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# Saving Lives by Lowering the Legal Drink-Drive Limit

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December 2015

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# About the Author

Professor Richard Allsop has extensive experience of research, training and advisory work on road safety, traffic management and other aspects of transport policy. He has a first in Mathematics from Cambridge, and a PhD and DSc from University College London, where he is Emeritus Professor of Transport Studies, having been Professor since 1976 and Director between then and 1997 of what is now the Centre for Transport Studies.

He has a longstanding involvement in road safety research and policy, including being a Special Adviser to PACTS (the Parliamentary Advisory Council for Transport Safety). He is a Board Member of the European Transport Safety Council (ETSC) and advises its European road safety performance index programme PIN. He has also provided inputs to road safety policy in Australia, Hong Kong, Japan, New Zealand and Poland.

He was made an OBE in 1997 for services to traffic management and road safety, is a Fellow of the Royal Academy of Engineering and holds the IHT Award for professional excellence. His report *The Effectiveness of Speed Cameras: A review of evidence for the RAC Foundation* was given the 2011 Prince Michael Road Safety Award. In 2015 he received a TRL Academy Award for outstanding contribution to road safety.

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# Disclaimer

This report has been prepared for PACTS and the RAC Foundation by Richard Allsop. Any errors or omissions are the author's sole responsibility. The report content reflects the views of the author and not necessarily those of the RAC Foundation.

# Contents

Foreword.....	iii
Executive Summary.....	v
1 Background.....	1
1.1 How the limit came to be set at 80mg/100ml .....	2
1.2 How things have changed .....	3
2 A Way of Estimating What is to be Gained by Lowering the Legal Drink-Drive Limit .....	5
2.1 How lowering the limit in Great Britain might reduce road casualties .....	5
2.2 Estimating the possible reduction in casualties .....	9
3 Estimated Casualty Savings for Great Britain in 2010–13 had the Legal Drink-Drive Limit been Lowered .....	13
4 References .....	16

# Foreword

There are few more emotive aspects of road safety than the drink-driving debate, particularly at this time of year.

Most crashes are linked to human error in one way or another - a momentary lapse of concentration, a failure to react to conditions on the road, a lack of judgement. Historically we've called them 'accidents' – there was no intention to cause harm.

But in the eyes of the majority of the public, anyone who consumes alcohol should know that by driving they are putting their own and others' lives at risk. The science is clear - there is a simple and direct relationship between quantity drunk and ability to function safely behind the wheel.

So what can we do to reduce the number of people who drink-drive and the number of people who are killed or injured each year as a result? Would cutting the drink-drive limit in England, Wales and Northern Ireland from 80mg alcohol/100ml blood to 50mg make a meaningful difference?

For the past year it has been 50mg in Scotland. Across the bulk of continental Europe it is 50mg. So should the rest of the UK be brought in line?

Saying we should cut the limit just because everyone else has is a poor assertion. But in this report the renowned researcher Professor Richard Allsop makes an argument for following suit based on robust data and sound analysis. Those responsible for the policy will need to study Richard's work and ask themselves whether the case for not cutting the limit really still stands up.

Steve Gooding



Director, RAC Foundation

David Davies



Executive Director, PACTS

The legal drink drive limit in the **England and Wales** is **80 mg alcohol/100 ml blood**;  
**Scotland** has a limit of **50 mg/100 ml**;  
**Northern Ireland** is expected to introduce a limit of **50 mg/100 ml** in **2016**;  
Nearly all other **EU** countries have a limit of **50 mg/100 ml** or lower.

By **2013**, the **proportion of road deaths and serious injuries**  
that arose from collisions **involving a drink-driving offence** was  
about **half** of that in **1979**.

In collisions involving a drink-driving offence between **2010 and 2013** the number  
of **killed** has remained steady at about **240 each year** and the number  
**seriously injured** has averaged about **1200 each year**.

Between **2010 and 2013** for  
every **4 deaths** in collisions involving a drink-drive  
offence **one more death** happened in a collision at  
a lower alcohol level.

The report estimates that had the limit been lowered from **80 to 50 mg/100 ml**  
**at the beginning of 2010**, then in every year between **2010 and 2013**  
about **25 lives** would have been **saved** and  
**95** people **saved** from **serious injury**.

# Executive Summary

The purpose of the legal limit on drivers' blood alcohol concentration (BAC) is to reduce death and injury on the roads. After over 50 years of continual dissemination of public information, it should be widely known by now that the best advice is never to drive after drinking – and if the world were an ideal one in terms of road safety, almost every driver's BAC would be zero or near zero.

But there is more to life than road safety, and legislation is about what it is reasonable to require of people for the common good. Therefore up to the time of writing, against a background of advice to avoid driving altogether after drinking any alcohol, the legal limit in England and Wales on a driver's BAC stands at 80 mg/100 ml (80 mg of alcohol per 100 ml of blood), as set in 1967.

