behavioural problems due to ageing**; or **personality defects** leading to seriously impaired judgment, behaviour or adaptability.
- **Alcohol dependency**: "Driving licences shall not be issued to, or renewed for, applicants or drivers who are dependent on alcohol or unable to refrain from drinking and driving. After a proven period of abstinence and subject to authorised medical opinion and regular medical check-ups, driving licences may be issued to, or renewed for, applicant or drivers who have in the past been dependent on alcohol."
- **Drugs and medicinal products**: "Driving licences shall not be issued to, or renewed for, applicants or drivers who regularly use psychotropic substances, in whatever form, which can hamper the ability to drive safely where the quantities absorbed are such as to have an adverse effect on driving. This shall apply to all other medicinal products or combinations of medicinal products which affect the ability to drive."
- **Renal disorders**: "Driving licences may be issued or renewed for applicants and drivers suffering from serious renal insufficiency subject to authorised medical opinion and regular medical check-ups."
- **Organ transplants or artificial implants which affect the ability to drive**: Once again licences may be issued "subject to authorised medical opinion and, if necessary, regular medical check-ups".

A notable feature in the language of the Directive is the requirement to consult with "authorised medical opinion" to obtain expert judgement on many of the factors. Thus one obvious issue for the UK, as for other Member States, is how that expert judgement is to be obtained and who is qualified to give it. In the UK, the onus is actually on licence-holder to notify DVLA (In Northern Ireland, the Driver and Vehicle Agency, DVA) of the development of any notifiable conditions (see DVLA, 2015a and 2014).

In addition to the issues covered by the driver and rider licensing regulations, there are a number of more temporary impairments that also affect fitness to drive, some of which overlap with the more permanent factors listed above. The most obvious of these factors are alcohol consumption, drug use (both licit and illicit) and fatigue.

For the purposes of this report, we have chosen not to include *activities* engaged in while driving, such as mobile phone use, as an impairment. The focus is on the individual's physiological and mental **capacity to drive** as opposed to whether the individual is fully engaged in the driving task.

Fitness to Drive as a Safety Problem

It is quite hard to determine how many crashes have unfitness to drive as a contributory factor. Police officers record contributory factors as part of their accident reporting, but the coverage of such reporting is by no means complete and underlying factors in a crash are often hard to determine. Five factors relevant to this report are included in the contributory factors scheme:

1. Impairment from alcohol
2. Impairment from drugs
3. Fatigue
4. Uncorrected defective eyesight
5. Mental or physical illness or disability

Of these, alcohol impairment is the most likely to be captured, given the encouragement to administer a breath test to all accident-involved drivers and riders. Table 1 shows the percentage of crashes occurring in 2014 in which each of the five factors was recorded as being relevant. It can be seen that the more severe the crash, the more likely impairment is to be recorded as a factor. It can also be seen that, apart from alcohol, the designation of impairment is low. That does not necessarily mean that these factors were not relevant, but rather that they are hard to identify, i.e. they tend to be hidden. They are also clearly very important from a policy perspective. It is a fundamental proposition of safety management that the operators of motor vehicles should be fit to drive or ride.

Table 1: Percentage of crashes for which an impairment contributory factors is reported (Great Britain, 2014)

Contributory Factor	Crash Severity			All
	Fatal	Serious	Slight	
Impaired by alcohol	8%	6%	4%	4%
Impaired by drugs	3%	1%	0%	1%
Fatigue	3%	2%	2%	2%
Uncorrected defective eyesight	1%	0%	0%	0%
Mental or physical illness or disability	6%	3%	2%	2%

Source: Department for Transport (2015).

Vision

Risk

There is conflicting evidence on the effects of vision impairment on risk in driving. Retrospective studies have investigated the link between impaired vision (visual acuity 6/12 or 6/15) and driving accident records. Only weak links have were found between visual acuity and the likelihood of crashes for those with lower visual acuity. Reduced visual acuity (categories including up to <6/15) has not been found to be significantly related to at-fault crashes in cataract patients but reduced contrast sensitivity did elevate the risk of crash involvement (EU Eyesight Working Group, 2005). A more recent review by Owsley and McGwin (2010) concluded that the association between visual acuity and risk of crash involvement was rather weak. They did, however, conclude that other aspects of visual performance — contrast

sensitivity, visual field impairment and cognitive performance aspects such as processing speed and divided attention deficits — were related to risk.

In general, despite evidence that in excess of 90% of the information required for effective and safe driving enters the brain via the visual cortex, there is no strong evidence that deficiencies in eyesight present a major road safety risk. One of the major reasons for this is probably that eyesight-deficient drivers are likely to restrict their driving to times when their risk of conflict with other drivers and therefore accident risk is minimised. This is particularly likely for elderly drivers who may have other health issues. However, it can also be argued that good eyesight is a minimum qualification for being permitted to drive and that, with an ageing population, eyesight is likely to increase as a risk factor. There is also reason to doubt that current procedures are sufficient to identify those with inadequate eyesight.

Interventions

It is an individual's responsibility to inform the DVLA if they have a medical condition that affects their driving. However, patients may discuss fitness to drive with their GP as a first course of action. In the UK General practitioners (GPs) will need to refer to the DVLA 'at a glance' guidance (DVLA, 2014) in order to advise their patients if they are unsure about a patients fitness to drive.

The law requires that:

A licence holder or applicant must be able to meet the prescribed eyesight requirements, i.e. to read in good daylight (with the aid of glasses or contact lenses if worn) a registration mark fixed to a motor vehicle and containing letters and figures 79 millimetres high and 50 millimetres wide (i.e. post 1-9-2001 font) at a distance of 20 metres, or at a distance of 20.5 metres where the characters are 79 millimetres high and 57 millimetres wide (i.e. pre 1-9-2001 font). In addition the visual acuity (with the aid of glasses or contact lenses if needed) must be at least Snellen 6/12 with both eyes open or in the only eye if monocular. If unable to meet these standards, the driver must not drive and the licence must be refused or revoked. DVLA should be informed if a vision correction is required to meet the eyesight requirement, and a driving license is coded with this information.

Registration for sight impairment or severe sight impairment is incompatible with holding a driving licence and should be notified.

Implications / Recommendations

There have been some calls for the introduction of regular eyesight tests as a means to improving driving safety. Although there is little evidence that deficiencies in eyesight present a major road safety risk, this area needs to be kept under review, particularly in view of an increasingly elderly driving population. There is evidence that some aspects of visual performance, apart from visual acuity, are related to risk of crash involvement.

Hearing

Risk

There is a legal obligation on bus, coach and lorry drivers to notify DVLA of severe hearing impairment. The notification form asks: *"*Is your hearing good enough to receive information using a telephone, with or without the use of a special appliance? e.g. Minicom*"*. There is no such obligation for car drivers or motorcycle riders.

A review of the relationship between impairments and crash risk for older drivers found the studies on the impact of hearing loss to be inconsistent: one retrospective study and one prospective study found no effect, but another study found an effect for self-reported hearing loss in the right ear only (Anstey et al., 2005). But the review also pointed out that self-reports may significantly underestimate true hearing loss. The overall conclusion was: *"*Compared with visual deficits, hearing deficits do not appear to be as important a risk factor for poor driving performance or crash risk.*"*

However, one very large study has found an effect of exposure to noise on hearing loss and crash risk. Picard et al. (2008) examined the driving records of over 46,000 male drivers who worked in noisy industries and linked the driving records to information on hearing from public health records. The period investigated was five years. They concluded that moderate hearing loss was associated with a small increase in crash risk, while more severe hearing loss was associated with a 30% increase in risk of a crash. The study also found that moderate hearing loss was associated with fewer speeding violations, but an increase in other violations and suggested that the explanation might be reduced vigilance to traffic hazards. However, given the study methodology, it is possible that the risk differences can be attributed to individual differences as opposed to hearing loss — those willing to work in noisy industries may differ from the general population in their tolerance of risk.