It was realised early in the history of motoring that too much alcohol made one unfit to drive, and this was recognised in law by creating the offence of driving while under the influence of drink; nevertheless, in the mid-1960s there was still active debate as to whether moderate drinking increased or (as seemed reasonable to some at that time) decreased the risk of collision, and hence the risk of death or injury on the roads.

All this changed with the publication in 1964 of a large-scale field study at Grand Rapids in the USA in 1962–3: its findings quantified the relationship between BAC level and the risk of involvement in a collision, providing convincing evidence for greatly increased risk which depends on drivers' alcohol levels. This brought the issue of a legal BAC limit onto the political agenda, and the question then became "What maximum level of BAC is appropriate?" The value chosen – 80 mg/100 ml – was probably determined by a combination of statistical considerations and wider ones.

Much has changed since 1967. International practice, including the widespread adoption elsewhere in Europe of limits of 50 mg/100 ml or lower, has combined with changed public attitudes and increased statistical evidence and understanding to cast considerable doubt upon whether the BAC limit of 80 mg/100 ml, set in 1967, is still the most appropriate one today. Successive UK governments have retained this limit, but over the last 20 years the question of whether it should be lowered to 50 mg/100 ml has been debated with increasing vigour. The matter was considered as part of a far-reaching review in 2010, and the limit was lowered to 50 mg/100 ml in Scotland in 2014.

The numbers of casualties in reported collisions which involve a drink-driving offence reveal a marked fall over the period from 1979 (when reporting largely assumed its present form) to 2013. With enforcement of the 80 mg/100 ml limit, accompanied by public information about the dangers of drink-driving, the annual numbers of those killed in such collisions, and of those seriously injured in them, had by 2013 fallen to 15% and 13% respectively of the corresponding numbers for 1979. By comparison, over the same period there were lesser falls – to 30% and 28% respectively – in the numbers killed and numbers seriously injured in all other kinds of reported collisions. Therefore by 2013, the last year for which complete

data is available at the time of writing, the numbers killed or seriously injured in reported collisions involving a drink-driving offence stood at only about one half of what they would have been if drink-driving had continued to contribute to road casualties to the extent that it did in 1979.

Numbers of casualties in reported collisions which involve a drink-driving offence are often mistakenly described as the numbers of casualties 'due to drink-driving', but doing this omits casualties that occur in collisions where a driver has a BAC which is appreciable – say at least 20mg/100ml – but is within the legal limit. Some of these casualties would not have occurred if the driver's BAC had been lower, and are therefore also attributable to drink-driving, though without the driver having committed a drink-driving offence.

Lowering the limit from 80 to 50mg/100ml can be expected to reduce casualties further through moderation of drinking among those currently driving in the following three categories:

- a. those with BACs below 50, and thus already within the new limit, but wishing to feel more confident of keeping within it;
- b. those with BACs between 50 and 80 and wishing to comply with the new limit, just as they were with the existing limit; or
- c. those with BACs somewhat above the existing limit, say up to 110mg/100ml, but who were intending to comply with the existing limit and would still intend to comply with the new limit.

In principle, lowering the limit might also lead to a moderation in drinking among those driving with BACs well above the existing limit; however, public information campaigns and enforcement of the drink-driving law since 1967 may well have had sufficient cumulative effect on drivers for those who still drive well above the limit to prove largely impervious to any lowering of it.

To make a rigorous estimate of the reduction in casualties that could be expected from lowering the limit from 80 to 50mg/100ml would require, for each BAC level:

- knowledge of current numbers of casualties in collisions involving a driver at that BAC level;
- for those currently driving at that BAC level, knowledge of the BAC levels at which they would drive under the new limit; and
- knowledge of the amount by which their risk of involvement in a collision would change as a result.

Relevant information to meet the first and third of these requirements is available from routine collision statistics, interpreted with the help of certain assumptions, and from the technical literature; with respect to the second requirement, however, it is necessary to rely wholly upon assumptions. A range of assumptions is therefore proposed concerning those with BACs in the ranges 0–20, 20–50, 50–80, 80–110 and over 110mg/100ml.

Under these assumptions, further reductions in casualties in collisions at BACs under 20 and over 110mg/100ml are regarded as small enough to be neglected here. For each of the

BAC ranges 20–50, 50–80 and 80–110 mg/100 ml, estimates are made of numbers killed and numbers seriously injured in collisions involving drivers with BACs in these ranges, and also of the proportions of these numbers that would be prevented by lowering the limit.