Some confirmation of an impact of hearing loss on driving performance comes from an Australian study of driving by older drivers along a fixed route (Hickson et al., 2010). Drivers were observed under three conditions: no distraction, auditory distraction and visual distraction. The conclusion was that the drivers with moderate or severe hearing impairment had significantly poorer driving performance in the presence of distracters than those with normal hearing or mild hearing loss. The impact of hearing loss, including the effect on visual tasks, was attributed to the greater cognitive effort required when hearing is impaired.

Implications

Overall then, the literature tends to confirm an effect of more severe hearing impairment. This certainly justifies the DVLA regulation, but also suggests that currently the risk for private drivers is being neglected.

Diabetes

Risk

The incidence of Type 2 (typically adult-onset) diabetes is rapidly increasing, in part as a result of growing obesity. Type 1 diabetes (auto-immune and generally childhood-onset) diabetes can be a serious road safety risk, but the increasing prevalence of Type 2 is also a cause for concern. TRL have produced a report around issues on Type II Diabetes (Parkes et al., 2014). The DVLA *At a Glance Guide* provides valuable information to drivers who maybe suffering from either Type 1 or Type 2I Diabetes.

There may be particular issues with professional drivers, who in some cases suffer from obesity as a result of sedentary lifestyle and diet. HGV drivers are likely to be a particular risk group.

Hypoglycaemia (also known as a hypo) is the medical term for a low blood glucose (sugar) level. The risk of hypoglycaemia is the main danger to safe driving and can occur with diabetes treated with insulin or tablets or both. Many of the crashes caused by hypoglycaemia are because drivers carry on driving even though they get warning symptoms of hypoglycaemia. If drivers get warning symptoms of hypoglycaemia while driving, they must stop as soon as safely possible.

Interventions

Again it is an individual's responsibility to inform the DVLA if they have a medical condition that affects their driving. DVLA advises drivers that they are required to report if they have more than one episode of severe hypoglycaemia (needing the assistance of another person) within a period of 12 months and in a number of other circumstances (DVLA, 2015b). For Group 2 (bus/lorry) drivers, one episode of severe hypoglycaemia must be reported immediately.

Implications / Recommendations

There is little evidence that hypoglycaemia derived from diabetes represents a significant road safety risk at present. Nevertheless, this area needs to be kept under review, particularly in view of a likely continuing population at risk from Type II diabetes.

Epilepsy and Multiple Sclerosis

These areas also represent medical risk factors concerning Fitness to Drive. At present it is reasonable to suggest that these factors are well controlled by interaction between patients and their respective medical practitioners. In particular, scrutiny of patients suffering from epilepsy and under drug treatment for that condition ensures that any road safety risk related to licence holding is being properly managed. The *At a Glance Guide* gives further information concerning the potential risk from these condition

Drugs

Risk

Much evidence since 2000 has shown a significant road safety risk from drugs.

In 1985 the Department for Transport (DfT) commissioned the then Transport Research laboratory (TRL) to undertake a study of the incidence of drugs in driver fatalities. This was at the behest of experimental research which suggested that medicinal drugs could have an adverse effect on reaction time. The results of this research were published in 1989 and showed that 6% of fatally injured drivers had traces of medicinal drugs and 3% had illicits. This proportion was considered at that time to be of very little concern compared with the 35% of drivers who had traces of alcohol!

The topic then remained relatively dormant until 1995 when increasing evidence of illicit drug use in the community, mainly cannabis, was giving rise to concern. The DfT then undertook its own repeat study of drugs in road user fatalities between 1995 and 2000. The results of this work were published in 2001 and showed a 6 fold increase in illicit use in drivers, from 3% to 18%, but no change in medicinal use at 6%, (Tunbridge et al, 2001). In 2010 Sir Peter North produced a report on drink and drug driving law (North, 2010) which recommended various actions to strengthen the law on drink and drug driving. Later in 2010 the House of Commons Transport Committee also produced a report on drink and drug driving with recommendations (House of Commons Transport Committee, 2010).

Illicit drugs

Following the North report (2010), the government set up an expert committee to examine the road safety risk from drugs. The risks are well researched and documented and following the expert committee's report (Wolff et al., 2013) and a public consultation, the drugs of concern are now subject to legal limits also under the new Crime and Courts Act 2013. This came into force in March 2015.

Much of the evidence for drug risk came from the pan-European study *Driving Under the Influence of Drugs* (DRUID). This study involved 20 European countries (but unfortunately not the UK), and looked at the risks and impairing effects of drugs, alcohol and medicines on driver safety. It involved both experimental and epidemiological studies over a 5 year period from 2006 to 2011. The results were published in September 2011 and are available at www.druid-project.eu.

The Act set proscribed limits for 8 illicit drugs: Cocaine and its principal metabolite Benzoylecgonine, Delta 9 THC (Cannabis), Ketamine, LSD, Methylamphetamine, MDMA (Ecstasy) and 6 Mono acetylmorphine (the principal metabolite of Heroin).

In addition a proscribed limit has also been set for amphetamine, after extensive consultation. This drug whilst predominantly used illicitly does have legitimate medicinal uses mainly as a drug to treat attention deficit hyperactivity disorder (ADHD). For this reason the limit has been set relatively high.

In contrast to the limits set for alcohol, which are based on impairment, the proscribed limits various other illicit drugs represent a "Zero Tolerance" approach to drug risk, which is more political than road safety based. Zero tolerance levels are those at which a drug can reliably be confirmed as being present in a blood sample, typically a 95% confidence level that the specific drug is present. Despite these low levels, the risk of prosecution for accidental contact, for instance for passive smoking intake of cannabis, will be very low.

In addition, the “urban myth” that cannabis can be detected several weeks after consumption (when impairment has long passed)and used to prosecute drivers needs to be dispelled. It is only the inactive metabolite THC – COOH (which is not tested) that is detectable after this period and only in urine. In contrast, the new THC in blood levels will relate to the parent drug and to recent use. Hence they address the likelihood of impairment and accident risk.

Medicinal drugs

The Crime and Courts Act 2013, which came into force in March 2015, makes it illegal to drive after consuming certain drugs over a specified limit. In terms of medicinal drugs, the drugs covered are nearly all (6 out of 8) benzodiazepines and are prescribed relatively rarely.

These drugs were identified by the Expert Committee which advised DfT as representing an increased risk of accident involvement. However, provided that these medicinal drugs are taken according to medical advice, they are unlikely to represent an increased accident risk and the Act allows for a medical defence provided the drugs were taken as prescribed.

The two other drugs proscribed under the Act with specific limits are Morphine and Methadone. The former is allowed to be prescribed and drivers may drive under its prescription for conditions such pain treatment for terminal cancer. Levels of Morphine which would normally severely affect an untreated driver are likely to represent minimal accident risk for a Morphine-tolerant patient. Methadone is an allowed Heroin substitute, which if taken as prescribed would be unlikely to substantially increase accident risk.

It should however be borne in mind that some medicinal drugs, particularly Benzodiazepines, are likely to be abused as heroin substitutes, so that the levels measured in suspect drug driving cases are likely to be crucial in any action for illegal driving under the Act.

Overall, the evidence from epidemiological studies suggests that risk of a road accident from medicinal drugs is relatively low compared to illicit drugs. Incidence in both fatal and non-fatal crashes is around 6%. Evidence suggests that this incidence has not changed substantially over the past 20 years in contrast to a very significant increase in the risk from illicit drugs. In addition, much of the evidence of risk from medicinal drugs comes from experimental studies carried out with young (18 – 25) healthy male volunteers. This group are not representative of the main population of medicinal drug users, who are predominantly over 40. For these persons, the risk from untreated Illness may be greater than the risk from the effects of the drugs used in treatment on driving ability.