The pattern of numbers of casualties in collisions which involve a drink-driving offence has been stable over the years 2010–13, and at levels that are lower than those seen in earlier years by a margin which is substantially greater than for casualties in collisions of other kinds. Calculations for this stable period indicate that in round figures, for every four deaths recorded as occurring in collisions involving a drink-driving offence, there is one more death occurring in a collision involving a drinking driver with a BAC below the legal limit that might not have happened if none of the drivers involved had been drinking at all.

Further calculations lead to the estimate that lowering the BAC limit from 80 to 50 mg/100 ml at the beginning of 2010 would, over the four years 2010–13, each year have saved about 25 lives and saved about 95 people from being seriously injured.

# 1. Background



The purpose of the legal limit on drivers' blood alcohol concentration (BAC) is to reduce death and injury on the roads. After over 50 years of continual dissemination of public information, it should be widely known by now that the best advice is never to drive after drinking – and if the world were an ideal one in terms of road safety, almost every driver's BAC would be zero or near zero.

But there is more to life than road safety, and legislation is about what it is reasonable to require of people for the common good. Therefore up to the time of writing, against a background of advice to avoid driving altogether after drinking any alcohol, numerically based legal sanctions in England and Wales concerning doing so have been confined to driving with BACs higher than 80mg/100ml, or broadly equivalent levels of alcohol in breath or urine.

**In this report, all alcohol levels mentioned are BACs and are given in the familiar units of mg of alcohol per 100 ml of blood, 'mg/100 ml'.**

In this report, driving is taken to mean being at the controls of a motor vehicle, and to include riding at the controls of a motorcycle or similar vehicle. **In this report, therefore, the category 'driver' or 'drivers' includes motorcycle and similar riders.**

The limit of 80mg/100ml in Great Britain was set in 1967, and although both the limit itself and its enforcement remained controversial for the first few subsequent years, both had gained widespread acceptance within a decade or so, and over the last 20 years the question of whether the limit should be lower has been debated with increasing vigour.

## 1.1 How the limit came to be set at 80 mg/100 ml

When considering the case for change, it is often helpful to recall the reasons for the status quo. It was realised early in the history of motoring that too much alcohol made one unfit to drive, and this was recognised in law by creating the offence of driving while under the influence of drink. All of that happened long before 1967, but in the mid-1960s there was still active debate as to whether moderate drinking increased or (as seemed reasonable to some at that time) decreased the risk of collision, and hence of death or injury on the roads.

Impairment of skills analogous to driving had been demonstrated in the laboratory, and reduced skill and judgement in vehicle handling had been demonstrated under experimental conditions; however, evidence of these kinds were insufficient to convince enough parliamentarians or opinion-formers that moderate drinking and consequent impairment increased the occurrence of collisions so as to call for legislation. The invention of the breathalyser in 1954 had opened the way for enforcement of a legal limit on BAC, but opponents of such legislation could cite the lack of direct evidence of increased collision risk (except from limited studies that were too easy to discount), and were ready with anecdotal accounts of improved driving after a few drinks.

All this changed with the publication of a large-scale field study in 1962–3 at Grand Rapids in the USA (Borkenstein et al., 1964). Reinforced by some reanalysis in 1965 by the author (Allsop, 1966), the findings of this study quantified the relationship between BAC level and the risk of involvement in a collision in a way that provided convincing evidence of greatly increased risk which depends on drivers' alcohol levels. This brought the issue of a legal BAC limit onto the practical political agenda, and the question then became "What maximum level of BAC is appropriate?" The value of 80 mg/100 ml, chosen by Barbara Castle as Minister of Transport and enacted by Parliament, was probably determined mainly by the combination of these facts:

- 80 mg/100 ml was the level above which the Grand Rapids evidence indicated that average risk of collision involvement was roughly doubled;
- 80 was in the range of levels then being considered or implemented in other countries;
- it was plausible that public and parliamentary acceptance could be gained – partly on the basis of advice that most people could have three small drinks without exceeding 80; and
- 80 was the level at which the Grand Rapids evidence, in the form in which it was published, enabled increased risk to be established with the conventional statistical 95% level of confidence against a background of genuine difference of opinion as to whether the risk was increased or decreased.

The last of these points is more statistically technical than the others, but it carried weight among those preparing advice for ministers, and its precise basis is relevant to the case for lowering the limit.