All available evidence shows that over the counter medicines, such as antihistamines, cold remedies and mild pain killers, if taken as directed, do not represent an increased road accident risk.

Interventions

The main issue regarding intervention on drug risk concerns the detection of drug drivers. At present only 2 out of the 16 proscribed drugs (THC and cocaine) have devices Type Approved for roadside detection. The fact that drivers under the influence of drugs are not easily detected at the roadside reduces the efficacy of a law which makes it illegal to drive with drugs which need to be measured at a specific level in an evidential blood sample.

Implications / Recommendations

Measures need to be taken rapidly to extend the availability of roadside drug screening devices. As a first step such devices should be available to detect MDMA (Ecstasy), which all available evidence suggests is at least as widely consumed as cocaine. It is 17 years since the first surveys of drivers gave clear evidence of the public acceptability of roadside drug screening and 12 years since the Railways and Transport Safety Act made provision for this. It is now time for this issue to be further progressed.

Alcohol

Risk

The effect of alcohol on performance, behaviour and risk has been confirmed by a large body of research. The 1967 Road Safety Act, which introduced an 80mg/100ml blood alcohol limit, together with the subsequent introduction roadside breath screening led to a very substantial reduction in deaths and serious injuries from drink driving. This was further enhanced by the 1981 Transport Act which allowed for evidential breath testing in a police station, introduced in 1983. That stepped-up enforcement, combined with education and publicity campaigns led to a significant shift in behaviour. But subsequent improvement has been relatively slow. Alcohol impairment continues to be a major contributory factor to crashes with an estimated 230 fatal crashes related to drink driving in 2013. Twenty-three percent of fatally injured drivers were alcohol impaired at the 0.08 level in 2013, with more than half being impaired at night-time. Forty-four percent of fatally injured pedestrians were impaired at the 0.08 level, and that number rose to 67% at night-time (Department for Transport, 2015).

Interventions

The Serious Organised Crime and Police Act 2005 made provision for the introduction of roadside evidential breath testing. This would allow for a very substantial increase in the in the number of roadside tests that the police could conduct. However, no such equipment has yet been approved for use by the Home Office.

Lowering the legal limit to 50mg/100ml was recommended by the North review (2010). There is, however, contention about the number of deaths and injuries that would be avoided by this measure. The recent analysis by Allsop (2015), which draws on recent evidence on how alcohol levels relate to the risk of involvement in a crash resulting in serious injury or fatality, estimates that annually 25 lives and 95 seriously injured persons would be saved by lowering the limit in England and Wales to 50mg/100ml.

Higher rates of enforcement would provide more of a deterrent. As indicated above, drink driving is still a considerable safety problem. The overall number of drivers and riders breath tested has fallen from 815,000 in 2009 to 684,000 in 2013 (Department for Transport, 2015.) Of those involved in injury crashes almost half are not tested. That is not acceptable and is likely to be related to the persistence of the problem.

For ensuring that professional drivers are not impaired and as an aid to helping those with a conviction for drink driving to resume driving safely, alcolocks could provide a valuable tool. But in spite of the positive experiences in countries such as Sweden where alcolocks are used as in the rehabilitation of offenders and more widely in government and fleet vehicles, in the UK there has been no progress since

the trial with devices about ten years ago (Beirness et al., 2008) and the DfT review of the research evidence in 2008 (Clayton and Beirness, 2008).

Recommendations

Maximum effort should be made by the DfT and the Home Office to type approve roadside evidential breath testing instruments. This would allow a much more efficient enforcement of drink- driving by saving police time in returning to a police station for an evidential test and freeing up time for further drink- driving roadside enforcement.

Further research should be conducted to look at the benefits of specific police targeting of drink-drivers; which policies are and have been the most effective?

Education should be developed for drivers on alcohol units consumed in relation to likely Blood Alcohol Concentration level — in particular, the effects of alcohol volume consumed over a specific period, gender, body weight and related food consumption.

Lowering of the legal limit in England and Wales, in line with the recommendations of Sir Peter North, would have clear casualty reduction benefits, assuming that sanctions were not reduced.

It is time once again to consider alcolocks both for rehabilitation and as a required fitment in fleet vehicles. The technology is now in widespread use across the world, and even in the UK (on National Express buses).

Fatigue

There have been two recent major reviews of the evidence on fatigue and driving. The first (Jackson et al. 2011) provides a thorough overview of the area. One if its recommendations is on the need for up-to-date research on drivers' understanding of driver fatigue, their use of countermeasures to combat fatigue and the effectiveness of current approaches to manage the problem. The second, completed in 2013, was conducted for the Road Safety Observatory and can be found at http://www.roadsafetyobservatory.com/Review/10061. It covers incidence, risk and countermeasures.

Risk

The contribution of fatigue to accident risk has been extensively documented in research over the last 20 years. However, it should be noted that prior to the major programme of research into driver fatigue undertaken by DfT in 1992, previous "On the Spot" and "At the Scene" in-depth accident studies had assessed the contribution of driver fatigue to road crashes at around 1%. This was because adequate techniques for assessing risk were not available. If a driver survived a fatigue related crash they were likely to deny culpability; if they did not survive then there was little evidence that fatigue was a cause.

Now that standardised techniques to identify the role of fatigue in crashes are available, post the DfT research, it is widely accepted that fatigue is a major contributory factor particularly in the early hours of the morning and on long distance journeys on major roads or motorways. Flatley et al. (2004) concluded that one-quarter of all fatal crashes were sleep-related.

Interventions

The DfT driver fatigue research programme in the 1990s showed clearly that taking a break every two hours on long journeys, a short nap (not above 20 minutes) and a caffeine stimulant (around 150mg from coffee) are effective measures to counter fatigue. The Highway Code now gives specific advice on this.

The most important factors in relation to sleep-related crashes are:

1. Sleep deprivation
2. Time on task
3. Circadian factors

Drivers suffering from sleep apnoea are also at increased risk. A recent review in the AIRSO weekly communication for members by Tom Harrington (2015) gives a useful overview of the issues relating to risk from sleep apnoea and driver tiredness in general; incidence of sleep apnoea is probably around 3% in the driving population as a whole. In conformity with recent amendments to the EU driving licences directive, as of December 2015 drivers diagnosed with Obstructive Sleep Apnoea Syndrome (OSAS), i.e. severe sleep apnoea, are required to inform DVLA of their condition and to stop driving immediately until the condition has been successfully treated. For truck and bus drivers, that successful treatment has to be confirmed by their medical consultant or specialist.

Implications / Recommendations

It is important to continue to emphasise to drivers the importance of adequate rest before a long journey, adequate regular breaks and a short nap if required. Minimising long journeys when natural alertness (circadian factors) are at a minimum, particularly between 00.00 and 06.00, will reduce exposure at risky times of the day.

Cognitive Health

Risk

There are many medical conditions that cause long-term cognitive impairment, including acquired brain injury, Parkinson's, dementia, multiple sclerosis and stroke. Many of these conditions are age related. In most European countries, the proportion of elderly people is likely to increase in the next 20 years. In 2014, 18.5% of the European population was aged 65 years or above, and 5.1% was aged 80 years and above. These percentages are expected to increase up to 26.9% and 9% respectively in 2040 (Eurostat, 2014). In the UK people are living longer and estimates suggest that the average life expectancy of males and females will rise to the mid 80's for men and early 90's for women (Bennett et al. 2015). This means that it is likely that the numbers of elderly drivers will increase substantially and it will be necessary to assess the impact of age related health issues that may affect driving and road safety. Age-related neurodegenerative conditions, such as Alzheimer's disease, affect multiple interacting aspects of cognition which are regarded as important for driving (Anderson et al., 2005). There is little population level data which identified the risk of crashing for people with brain injury or illness. There is some evidence of an increase in collision involvement rates among older drivers (see Figure 1 and Figure 2). Older people with dementia are particularly at risk: Bieliauskas (2005) estimated an eight-fold increase in risk of collisions in Alzheimer's patients relative to controls.