## 1.2 How things have changed

Much has changed since 1967 to cast considerable doubt upon whether the BAC limit of 80mg/100ml, which was set in 1967 and which successive UK governments have retained, is still the most appropriate one today. Just a few of the most salient changes of relevance are:

- A further large-scale study was carried out at Long Beach and Fort Lauderdale in the USA in the late 1990s (Blomberg et al., 2009; Compton et al., 2002), analogous to the Grand Rapids study in data collection but helped by advances in statistical technique since the 1960s. The results showed a somewhat more rapid rise in risk of collision involvement than was found in Grand Rapids as BAC increases up to a doubling of risk at about 70mg/100ml, and a much more rapid rise in risk at higher BACs than was found in Grand Rapids.
- Estimates were made (Maycock, 1997) of the relationship in Great Britain between BAC and risk of involvement in a collision. In contrast to the estimates from the Grand Rapids study and its successors, Maycock's did not apply to the involvement of drivers in a collision of any kind – including the many in which no one is hurt – but specifically to their involvement in a collision which caused injury or in one which caused their death. For example, the risks of involvement in an injury collision with a BAC of 50 and with a BAC of 80mg/100ml are estimated to be, respectively, 2.9 times and 5.6 times the corresponding risk with a BAC of zero; the risks of being killed in a collision are estimated to be, respectively, 5.0 times and 12.4 times the corresponding risk with a BAC of zero. The last two estimates are broadly corroborated by a study of 1,766 drivers killed in collisions in nine states of the USA in the three years 2006–8 (Romano et al., 2014). Thus, according to Maycock's work, the increases in risk of a drivers' involvement a collision, if they have a BAC of 80mg/100ml, is nearly 3 *times* (for collisions leading to injury) and about 6 *times* (for collisions leading to their death) the mere doubling that informed the setting of the limit at 80mg/100ml in 1967. Even at the lower BAC of 50mg/100ml the increases in risk are about 1.5 and 2.5 times that doubling respectively.
- There is now a widespread understanding that the risk of involvement in a collision is indeed increased by even moderate drinking, and there is an associated acceptance of a legal limit on BAC and of its enforcement.
- An acceptance that risk of a collision increases with increasing BAC changes the appropriate statistical process for assessing level of confidence in analysing the Grand Rapids and similar data from a two-tailed to a one-tailed test. The consequence of this for the Grand Rapids data, in the form in which it was published, is that increased risk is established, with the statistical 95% level of confidence, at BACs from 60mg/100ml upwards, instead of from 80 upwards as was the case against the background of genuine difference of opinion that prevailed in 1967.
- The Government was minded in 1998 to lower the limit to 50mg/100ml, and consulted on this and other measures to reduce drink-driving (DETR, 1998). The response was on balance supportive of lowering the limit (DETR, 1999) but the

Government's road safety strategy to 2010 (DETR, 2000) stated an intention to deal with the matter in the context of European harmonisation that was then under review, which might have led to a Directive requiring the limit to be lowered.

- In January 2001, the European Commission adopted instead a non-binding Recommendation that Member States should set BAC limits at or below 50mg/100ml; the only territories in the European Union whose administrations have not yet complied with this Recommendation are England, Wales, Malta and Northern Ireland. Scotland lowered the limit to 50mg/100ml in December 2014 and the Northern Ireland administration is in the course of doing so.
- In April and May of 2008, a poll of about 17,500 members of the Automobile Association (AA) found 66% of respondents in support of lowering the limit and 20% opposed to doing so (House of Commons Transport Committee, 2010: Ev77–Ev80). Various other surveys have indicated continuing widespread public concern about drink-driving.
- In December 2009, a Review of Drink and Drug Driving Law, to be undertaken by Sir Peter North, was established by the then Secretary of State for Transport, and the Review reported to his successor in May 2010 (North, 2010). As one of 28 recommendations concerning drink-driving law and its enforcement, the Review recommended that the BAC limit should be reduced from 80 to 50mg/100ml.

But the limit has not been lowered. In December 2010, the House of Commons Transport Committee reported (2010) on its inquiry into this and some other recommendations of the Review, but recommended no immediate reduction in the BAC limit.

In March 2011, the Secretary of State for Transport presented (2011) to Parliament the Government's response to the Review's report and to the report of the Transport Committee. The response accepted a number of the Review's recommendations concerning enforcement of the BAC limit, but saw lowering the limit as widening the scope of the drink-driving offence in a way that would be inconsistent with the successful enforcement approach of focusing on the most dangerous drink-drivers, those driving with BACs well above the existing limit.

## 2. A Way of Estimating What is to be Gained by Lowering the Legal Drink-Drive Limit



### 2.1 How lowering the limit in Great Britain might reduce road casualties

Most people driving in Great Britain have no alcohol, or very little, in their blood, but a minority have been drinking shortly enough before driving to have BACs ranging from a few mg/100ml to several times the legal limit of 80. The proportions having BACs in various ranges can be estimated by stopping drivers at random at places broadly representative of the use of the roads, and breath-testing them in carefully planned surveys designed to gain the cooperation of the drivers. Such surveys are, however, expensive and infrequent. The most recent extensive such survey in Great Britain for which the results have been published fully took place a quarter of a century ago, over the months of April to October 1990, between 7 p.m. and 2 a.m. on Thursday, Friday and Saturday nights at over 400 sites in nine counties and one conurbation police area in England (Everest et al., 1991). The results showed,

for example, that at these times in the week very roughly 1% of drivers had BACs over the legal limit of 80mg/100ml, with another 2% registering between 50 and 80, and another 5% between 20 and 50. Of the BACs over the legal limit, about half were between 80 and 110 and about half were over 110mg/100ml. Of the 92% below 20, the great majority had too little alcohol in their breath to provide evidence that they had been drinking at all.