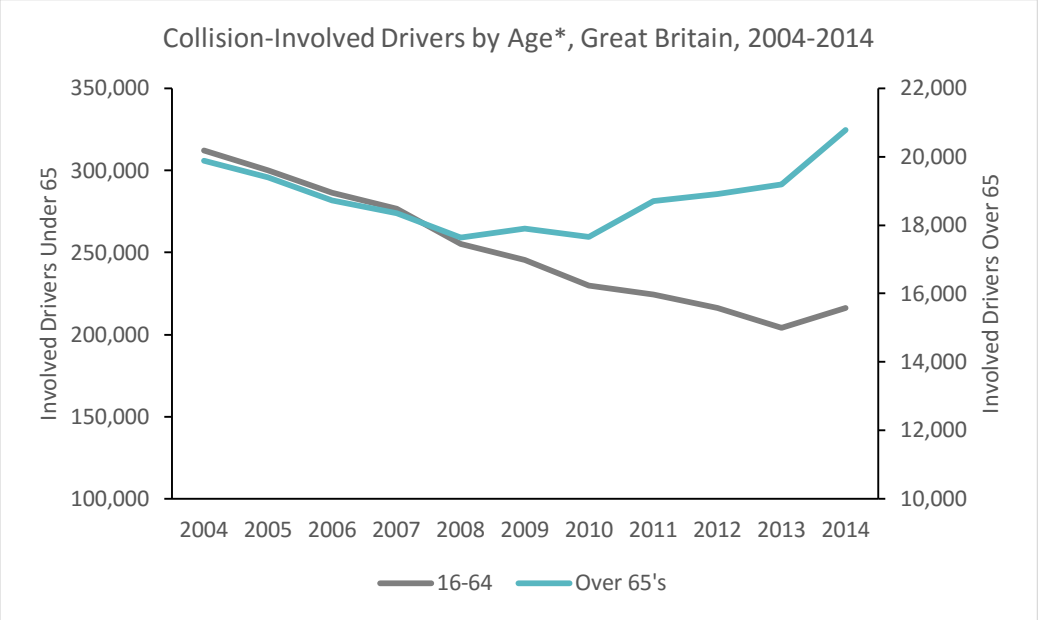


Figure 1: Collision involved drivers by age (MAST online, **where age was reported*)

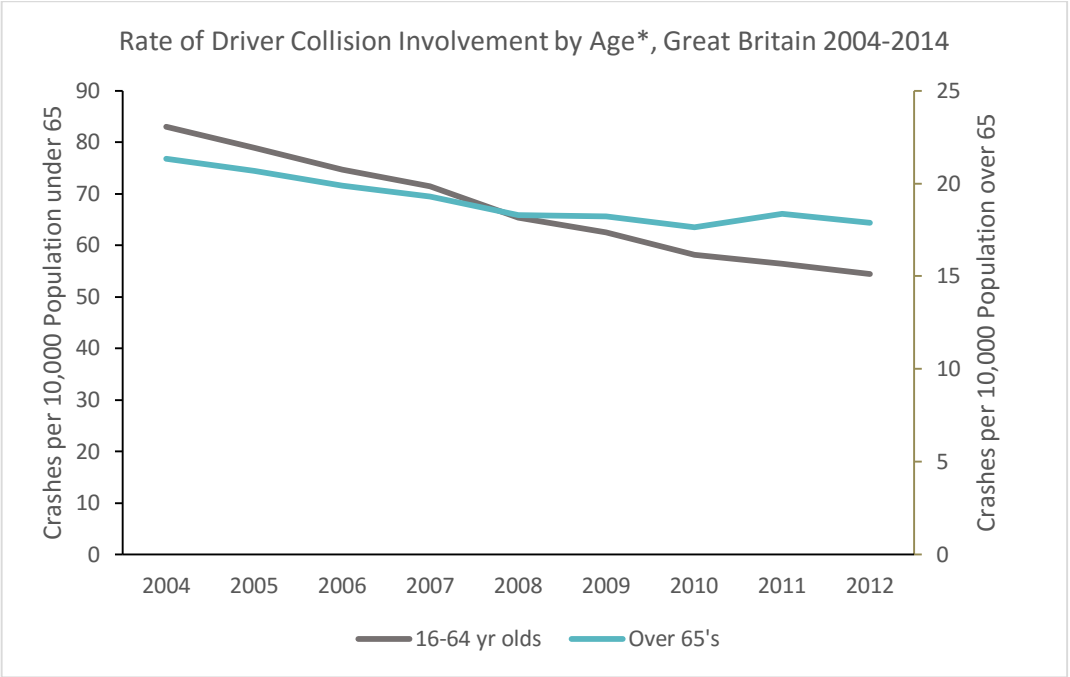


Figure 2: Crash involvement by age per 10,000 population (MAST online, **where age was reported*)

Interventions

Primary care

It is an individual's responsibility to inform the DVLA if they have a medical condition that affects their driving. However, patients may discuss fitness to drive with their GP as a first course of action. In the UK General Practitioners (GPs) are expected to refer to DVLA 'at a glance' guidance[1] in order to advise their patients and may refer the patient to specialist assessment services especially if they are unsure about a patient's fitness to drive. Discussing fitness to drive may be difficult for the GP who may fear jeopardising their relationship with the patient. GPs and family members need to put in place measures to handle the negative aspects of licence revocation which may include loss of independence, isolation and depression (Marottoli et al., 2000; Satariano et al., 2012). The role of the GP is extremely important, given that drivers with cognitive impairment are less likely to report to DVLA compared to those with a physical impairment (Smith et al., 2005).

Specialist screening

Screening all older drivers

In the injury prevention community, there are currently calls for better guidance on how to assess fitness to drive among older people per se (Salmi et al., 2014). Evidence suggests that mandatory assessment of older drivers would not be cost effective because the heterogeneity of the ageing process and the tendency for drivers to self-regulate to avoid risky scenarios (Lang et al., 2013). Diseases such as dementia are progressive but the rate of progression is highly variable between individuals; again this has led to rejection of the idea of screening all drivers as not being cost-effective. Age is not a good predictor of fitness to drive. The main risk factor is ill health, not age.

Screening of older drivers suffering from illness or injury

Most clinicians use neuropsychological testing to make recommendations regarding fitness to drive, though half are not confident about their recommendations, and many are concerned that there is little knowledge about the relationship between cognitive testing and driving ability (Christie et al., 2001a). This picture has changed little since the survey by Christie et al. over fifteen years ago. Amongst clinicians there still seems to be no standard testing protocol, with a plethora of tests used, and a lack of confidence in the ability of cognitive testing to predict driving ability of those with illness or injury affecting the brain and therefore cognitive function (Bichard and Newby, 2014; Hawley, 2010).

Different diseases and injuries produce different types of cognitive impairment which may impact on driving. It is not clear whether there is one set of tests that can be used to assess fitness to drive irrespective of the underlying causes of the impairment.

There is some evidence that the Stroke Driver Screening Assessment (SDSA) tool with additional information processing tasks may be useful as predictors of driving in head-injury patients and those with multiple sclerosis or dementia, but not for those with Parkinson's (Lincoln et al., 2006; Lincoln et al., 2012). However, the results of the SDSA are not consistent and need more validation. For example, an adapted version of the SDSA tool did not successfully predict the outcome of an on-road test, casting doubt on whether it should be used as a stand-alone test to determine the fitness to drive of individual

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/418165/aagv1.pdf.

participants. In particular, it was notably less effective at predicting the performance of dementia patients compared to those with stroke (Selander et al., 2010).