Using data on the BACs of killed drivers and Maycock's risk relationship, Rafia and Brennan (2010) employed a numerical procedure to estimate the proportions of driving in England and Wales at different BACs over the whole week. Their estimates indicate that in 2005–7 less than 0.3% of driving was at BACs of over 80mg/100ml, and about another 0.3% between 50 and 80.

All this was in the context of a legal limit of 80mg/100ml, and it is reasonable to suppose that without the limit, the proportions driving with BACs higher than 80 would have been larger. This supposition is supported strongly by the numbers killed and numbers seriously injured shown in Table 2.1. These numbers show that over 34 years of enforcement of the limit of 80, accompanied by public information about the dangers of drink-driving, the annual numbers of those killed in reported collisions involving a drink-driving offence, and of those seriously injured in such collisions, had fallen by 2013 to 15% and 13% respectively of the corresponding numbers in 1979 (when reporting assumed largely its present form). By comparison, over the same period the numbers killed and numbers seriously injured in all other kinds of reported collisions fell to 30% and 28% respectively of their 1979 values. The fact that the former pair of percentages are only half the latter pair shows that by 2013, the numbers killed and numbers seriously injured in reported collisions which involve a drink-driving offence stood at only about one half of what they would have been if drink-driving had continued to contribute to road casualties to the extent that it did in 1979.

**Table 2.1: Casualties in reported collisions involving a drink-driving offence\* in Great Britain 1979 to 2013\*\***

Year	Killed	Seriously injured	Year	Killed	Seriously injured
1979	1,640	8,300	1997	550	2,940
1980	1,450	7,970	1998	460	2,520
1981	1,420	7,370	1999	460	2,470
1982	1,550	8,010	2000	530	2,540
1983	1,110	6,800	2001	530	2,700
1984	1,170	6,820	2002	550	2,790
1985	1,040	6,810	2003	580	2,590
1986	990	6,440	2004	580	2,340
1987	900	5,900	2005	550	2,090
1988	790	5,100	2006	560	1,970
1989	810	4,790	2007	410	1,760
1990	760	4,090	2008	400	1,620
1991	660	3,610	2009	380	1,500
1992	660	3,280	2010	240	1,240
1993	540	2,660	2011	240	1,270
1994	540	2,840	2012	230	1,200
1995	540	3,000	2013	240	1,100
1996	580	3,010			

Source: Department for Transport (DfT, 2015a)

Notes: \* A collision involving a drink-driving offence is one in which a driver or rider either refused a breath test, or had a breath test indicating that the legal limit was exceeded, or was killed and found to have a BAC above the legal limit.

\*\* Data for 2014 available at the time of writing remains provisional for reasons that apply each year (DfT, 2015b).

The numbers of casualties in Table 2.1 are often mistakenly described as the numbers of casualties ‘due to drink-driving’, but doing this omits casualties that occur in collisions where a driver has a BAC which is appreciable – say at least 20mg/100ml – but is within the legal limit. Some of these casualties would not have occurred if the driver’s BAC had been lower, and are therefore also attributable to drink-driving, though without the driver having committed a drink-driving offence. This omission is only marginally offset by the fact that just a few of the casualties in Table 2.1 would still have occurred even if the drivers concerned had not been drinking. The identification of a category of casualties to be described as ‘due to drink-driving’ already calls for thought, and would be in still greater need of consideration if the legal BAC limit were lowered.

It should not be assumed, and is not assumed in this report, that every collision involving a driver who has been drinking would have been prevented if the driver had been sober. A proportion of such collisions arise in ways unconnected with the driver’s drinking and would

have still happened without it. At each BAC level, this proportion can be estimated from risk relationships like Maycock's. For fatal collisions at BACs much above 80mg/100ml, the proportion is very small.

It is reasonable to suppose that imposing and enforcing the limit has reduced the number of casualties in collisions where a driver has been drinking within the limit. This is likely to have happened through drivers moderating their drinking within the limit, even quite well within it, with a view to reducing the risk of exceeding the limit by mistake. But this still leaves scope for further reducing the number of such casualties by lowering the limit.

Lowering the limit from 80 to 50mg/100ml can be expected to reduce road casualties through moderation of drinking among those currently driving in the following three categories:

- a. those with BACs already below 50, and thus already within the new limit, but wishing to feel more confident of keeping within it;
- b. those with BACs between 50 and 80 and wishing to comply with the new limit just as they were with the existing limit; or
- c. those with BACs somewhat above the existing limit, say up to 110mg/100ml, but who were intending to comply with the existing limit and would still intend to comply with the new limit, although they may still fail in practice to achieve their aim.

Identifying these three groups of drivers in terms of their BAC levels is in no way meant to imply awareness of those levels by the drivers themselves.

In principle, lowering the limit might also lead to a moderation in drinking among those driving with BACs well above the existing limit, as was the case in South Australia in 1991 (Rafia and Brennan, 2010) where 2.5% of driving was at BACs above the limit of 80mg/100ml before the limit was lowered to 50, compared with less than 0.3% in England and Wales in 2005–7. But it is the author's view that public information campaigns and enforcement of the drink-driving law since 1967 have had a cumulative effect on drivers such that those who still drive well above the limit in Britain would prove largely impervious to any lowering of a limit that they continue to exceed greatly. This is not to deny the possibility that lowering the limit may contribute in the long term to changes in the culture of drinking and driving that may lead to still fewer people ever developing the habit of driving after heavy drinking.

## 2.2 Estimating the possible reduction in casualties

To make a rigorous estimate of the reduction in casualties that could be expected from lowering the limit from 80 to 50 mg/100 ml would require, for each BAC level:

- knowledge of current numbers of casualties in collisions involving a driver at that BAC level;
- for those currently driving at that BAC level, knowledge of the BAC levels at which they would drive under the new limit; and
- knowledge of the amount by which their risk of involvement in a collision would change as a result.

Taking the most straightforward of these first, information which meets the third requirement is provided by the estimates made by Maycock (1997), recently broadly corroborated by Romano et al. (2014).

Two items of information relevant to the first requirement are available annually for Great Britain (subject to uncertainty as discussed by the DfT (2015b)):

- numbers, shown in Table 2.1, of casualties in reported collisions involving a driver with a BAC of over 80 mg/100 ml or refusing a breath test (and therefore likely to have had a high BAC); and
- the distribution of the BACs of drivers who are killed in collisions, as estimated by the Road Accidents Statistics team in DfT from data provided by Coroners in England and Wales and Procurators Fiscal in Scotland; this distribution is summarised for recent years in Table 2.2.

**Table 2.2: Estimated distributions of BACs of drivers and riders killed in collisions in Great Britain in 2010–13**

BAC range (mg/100ml)	Percentage of killed drivers and riders				
	2010	2011	2012	2013	2010–2013
0–19	80.4%	80.2%	77.5%	77.3%	78.9%
20–49	2.0%	2.9%	4.1%	4.2%	3.2%
50–79	0.9%	1.5%	0.5%	1.9%	1.2%
80–109	1.5%	1.1%	2.5%	1.6%	1.6%
110+	15.2%	14.4%	15.5%	15.1%	15.0%
<b>All*</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>
Hence 80+	16.7%	15.5%	18.0%	16.7%	16.6%

Source: DfT (2015c) with BAC ranges adjusted for the purposes of this report by DfT Road Accident Statistics team  
 Note: \*Component percentages do not always sum to 100.0% owing to rounding.

Concerning the second requirement, the author knows of no evidence as to how drivers in Britain would alter the BACs at which they drive following a lowering of the limit, nor of any way of determining this short of actually making the change and carrying out surveys before and after doing so.

Estimation of the possible reductions in numbers killed and numbers seriously injured therefore proceeds from Tables 2.1 and 2.2 and the Maycock relationships by means of a series of assumptions; these assumptions are intended to be either cautious (by erring on the side of underestimating rather than overestimating the reduction in casualties), or neutral in this respect.

The first assumption is that the BACs of drivers who are killed in collisions are representative of the BACs of drivers involved in fatal collisions. This stems from the fact that in a collision that leads to a death, just which of the road users involved in the collision is killed is a matter partly of chance, as affected by many aspects of the collision. This assumption is subject to the reservation that different kinds of collisions involve different combinations of kinds of road users, and the distribution of BACs of drivers in collisions in which passengers, pedestrians or cyclists are killed may differ from that of drivers in collisions in which a driver is killed. It is cautious to the extent that high BACs are overrepresented among drivers who are themselves killed compared with drivers involved in fatal collisions, because this would cause the calculations to underestimate the numbers of deaths in collisions at lower BACs.

The second assumption is that these BACs of killed drivers are also representative of those of drivers involved in serious injury collisions. This should lead to an underestimation of the proportions involved in such collisions at lower BACs relative to the proportion at higher BACs because the risk of involvement in a serious injury collision rises less rapidly with rising BAC than does the risk of involvement in a fatal collision. This in turn makes the assumption cautious with respect to estimation of reduction in the number of seriously injured casualties that can be expected from lowering the limit, because the estimated reduction in numbers seriously injured is proportional to estimated numbers involved in serious injury collisions at lower BACs, and these numbers involved are estimated from recorded numbers in collisions at over 80mg/100ml by using the respective proportions of killed drivers in the various BAC ranges.