Moreover, there is currently no research that has consistently identified a cut-off point on cognitive test scores to differentiate safe from unsafe drivers (British Psychological Society, 2001; Ott et al., 2008). It is generally agreed that there is a significant relationship between neuropsychological functioning and driving ability as measured by on-road tests. However, there is a big problem in assessing the fitness to drive of borderline cases. Cognitive tests also tend to misclassify a quarter of cases (Christie et al., 2001b). In addition, on road assessments are expensive, facilities are limited and therefore a long distance to travel to and the testing procedure may produce significant anxiety among patients and therefore should only be used for those who really need it.

Anderson et al., (2005) argued that deficits in multiple aspects of cognition can contribute to unsafe driving and therefore it is unlikely that any single neuropsychological test will be an adequate screening tool. However, he argued that the test battery should be brief and cover key domains of cognition necessary for safe driving such as attention, memory, spatial perception, and visuomotor coordination. Therefore research has sought to establish a suite of neuropsychological tests that can be used as a 'clinically viable' substitute for an on-road driving test (Bhalla et al.,2007).The batteries of neuropsychological tests which have some validity for purposes of assessment tend to be very long and therefore not a practical solution in the primary care setting. There is a need to develop a shorter test, more accessible to clinical teams, but its accuracy would need to be validated.

A recent Cochrane review focused on driving assessment for maintaining mobility and safety in drivers with dementia (Martin et al., 2013). The review sought evidence on whether formalised driving assessments are effective in maintaining mobility and safety in drivers with dementia rather than merely excluding those who are unfit to drive. This acknowledges that there is a balance to be struck between maintaining driving and protecting against a safety risk to others as crashes are relatively infrequent events, especially with a low risk of fatality at 1 per 50 million km driven.

The review found no study that evaluated whether assessment prevents crashes or fatalities. It found consistent support for the hypothesis that mandatory medical testing of older drivers is not associated with reduced fatalities (Hakamies-Blomqvist, 1996; Langford, 2004). The review identified a need for more information on the types of measures that can accurately classify drivers as fit or unfit to drive. The review suggests that composite tests are needed (e.g. Clark et al., 2005) and that these should be used to screen those who might then be referred for a driving assessment.

One of the findings of the review is that research has been hampered by lack of research that has used a theoretical model of driving behaviour to help identify which cognitive functions are related to safe driving. There could be some value in applying the Michon model of driving to explore the relationship between cognitive functions required, and how they can be measured and how they relate to safe performance (De Raedt et al., 2000).

Implications

1. Crashes are rare outcomes and therefore we have to rely on surrogate measures such as cognitive tests scores, and driving simulator and road test performance to assess the safety of people who have long term cognitive impairment caused by disease or injury.

2. These surrogate measures have their own problems. There is no consensus as to which cognitive screening tests are most reliable; driving simulators vary in the degree of fidelity to the driving task and can be associated with motion sickness especially among older people; people's performance in driving tests can be highly variable and often there is poor correlation between desk tests and on-road measures.

3. Different diseases and injuries produce different types of cognitive impairment which may impact on driving. It is not clear whether there is one set of tests that can be used to assess fitness to drive irrespective of the underlying cause of the impairment.

4. Primary care physicians and clinical specialists need support to make decisions about whether or not to suggest driving cessation as they have to manage the balance between risk and the potential negative consequences of their decisions.

5. It is likely that the most acceptable way forward is to have a desk-based initial assessment protocol that identifies those at risk of being unsafe, with referral to an on-road driving test for confirmation. This then needs to be followed up with support for alternative travel arrangements.

6. There are very few specialist driving assessment centres (only 17 throughout the UK http://www.mobility-centres.org.uk/) which can assess driving for people who suffer injury or illness which impairs cognitive function. More needs to be done to increase the number of assessment facilities to provide support for decision making among clinicians.

7. The evidence base is fragmented and conflicting on the topic of fitness to drive. Research in this area has also been hampered by lack of a theoretical perspective of which cognitive skills are required for driving, how these can be accurately measured using cognitive tests and how they relate to safety outcomes.

Recommendations

1. The Government should fund research into developing a clinically viable desk based assessment of driving safety.
2. The Government needs to then commission a randomised controlled trial that assigns people who drive to either formal testing or usual care and assessment, with long term follow-up of crashes or violations.
3. Given the potential underreporting of illnesses and injuries which affect cognitive impairment to the DVLA, there is a need for a protocol for GPs and other health professionals to discuss fitness to drive with their patients. However, it is important that these health professionals are not, and should not appear to their patients to be, responsible for deciding whether a licence is to be revoked.
4. There needs to be standard care pathway adopted in clinical settings which helps manage the safe mobility of people with cognitive impairment. Where the driver is recommended to cease driving they need to be supported with alternatives to maintain mobility and avoid social exclusion.
5. Future technologies such as autonomous cars may have a role to play in supporting the safer mobility of people with cognitive impairment. Research needs to look at issues around the training for and acceptability of this type of transport for older people in particular.

The Department for Transport and Department of Health need to act on these recommendations.

Reduced Physical Strength and Mobility

Risk

Whilst there is evidence that "declines in functional ability are linked with changes in driving habits, performance and crash rates" (Maratolli et al. 2007) the majority of the academic work points to this decline being rooted in cognitive dysfunction rather than being due to strength and conditioning:

"Only in the case of severe sensory, perceptual, and cognitive limitations does the relation between functional limitations and crash involvement become evident." (Brouwer and Davidse, 2002)

As a result there does not seem to be a reliable bank of standardised assesments that investigate issues such as range of movement, strength and flexibility. Instead, pragmatic responses seem to be made to a driver's physical limitations with a preference towards vehicle adaptation.

Despite the assertion being made that reduced joint flexibility increases risk at junctions or when merging with other traffic (DaCoTA, 2012), there is only limited support within the injury data to uphold this view. In an examination of GB road casualty data (STATS19), the potential age effect on drivers involved in collisions on motorway slip roads, where reduced neck rotation might hinder good observation, does show that older drivers have a higher risk index than younger drivers as shown in Table 2.

Table 2: "Failed to look" for drivers involved in collisions on motorway slip roads, 2004-2013

Driver Age Group	Involved in these collisions	Drivers in these collisions who received CF405 'Failed to Look'	Relative Risk
Under 65	6,238 (95%)	1,012 (92%)	0.97
65 and over	349 (5%)	90 (8%)	1.54

When compared to the attribution of 'Failed to Look' in collisions attributed to older drivers on the road network as a whole (see Table 3) this index is higher than expected.

Table 3: "Failed to look" for drivers involved in collisions on all roads, 2004-2013

Driver Age Group	Involved in these collisions	Drivers in these collisions who received CF405 'Failed to Look'	Relative Risk
Under 65	1,580,563 (93%)	327,076 (90%)	0.97
65 and over	125,679 (7%)	36,321 (10%)	1.36

These figures may support the assertion that there is an increased collision risk in certain locations from reduced mobility. This is an area that would benefit from more detailed research.

Regulatory Environment for Adapted Vehicles

Currently when vehicles are adapted for wheelchair users or with other disability aids there is a requirement for them to be certified under the Individual Vehicle Approval Scheme (VOSA, 2014). Whilst the regulations and inspection process check for suitability of materials, there is currently a specific exclusion within the approval process of consideration of the effect on the crash risk on front and side impacts. The effect of this exclusion may result in vehicles, being used by already vulnerable drivers, that have been altered structurally, and which no longer offer the expected performance in a collision.

Interventions

Physical Conditioning

If strength and conditioning are aggravating factors influencing the risks of some drivers then programmes to improve physical conditioning would represent a viable intervention. A multicomponent physical conditioning program targeted at flexibility, coordination, and speed of movement has been shown to improve driving performance among older drivers (Marottoli et al., 2007) and may offer similar benefits to a wider group of drivers for whom mobility and range of movement needs to be maintained in support of the driving task.

Functional Assessment as Part of a Wider Battery

Given the difficulty in assessing cognitive impairment risk, a stand-alone assessment of functional capability is unlikely to be sufficiently insightful or robust to reduce risk unless integrated with a wider battery of physical, sensory and cognitive/perceptual skills. The development of the 'Occupational Therapy - Driver Off-Road Assessment Battery (OT-DORA) (Unsworth et al. 2011) brings together a suite of assessments which set functional capability within a broader context of fitness to drive.

Mobility Centre Assessments

Off-road assessments, such as the OT-DORA above, have demonstrated their validity in identifying fitness to drive, but may require further validation in the form of specialist on-road assessment. In view of the costs of such an on-road element being considerably higher than an off-road assessment, the off-road element can usefully serve as a screening device to help to see that those drivers most in need of an on-road element are prioritised. The Forum of Mobility Centres (www.mobility-centres.org.uk) is the representative body for such specialist on-road provision in the UK.

Enhancing the Regulatory Environment for Adapted Vehicles

The current regulations on vehicle adaptations seem to leave open the possibility that vehicles with high levels of safety performance at the point of manufacture could be significantly degraded through the adaptation process. From a policy perspective more stringent regulation of the vehicle adaptations market might lead to improved safety within the adapted fleet. Currently, adapted vehicles are not identified separately in the road casualty data.

Implications

The delivery of physical conditioning programmes could be supported through voluntary groups, day centres, leisure facilities or primary care commissioning. It would however come with a training demand to ensure that exercises were understood and delivery was of a sufficiently high quality that the effects identified during the clinical trial could be reflected in the field.

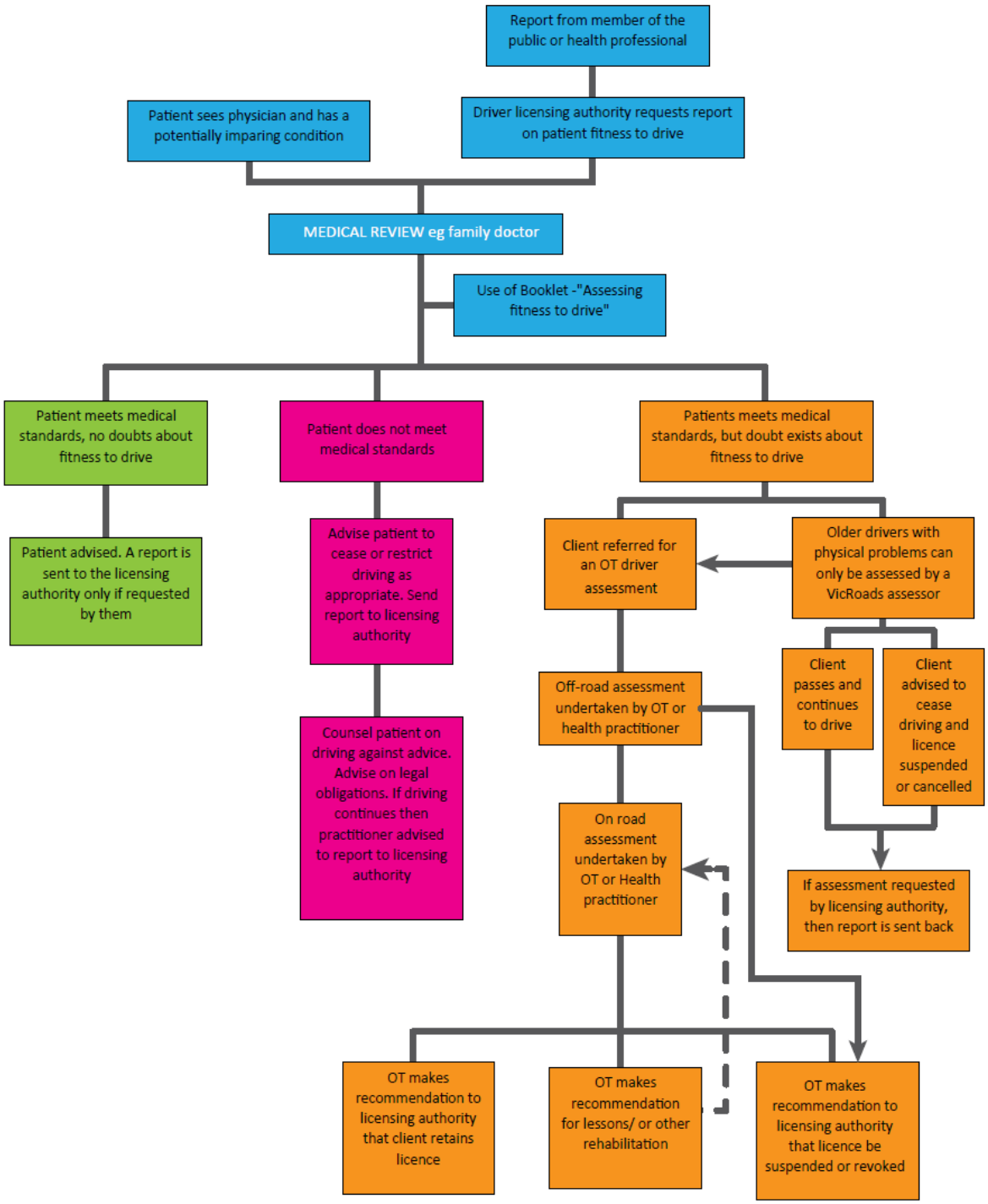
There are currently relatively small numbers of Occupational Therapists with any specialism in driving assessment (whether on or off-road). A large scale roll-out of functional assessments (as part of a wider battery) would require additional training or availability from trained therapists.

Increasing throughput for on-road assessments could overwhelm the currently limited service available through the Forum of Mobility Centres creating a demand for more locations and assessors.

Enhancing the regulatory environment on adapted vehicles, especially if it required evidence of sustained safety in crash tests would likely create significant increased costs for the adapted vehicle market; these

may be unsustainable for the companies involved or increase the purchase costs of adapted vehicles in such a way that they would be prohibitively expensive for the end user. This may have the unintended consequences of reducing independent travel options for people with functional limitations.

A clear process for assessment of fitness to drive is currently lacking in the UK. Figure 3, which draws on Australian guidance on procedures (Austroads, 2003), shows how this could work.



OT: Occupational therapist

Figure 3: Recommended process for assessing fitness to drive

Recommendations

1. DVLA licensing data does not currently include publication of vehicles exempt from excise duty because of use as an adapted vehicle. More extensive publication of data around numbers of these vehicles should be sought to underpin further research.

2. Conduct to quantify any collision and injury risks associated with adapted vehicles to enumerate the scale of any problem in order to determine the validity of enhancing the regulatory framework on adaptations or investing in more rigorous driver assessments.

3. Work with third sector stakeholders to conduct a feasibility study on delivery of a physical conditioning programme to drivers most likely to suffer from functional limitations based on age and disability.

4. Work with the College of Occupational Therapists, Forum of Mobility Centres, clinical commissioning groups and the road safety profession to look at current provision of off-road and on-road assessment for drivers with functional limitations with a view to building capacity in the relevant professions.

Personality

Risk

The "Big 5" personality factors are:

1. Extraversion
2. Neuroticism
3. Conscientiousness
4. Agreeableness
5. Openness

Clarke and Robertson (2005) did a meta-analysis of the relationship of the Big 5 with occupational and non-occupational accident involvement. They found:

- Low conscientiousness and low agreeableness were reliably associated with accident involvement
- Extraversion was a valid predictor of traffic accidents but not of occupational accidents

One facet of extraversion is Sensation Seeking. There is extensive literature on the relationship between Sensation Seeking and risky behaviour in driving (e.g. Jonah, 1997). This overwhelmingly shows that persons who score highly on one of the standard Sensation Seeking questionnaire habitually engage in more risky driving behaviours (e.g. driving at inappropriately high speed) and are more crash-involved. Studies of emotion in traffic, such as anger, have shown the crucial role of Sensation Seeking as a personality factor in stimulating anger (Mesken, 2006). Other research has shown that anger is related to driving violations (Lajunen, Parker and Stradling, 1998; Lajunen and Parker, 2001).