Thirdly, in the absence of evidence about the likely moderation of drinking following lowering of the limit, it is necessary to make assumptions about how the BACs of drivers in groups (a), (b) and (c) defined in section 2.1 would change.

A simple starting point would be to consider the possibility of all their BACs being reduced by 30mg/100ml, the amount by which the limit is lowered. But this would clearly overestimate the likely effect, because each of the three groups includes many drivers who could satisfy their assumed wishes by BAC reductions of much less than 30, and by no means all of those driving with BACs of up to 110mg/100ml would be motivated to respond at all to lowering of the limit.

With this in mind, the author proposes the following assumptions:

- For those with BACs lower than 20 mg/100 ml, although some may reduce their BACs, the effect of such changes on numbers of casualties would be small enough to be neglected here.
- For those with BACs in the range 20–50, their existing BACs are distributed uniformly over that range and will under the lowered limit be redistributed uniformly in the same order over the range 0–50 (which implies reductions ranging from 0 to 20).
- For those with BACs in the range 50–80, their existing BACs are distributed uniformly over that range and will under the lowered limit be redistributed uniformly in the same order over the range 20–80 (which implies reductions ranging from 0 to 30).
- For those with BACs in the range 80–110, their existing BACs are distributed uniformly over that range and will under the lowered limit be redistributed uniformly in the same order over the range 50–110 (which implies reductions ranging from 0 to 30).
- For those with BACs of over 110 mg/100 ml, although some may reduce their BACs, the effect of such changes on numbers of casualties would be small enough to be neglected here.

No claim is made that these five assumptions are evidence-based or objectively optimal. They result from the application of common sense by the author, in the absence of evidence, in the course of reflection and discussion with colleagues over the period between his work leading to estimates made for the Parliamentary Advisory Council for Transport Safety (PACTS) during the Road Safety Bill debate early in 2005 (Allsop, 2005; PACTS, 2005) and his submission of written evidence to the House of Commons Transport Committee in 2010 (2010: Ev46–Ev53). In particular, the author gave attention to Maloney's critique (2005) of his early estimates, notwithstanding its emphasis on sources of overestimation without reference to sources of underestimation.

Each of the middle three of these five assumptions reflects a supposition that in each of the ranges of BACs, the responses of drivers are likely to range upwards from none at all without exceeding a moderation in drinking that matches the reduction in the limit. The numerical form in which this supposition is represented enables the Maycock relationships to be applied readily to estimate changes in numbers killed and numbers seriously injured. The threshold of 110 mg/100 ml is chosen to be as far above the existing limit as the new limit would be below it, so that a driver with a BAC in the range from 80 to 110 who reduced their BAC by the largest amount that is supposed likely would put themselves in the same relationship to the new limit as they were before to the existing limit. The assumption that no reduction would exceed 30 means that no driver exceeding the existing limit is assumed to bring their BAC below the new limit.

The implications of the middle three assumptions and the Maycock relationships for annual numbers killed and numbers seriously injured in collisions involving drivers with BACs currently in the ranges 20–50, 50–80 and 80–110mg/100ml can be derived by integration in the form of factors by which the numbers killed and numbers seriously injured would be reduced, as follows (House of Commons Transport Committee, 2010: Ev53). When  $k$  is the parameter of the Maycock relationship, so that risk of involvement in a collision while driving with a BAC of  $x$  is proportional to  $\exp(kx)$ , and BACs in the range  $(b, c)$  are redistributed in the same order over the range  $(a, c)$ , with  $a < b$ , each BAC  $x$  in this range is reduced by  $(c - x)(b - a) / (c - b)$  and the number of casualties is multiplied by:

$$\int_b^c \exp[-k(c - x)(b - a) / (c - b)] / (c - b) dx = \{1 - \exp[-k(b - a)]\} / k(b - a)$$

If this multiplier is  $M$ , then the proportion of casualties prevented is  $1 - M$ , as illustrated in Table 2.3

**Table 2.3: Multipliers and proportions prevented for estimated numbers killed and numbers seriously injured under the assumed changes in BACs of drivers and riders**

Existing BAC range (mg/100 ml)	Resulting BAC range (mg/100 ml)	Numbers killed $k = 0.032$		Numbers seriously injured $k = 0.021$	
		multiplied by $M =$	proportion prevented	multiplied by $M =$	proportion prevented
20–50	0–50	0.739	0.261	0.817	0.183
50–80	20–80	0.643	0.357	0.742	0.258
80–110	50–110	0.643	0.357	0.742	0.258

Source: Author's calculations

The way in which this whole range of assumptions leads from the information that is available to estimates of likely reductions in numbers killed and numbers seriously injured is illustrated for the case of Great Britain over the period 2010–13 in Section 3.

### 3. Estimated Casualty Savings for Great Britain in 2010–13 had the Legal Drink-Drive Limit been Lowered



Over the four years 2010–13 the annual number killed in collisions involving a drink-driving offence has remained steady at about 240, the total over the period being 950. As Table 2.1 shows, numbers in the preceding years had been substantially higher. The fact that the author's previous estimates of likely reductions in numbers killed following a lowering of the BAC limit were based on earlier years makes it timely to recalculate the estimates for the stable situation that has prevailed since 2010.

The number seriously injured in such collisions has also been substantially lower than in the preceding years and has changed only slowly since 2010, with some suggestion of a gradual downward trend. The total for the years 2010–13 is 4,810.

These reductions from earlier years are substantially greater than for numbers killed and numbers seriously injured in collisions of other kinds.

These four-year totals of 950 and 4,810 can be regarded as numbers killed and numbers seriously injured respectively in collisions in which a driver had a BAC of over 80. Under the assumptions made in section 2.2, the numbers killed and numbers seriously injured in collisions in which a driver had a BAC in each of the intervals 20–50, 50–80 and 80–110mg/100ml can be estimated by means of the percentage distribution for 2010–13 in Table 2.2 (in which, for example, the range 20–49 is taken to include all values in the range 20–50 except 50 itself). The results are shown in Table 3.1.

**Table 3.1: Estimated numbers killed and numbers seriously injured in collisions involving drivers or riders with BACs of over 20 in Great Britain 2010–13**

BAC range (mg/100ml)	Percentage distribution	Number in 2010–13	
		Killed	Seriously injured
<b>Observed numbers (see Table 2.1)</b>			
80+	16.6%	950	4,810
<b>Numbers estimated from percentages in Table 2.2</b>			
20–50	3.2%	183	927
50–80	1.2%	69	348
80–110	1.6%	92	464

Source: Author's calculations

Table 3.1 shows that the estimated number killed in collisions involving drivers with BACs between 20 and 80, at 252, is just over one quarter of the number killed where a driver's BAC was over 80. This means that, in round figures, for every four deaths in collisions involving a drink-driving offence, there is one more death in a collision that might not have happened if none of the drivers involved had been drinking at all. For example, where the driver had a BAC of about 50, and therefore a risk of fatal collision about 5 times the risk if they had not been drinking, four out of five of the deaths would not have happened if the driver had not been drinking. This gives an indication of how the numbers of casualties due to drink-driving are underestimated because only those in collisions which involve a drink-driving offence are counted.

Only some of these additional drink-driving casualties would be prevented by lowering the limit from 80 to 50, but estimated reductions in numbers killed and numbers seriously injured that would have followed this lowering of the limit if it had been implemented at the beginning of 2010 are obtained in Table 3.2 by applying, to the last three rows of Table 3.1, the corresponding proportions prevented that are shown in Table 2.3.

**Table 3.2: Estimated reductions in numbers killed and numbers seriously injured in Great Britain in 2010–13 that would have followed from reducing the BAC limit to 50 at the beginning of 2010**

Existing BAC of driver or rider	Killed			Seriously injured		
	Estimated number	Proportion prevented	Estimated reduction	Estimated number	Proportion prevented	Estimated reduction
20–50	183	0.261	47.8	927	0.183	169.6
50–80	69	0.357	24.6	348	0.258	89.8
80–110	92	0.357	32.8	464	0.258	119.7
<b>Total</b>			<b>105.2</b>			<b>379.1</b>

Source: Author's calculations

The estimated reductions over the 4 years 2010-13 shown in Table 3.2 amount to average annual savings of 26.3 lives and 94.8 people seriously injured.

These estimated savings are smaller than the author's previous estimates made between 2005 and 2010 mainly because the numbers of casualties in reported collisions involving a drink-driving offence have been markedly lower since 2010 than they were in relevant earlier years. The estimated saving in numbers seriously injured is further reduced by making a more cautious assumption than was previously used about the distribution of BACs of drivers involved in serious injury collisions.

Estimates made by this method for other periods, for example for years after 2013 when data for these years becomes available, may differ from these estimates for 2010–13 either because of further changes in numbers of casualties in reported collisions which involve a drink-driving offence, or because of changes in the distribution over the range 20–110 of BACs of drinking drivers, or for both of these reasons.

In conclusion, it is estimated here that, in round figures, lowering the BAC limit from 80 to 50 at the beginning of 2010 would, over the four years 2010–13, in every year have saved about 25 lives and saved about 95 people from being seriously injured.

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