Implications

The findings of Clarke and Robertson (2005) suggest that extraversion can be managed in occupational situations. The question is whether the same is true in non-occupational driving. There are two hypotheses here: it may be the case that sensation-seekers get weeded out of occupational driving, or alternatively the management of occupational safety may "contain" the effects of sensation seeking. If the latter, there is a possibility that the techniques used in occupational settings could be applied to driving more generally.

However, research to date has not found an effective way to manage personality-related issues on non-occupational driving. The well-known Goals for Driver Education (GDE) framework (Hatakka et al., 2002) has a top level that goes beyond teaching the skills taught in traditional driving education; it is oriented at teaching "goals for life and skills for living." Education in this top level is intended to impart knowledge on and control over how personal life goals and values, behavioural style and group norms affect driving (and hence risk). Some driver education programmes now incorporate elements of this higher level. However, whether training in these more general skills has an impact on long-term behaviour and crash involvement has yet to be determined.

The other possible intervention is to use personality tests as a screening tool in driver licensing. However this is fraught with problems related to (a) the reliability of the tests as predictors of individual risk (b) the risk of false positives and (c) public acceptability.

Recommendations

Policy

Regulatory framework

1. Look at the connection between the EU Directive and the UK process on driver licensing.
2. Reduce the blood alcohol concentration limit to 50mg in line with Scotland and the rest of Western Europe.
3. Place a duty on Highways England and the relevant road authorities in Scotland, Wales and Northern Ireland to proactively work to reduce fatigue-related collisions on the strategic road network.
4. DVLA licensing data does not currently include publication of information on vehicles exempt from excise duty because of use as an adapted vehicle. More extensive publication of data around numbers of these vehicles should be sought to underpin further research.

Enforcement

5. Measures need to be taken rapidly to extend the availability of roadside drug screening devices, with a valid MDMA test being the priority.
6. DfT and the Home Office should speed up the Type Approval process for roadside evidential breath testing equipment.

Road design

7. Highways England and other strategic road authorities need to address stretches of road without rest stops.

Health practice

8. There needs to be standard care pathway adopted in clinical settings which helps manage the safe mobility of people with cognitive impairment. Where the driver is recommended to cease driving they need to be supported with alternatives to maintain mobility and avoid social exclusion.
9. Given the potential underreporting of illnesses and injuries which affect cognitive impairment to the DVLA, there is a need for a protocol for GPs and other health professionals to discuss fitness to drive with their patients. However, it is important that these health professionals are not, and should not appear to their patients to be, responsible for deciding whether a licence is to be revoked.
10. There should be joint work by the College of Occupational Therapists, Forum of Mobility Centres, clinical commissioning groups and the road safety profession to look at current provision of off-road and on-road assessment for drivers with functional limitations with a view to building capacity in the relevant professions.

Management of occupational road risk

11. There are particular responsibilities for employers in ensuring the fitness of their employees to drive, and HSE needs to take a far more active role here. Currently no central government agency or department is taking responsibility in this crucial area.

Research

Health practice

1. Find out whether GPs actually know about the DVLA advice.
2. Research should be carried out to examine the validity of an improved eyesight test that goes beyond a simple visual acuity check.
3. With increased levels of prescription medicines, research should be commissioned to look in more detail at any potential associated risks.
4. Research is needed into developing a clinically viable desk based assessment of driving safety.
5. DfT should work with third sector stakeholders to conduct a feasibility study on delivery of a physical conditioning programme to drivers most likely to suffer from functional limitations based on age and disability.

Road and vehicle design

6. Future technologies such as autonomous cars may have a role to play in supporting the safer mobility of people with cognitive impairment. Research needs to look at issues around the training for and acceptability of this type of transport for older people in particular.
7. Highways England and the other strategic road authorities should to look at whether there are design treatments that can ameliorate monotonous road design.
8. Conduct research to quantify any collision and injury risks associated with adapted vehicles to enumerate the scale of any problem in order to determine the validity of enhancing the regulatory framework on adaptations or investing in more rigorous driver assessments.

References

Allsop, R. (2015). Saving lives by lowering the legal drink-drive limit. PACTS and RAC Foundation, London.

Anderson, S.W. , Rizzo, M., Shi, Q., Uc, E.Y. and Dawson, J.D. (2005). Cognitive abilities related to driving performance in a simulator and crashing on the road. Proceedings of the Third International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design, Rockport, Maine, June 27-30.

Anstey, K.J., Wood, J., Lord, S. and Walker, J.G. (2005). Cognitive, sensory and physical factors enabling driving safety in older adults. Clinical Psychology Review, 25(1): 45-65.

Austroads (2003). Assessing fitness to drive for commercial and private vehicle drivers. 3rd edition. Austroads Incorporated, Sydney, Australia.

Bennett, J.E., Li, G., Foreman, K., Best, N., Kontis, V., Pearson, C., Hambly, P. and Ezzati, M. (2015). The future of life expectancy and life expectancy inequalities in England and Wales: Bayesian spatiotemporal forecasting. The Lancet, 386(9989): 163-170.

Beirness, D. J., Clayton, A. B. and Vanlaar, W. (2008). An investigation of the usefulness, the acceptability and impact on lifestyle of alcohol ignition interlocks in drink-driving offenders. Road Safety Research Report No. 88. Department for Transport, London.

Bieliauskas, L.A. (2005). Neuropsychological assessment of geriatric driving competence. Brain Injury, 19(3): 221-6.

Bhalla, R.K., Papandonatos, G.D., Stern, R.A. and Ott, B.R. (2007). Anxiety of Alzheimer's disease patients before and after a standardized on-road driving test. Alzheimer's and Dementia, 3(1): 33-39.

Bichard, H. and Newby, G. (2014). Personal communication regarding a repeat survey of clinicians that was not yet published.

Brouwer, W.H. and Davidse, R.J. (2002). Oudere verkeersdeelnemers [Older road users]. In: J.J.F. Schroots (Ed.), Handboek psychologie van de volwassen ontwikkeling en veroudering [Handbook of Psychology of Adult Development and Aging], pp. 505-531. Assen, the Netherlands: Koninklijke Van Gorcum.

Christie, N., Savill, T., Buttress, S., Newby, G. and Tyerman, A. (2001a). Assessing fitness to drive after head injury: a survey of clinical psychologists. Neuropsychological Rehabilitation, 11 (1), 45-55.

Christie, N., Savill, T., Grayson, G., Newby, G. and Tyerman, A. (2001b). The assessment of fitness to drive after brain injury or illness. Report TRL485, TRL, Crowthorne.

Clark, M., Hecker, J., Cleland, E., Field, C., Berndt, A., Crotty, M. and Snellgrove, C. (2005). Dementia and driving. Australian Transport Safety Bureau, Canberra.

Clayton, A. and Beirness, D. (2008). A review of international evidence on the use of alcohol ignition interlocks in drink-drive offences. Road Safety Research Report 89. Department for Transport, London.

DaCoTA (2012). Older drivers. Deliverable 4.8k of the EC FP7 project DaCoTA.

Department for Transport (2015). Reported road casualties Great Britain 2014. Department for Transport, London.

De Raedt, R. and Ponjaert-Kristoffersen, I. (2000). Can strategic and tactical compensation reduce crash risk in older drivers? Age and Ageing, 29(6): 517-521.

DRUID. www.druid-project.eu.

DVLA (2014). For medical practitioners: at a glance guide to the current medical standards of fitness to drive. Drivers Medical Group, Driver & Vehicle Licensing Agency, Swansea.

DVLA (2015a). Medical conditions, disabilities and driving. Available at https://www.gov.uk/driving-medical-conditions. Web page last updated 23 November 2015.

DVLA (2015b). Information for drivers with diabetes treated by non insulin medication, diet, or both. INF 188/2. Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193489/INF188_2.pdf. Web page last updated 12 October 2015.

Eurostat (2014). Population data (update 10/12/2014) and populations projection data (update 8/8/2014).

Eyesight Working Group (2005). New standards for the visual functions of drivers. Report of the Eyesight Working Group. European Commission, Brussels.

Flatley, D., Reyner, L.A. and Horne, J.A. (2004). Sleep-related crashes on sections of different road types in the UK (1995-2001). Road Safety Research Report No. 52. Department for Transport, London.

Harrington, T. (2015). Driver tiredness. AIRSO Weekly Communication to Members, 20 March. Association of Industrial Road Safety Officers (AIRSO).

Hatakka, M., Keskinen, E., Gregersen, N.P., Glad, A. and Hernetkoski, K. (2002). From control of the vehicle to personal self-control: Broadening the perspectives to driver education. Transportation Research Part F: Traffic Psychology and Behaviour, 5(3): 201-216.

Hawley, C. (2010). The attitudes of health professionals to giving advice on fitness to drive. Road Safety Research Report No. 91. Department for Transport, London.

Hickson, L., Wood, J., Chaparro, A., Lacherez, P. and Marszalek, R. (2010). Hearing impairment affects older people's ability to drive in the presence of distracters. Journal of the American Geriatrics Society 58(6): 1097-1103.

House of Commons Transport Committee (2010). Drink and drug driving law. First Report of Session 2010-11. Volume 1. London: The Stationery Office.

Jackson, P., Hilditch, C., Holmes, A., Reed, N., Merat, N. and Smith, L. (2011). Fatigue and road safety: a critical analysis of recent evidence. Road Safety Web Publication No. 21. Department for Transport, London.

Lajunen, T. and Parker, D. (2001). Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. Accident Analysis and Prevention, 33(2): 243-255.

Lajunen, T., Parker, D. and Stradling, S. (1998). Dimensions of driving anger, aggressive and highway code violations and their mediation by safety orientation in UK drivers. Transportation Research Part F: Traffic Psychology and Behaviour, 1(2): 107-121.

Lang, B., Parkes , A. and Fernández Medina, K. (2013). Driving choices for the older motorist: the role of self-assessment tools. RAC Foundation, London.

Lincoln, N.B., Radford, K.A., Lee, E. and Reay, A.C. (2006). The assessment of fitness to drive in people with dementia. International Journal of Geriatric Psychiatry, 21: 1044-1051.

Lincoln, N.B., Radford, K.A. and Nouri, F.M. (2012). Stroke Drivers' Screening Assessment: revised manual. University of Nottingham.

Marottoli, R.A., Allore, H., Araujo, K.L., Iannone, L.P., Acampora, D., Gottschalk, M., Charpentier, P., Kasl, S. and Peduzzi, P. (2007). A randomized trial of a physical conditioning program to enhance the driving performance of older persons. Journal of General Internal Medicine, 22(5): 590–597.

Marottoli, R.A., de Leon, C.F.M., Glass, T.A., Williams, C.S., Cooney, L.M. Jr. and Berkman, L.F. (2000). Consequences of driving cessation: decreased out-of-home activity levels. Journal of Gerontology: Social Sciences, 55B(6):S334-S340.

Martin, A.J., Marottoli, R. and O'Neill, D. (2013). Driving assessment for maintaining mobility and safety in drivers with dementia. Cochrane Database of Systematic Reviews, Issue 8. Art. No.: CD006222. DOI: 10.1002/14651858.CD006222.pub4.

Mesken, J. (2006). Determinants and consequences of drivers' emotions. PhD thesis, University of Groningen, The Netherlands.

North, P. (2010). Report of the review of drink and drug driving law. Department for Transport, London.

Ott, B.R., Heindel, W.C., Papandonatos, G.D., Festa, E.K., Davis, J.D., Daiello, L.A and Morris, J.C. (2008). A longitudinal study of drivers with Alzheimer disease. Neurology, 70(14): 1171-1178.

Owsley, C. and McGwin, G. Jr. (2010). Vision and driving. Vision Research, 50(23): 2348-2361.

Parkes, A., Tong, S, and Fernández-Medina, K. (2014). The forgotten risk of driving with hypoglycaemia in type 2 diabetes. Report PPR720. TRL, Crowthorne.

Picard, M., Girard, S.A., Courteau, M., Leroux, T., Larocque, R., Turcotte, F., Lavoie, M. and, Simard, M. (2008). Could driving safety be compromised by noise exposure at work and noise-induced hearing loss? Traffic Injury Prevention, 9(5): 489-499.

Salmi, L.R., Leproust, S., Helmer, C. and Lagarde, E. (2014). Assessing fitness to drive in the elderly and those with medical conditions: guidelines should specify methods and evidence. Injury Prevention, published online, 20 February.

Satariano, W.A., Guralnik, J.M., Jackson, R.J., Marottoli, R.A., Phelan, E.A. and Prohaska, T.R. (2012). Mobility and aging: new directions for public health action. American Journal of Public Health, 102(8):1508-1515.

Selander , H., Johansson , K., Lundberg, C. and Falkmer, T. (2010). The Nordic Stroke Driver Screening Assessment as predictor for the outcome of an on-road test. Scandinavian Journal of Occupational Therapy, 17(1): 10-17.

Smith, L. R., Hawley, C. and Inwood, C.M. (2005). Returning to driving following a head injury or amputation: results of a drivers' survey. Report PPR064. TRL, Crowthorne.

Tunbridge, R.J., Keigan, M. and James, F. (2001). The incidence of drugs and alcohol in road accident fatalities. Report TRL495. TRL, Crowthorne.

Unsworth, C. A., Baker, A., Taitz, C., Chan, S.-P., Pallant, J. F., Russell, K. J. and Odell, M. (2012). Development of a standardised occupational therapy – driver off-road assessment battery to assess older and/or functionally impaired drivers. Australian Occupational Therapy Journal, 59: 23–36.

Unsworth, C. A., Pallant, J.P., Russell, K.J and Odell, M. (2011). OT–DORA: Occupational Therapy Driver Off-Road Assessment Battery. Bethesda, MD: AOTA Press.

Unsworth, C. A., Pallant, J.F., Russell, K., Odell, M. and Coulson, M. (2011). Interrater reliability of the road law and road craft test as part of the OT-DORA battery for off-road driver assessment. British Journal of Occupational Therapy, 74(8): 394-398.

VOSA (2014). The Individual Vehicle Approval Scheme. Version 7.3. Vehicle & Operator Services Agency, Doncaster. www.gov.uk/government/publications/guide-to-the-individual-vehicle-approval-iva-scheme.

Wolff, K., Brimblecombe, R., Forfar, J.C., Forrest, A.R., Gilvarry, E., Johnston, A., Morgan, J., Osselton. M.D., Read, L. and Taylor, D. (2013). Driving under the influence of drugs: report from the expert panel on drug driving. Department for Transport, London.

PACTS

Parliamentary Advisory Council for Transport Safety

(an All-Party Parliamentary Group)

The Parliamentary Advisory Council for Transport Safety (PACTS) is an All-Party Parliamentary Group and a registered charity

Clutha House
10 Storey's Gate
Westminster
London
SW1P 3AY
Telephone: 020 7222 7732
www.pacts.org.uk
Email: admin@pacts.org.uk
Twitter: @pacts